By River, Fields and Factories: The Making of the Lower Lea Valley

Archaeological and cultural heritage investigations on the site of the London 2012 Olympic and Paralympic Games

By Andrew B. Powell

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Location of the archive

The project archive has been deposited with the London Archaeological Archive and Research Centre (LAARC; see Appendix 2 for site codes). Selected specialist reports are also available on line through the Archaeological Data Service (archaeologydataservice.ac.uk). The boat has been donated to Bournemouth University.

Abstracts

The comprehensive programme of cultural heritage works undertaken on the site of the London 2012 Games, has provided a rare opportunity to study and understand the evolution of a large area of the River Lea valley on the eastern fringes of London, and the development of the diverse and changing communities that settled and worked there and shaped its character.

Between 2005 and 2009 archaeological works (desk-based assessments, evaluation and mitigation excavations, and built heritage recording) were undertaken within the Olympic Park by Museum of London Archaeology Service (MoLAS, now MoLA) and Pre-Construct Archaeology working as a joint venture (MoLAS-PCA), and RPS Planning and Development and AOC Archaeology Group. Geoarchaeological work and site-wide assessment was undertaken by Wessex Archaeology in 2009. Analysis and dissemination of the results of the fieldwork, resulting in this publication, was begun in May 2010.

The results from the investigations were varied in terms of complexity, date and importance. The residues from everyday lives from early prehistory to the early 21st century were found. Important amongst these are the remains of Neolithic activity in Trench 118; the Bronze Age and Iron Age settlement in Trench 9; the waterlogged boat in Trench 58; the complex post-medieval and Victorian archaeology at Temple Mills (Trench 75); and surviving built structures of the area's industrial heritage.

The work, which provided a rare opportunity to examine an area of the Lea Valley in some detail, had a very strong emphasis on the examination of landscape development. It was undertaken in conjunction with an extensive programme of radiocarbon dating, and geoarchaeological and palaeoenvironmental analyses, and provides a model for future investigations. The examination of cores from over 5,000 boreholes produced evidence for landscape and environment from the pre-Holocene onwards, enabling a deposit model of the sub-surface sediments to be created and the prehistoric surface topography to be mapped, identifying the courses of the major palaeochannels, as well as probable areas of wetland, and higher, drier ground suitable for occupation.

The investigations have shown that regeneration in this part of east London is not a new phenomenon, but is simply the latest of a series of transformations, from the last Ice Age to the modern day, each of which have fundamentally changed the character of the valley. The London 2012 Olympic and Paralympic Games have provided an opportunity to examine and understand those changes, to place the new park in its historical context, and as such provides a lasting legacy for its future development.

Résumé

Le vaste programme de travaux sur le patrimoine culturel entrepris sur le site des Jeux de Londres 2012, nous a fourni la rare opportunité d'étudier et de comprendre l'évolution d'une zone étendue de la vallée de la Lea aux limites est de Londres et le développement des communautés, diverses et changeantes, qui s'y sont installées, y ont travaillé et ont façonné son caractère.

Entre 2005 et 2009 des travaux archéologiques (diagnostics sur étude documentaire, excavations d'évaluation et de mitigation et enregistrement du patrimoine bâti) furent entrepris à l'intérieur du Parc Olympique par le service d'archéologie du Musée de Londres (MoLAS, maintenant MoLA) travaillant conjointement avec Pre-Construct Archaeology (MoLAS-PCA), ainsi que RPS Planning et Development et AOC Archaeology Group. Les travaux géo-archéologiques et l'évaluation de l'ensemble du site furent menés par Wessex Archaeology en 2009. L'analyse et la diffusion des résultats de la prospection pédestre, dont cette publication est le résultat, commença en mai 2010.

Les résultats des investigations variaient en matière de complexité, date et importance. On retrouva des résidus de la vie quotidienne datant du début de la préhistoire jusqu'au début du XXIème siècle. D'une importance particulière parmi ceux-ci, sont les restes

d'une activité néolithique dans laTranchée 118; d'une occupation de l'âge du bronze et de l'âge du fer dans la Tranchée 9; le bateau imprégné d'eau de la Tranchée 58; le complexe post-moyen-âgeux et l'archéologie victorienne à Temple Mills (Tranchée 75) et ce qui reste des structures bâties du patrimoine industriel de la région.

Les travaux qui nous ont offert une rare opportunité d'examiner en détail une zone de la vallée de la Lea, ont essentiellement mis l'accent sur l'étude de l'évolution du paysage. Ils ont été entrepris conjointement avec un vaste programme de datation au C14 et d'analyses géoarchéologiques et paléoenvironnementales et nous fournissent un modèle pour de futures investigations. L'examen des carottes de plus de 5000 sondages ont fourni des témoignages de paysages et d'environnement d'à partir du pré-holocène, nous permettant de créer un modèle des dépôts des sédiments sous la surface et de cartographier la topographie de la surface préhistorique, identifiant le cours des principaux paléo-canaux ainsi que d'éventuelles zones marécageuses et des terres plus hautes et plus sèches propices à une occupation.

Les investigations ont montré que la régénération de cette partie de l'est de Londres n'est pas un phénomène nouveau mais est, tout simplement, la dernière d'une série de transformations, allant de la dernière glaciation aux temps modernes, chacune ayant fondamentalement modifié le caractère de la vallée. Les jeux olympiques et paralympiques de Londres 2012 nous ont fourni l'occasion d'examiner et de comprendre ces changements, de replacer le nouveau parc dans son contexte historique et, ainsi, constituer un legs durable pour son futur développement.

Annie Pritchard

Zusammenfassung

Das umfangreiche archäologische Arbeitsprogramm, das auf den Stätten der Olympischen Spiele 2012 in London durchgeführt wurde, bot die seltene Gelegenheit die Entwicklung eines großen Areals des River Lea Valley am Ostrand Londons zu untersuchen und die Geschichte der unterschiedlichen und sich wandelnden Gemeinschaften zu verstehen, die hier lebten und arbeiteten und den Charakter der Region formten.

Die Vorabgutachten, die archäologischen Voruntersuchungen und Testgrabungen und die Baudenkmalsdokumentation wurden zwischen 2005 und 2009 erstellt und durchgeführt vom Museum of London Archaeology Service (MoLAS, nun umbenannt in MoLA) in einem Joint Venture mit Pre-Construction Archaeology (MoLAS-PCA) sowie von RPS Planning and Development und AOC Archaeology Group. Die geoarchäologischen Arbeiten und die Beurteilung der gesamten Fläche wurden von Wessex Archaeology im Jahr 2009 ausgeführt. Die Auswertung und Vorlage der Ergebnisse der Felduntersuchung begann im Mai 2010 und resultiert in der vorliegenden Publikation.

Die Ergebnisse der Untersuchungen variieren sowohl in Komplexität als auch in Datierung und Bedeutung. Gefunden wurden Hinterlassenschaften des alltäglichen Lebens von der Vorgeschichte bis ins frühe 21. Jahrhundert. Bedeutsam sind hier insbesondere die Spuren neolithischer Aktivitäten in Trench 118; die bronzezeitliche und eisenzeitliche Besiedlung in Trench 9; das im Feuchtboden erhaltene Boot in Trench 58; die komplexe nachmittelalterliche und viktorianische Archäologie von Temple Mills (Trench 75); und erhaltene Gebäudestrukturen aus dem industriellen Erbe des Areals.

Ein Schwerpunkt der Arbeiten, die die seltene Gelegenheit boten einen Abschnitt des Lea Tals detaillierter zu untersuchen, war die Erforschung der Landschaftsentwicklung. Diese Forschung wurde umgesetzt in Verbindung mit einem umfangreichen Programm von Radiokarbondatierungen, geoarchäologischen und Paläoumweltanalysen und bietet ein Vorbild für zukünftige Untersuchungen. Die Auswertung von über 5000 Bohrkernen lieferte Hinweise für die Entwicklung der Landschaft seit dem Prä-Holozän und ermöglicht, sowohl ein Ablagerungsmodell der subterranen Sedimente zu erstellen als auch die prähistorische Oberflächentopographie zu kartieren, wodurch der Verlauf der wichtigsten vorgeschichtlichen Wasserläufe sowie die mutmaßliche Ausdehnung von Feuchtböden und von höher gelegenen, trockenen, für Besiedlung geeigneten Böden festgestellt werden konnten.

Die Untersuchungen haben gezeigt, dass die Stadterneuerung in diesem Teil Ost-Londons kein neues Phänomen ist, sondern vielmehr die jüngste einer Reihe von Transformationen von der letzten Eisenzeit bis in die Moderne, deren jede den Charakter des Tals grundlegend geändert haben. Die Olympischen und Paralympischen Sommerspiele 2012 London ermöglichten diese Veränderungen zu untersuchen und zu verstehen und den neuen Park in seinen historischen Kontext zu stellen; dadurch bescheren uns die Arbeiten ein dauerhaftes Erbe für die künftige Entwicklung der neu geschaffenen Anlage.

Alexander Gramsch

Chapter 1
Introduction

Olympic Park

The Olympic Park, the site of the London 2012 Olympic and Paralympic Games, lies in the valley of the River Lea, London's second river, close to where it flows into the River Thames on the east side of the capital (Fig. 1.1). The valley, formed as a result of climatic cycles through previous glacial-interglacial periods, is a place where people have lived and worked for thousands of years and its character has changed many times. A record of the valley's unique history – as a natural landscape, as enclosed farmland, and ultimately as an industrial centre bound to the nation's capital – has been preserved in the layers that have built up on its floor.

London's selection to host the 2012 Games opened a new chapter in the history of the lower Lea Valley, and the construction of the Park marked a reversal in the area's post-industrial decline. The development of the site will provide a legacy for future generations, an essential part of which is the recording and preservation of its past – its origins, its history, and the story of the diverse and changing communities who have contributed to its distinctive character.

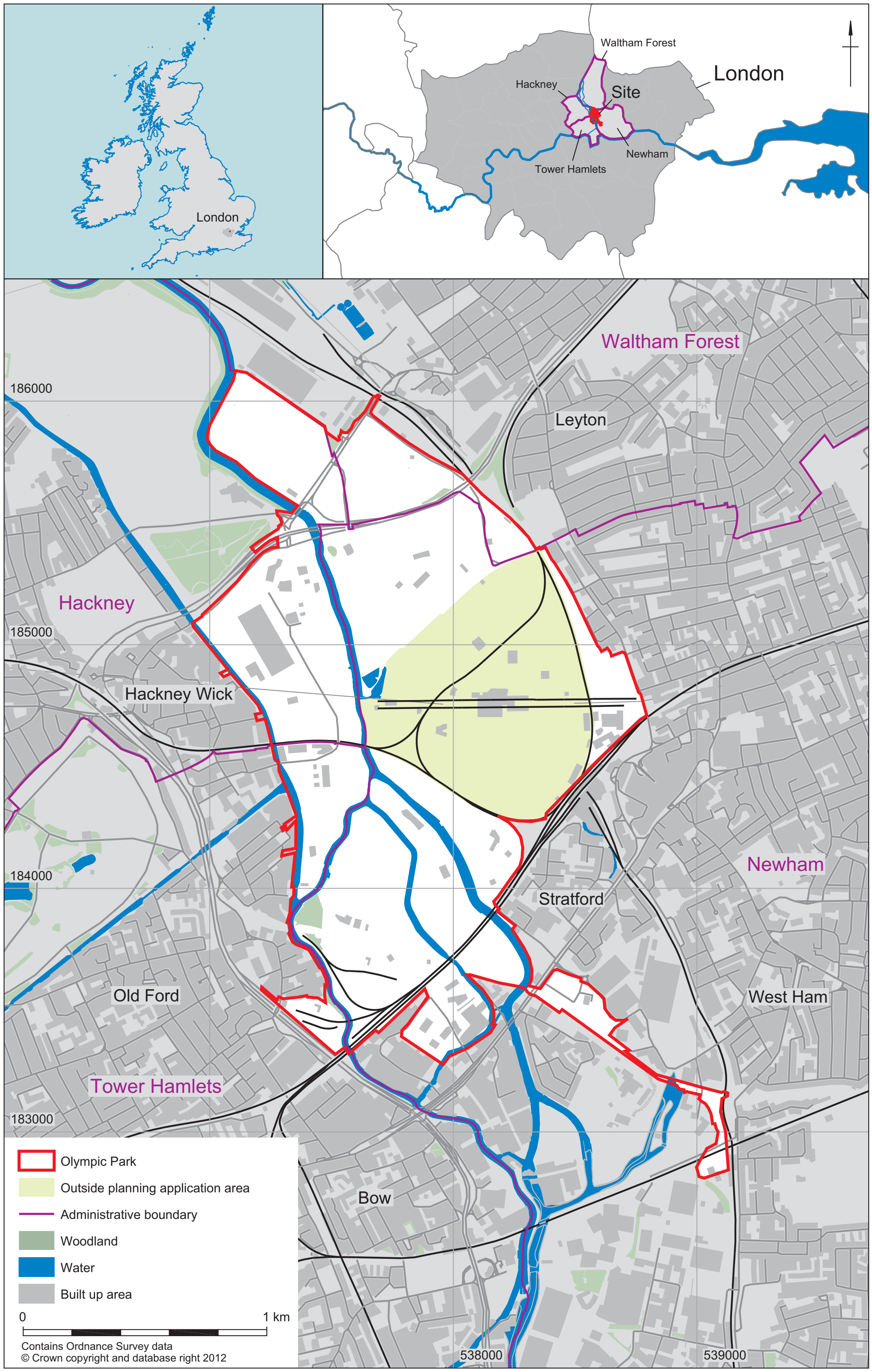
Building the Olympic and Paralympic facilities has been one of the most important infrastructure projects in the UK in recent years. Because of the scale of its potential impact on the archaeological, geoarchaeological and historical remains within the site, the Olympic Delivery Authority (ODA), the body responsible for construction of the new venues and infrastructure (Fig. 1.2, Pl. 1.1) and their use afterwards, implemented a comprehensive programme of cultural heritage mitigation works. These were designed to investigate, map and record those remains, and where they could not be preserved in the ground, to make an accurate record of them, accessible for future generations.

Plate 1.1: The Olympic Park

The final stage of the ODA's programme, therefore, is the dissemination of those findings to the widest possible audience. This includes a popular publication and web-based resources, and this academic volume, which provides the definitive statement on the cultural heritage investigations carried out as part of the Olympic Park development. It also involves direct engagement by the ODA with the local community in whose midst the 2012 Games are taking place.

Community engagement has been a priority from the start of the investigation process. The ODA's Discover programme

*Figure 1.1:
The location of the
Olympic Park*



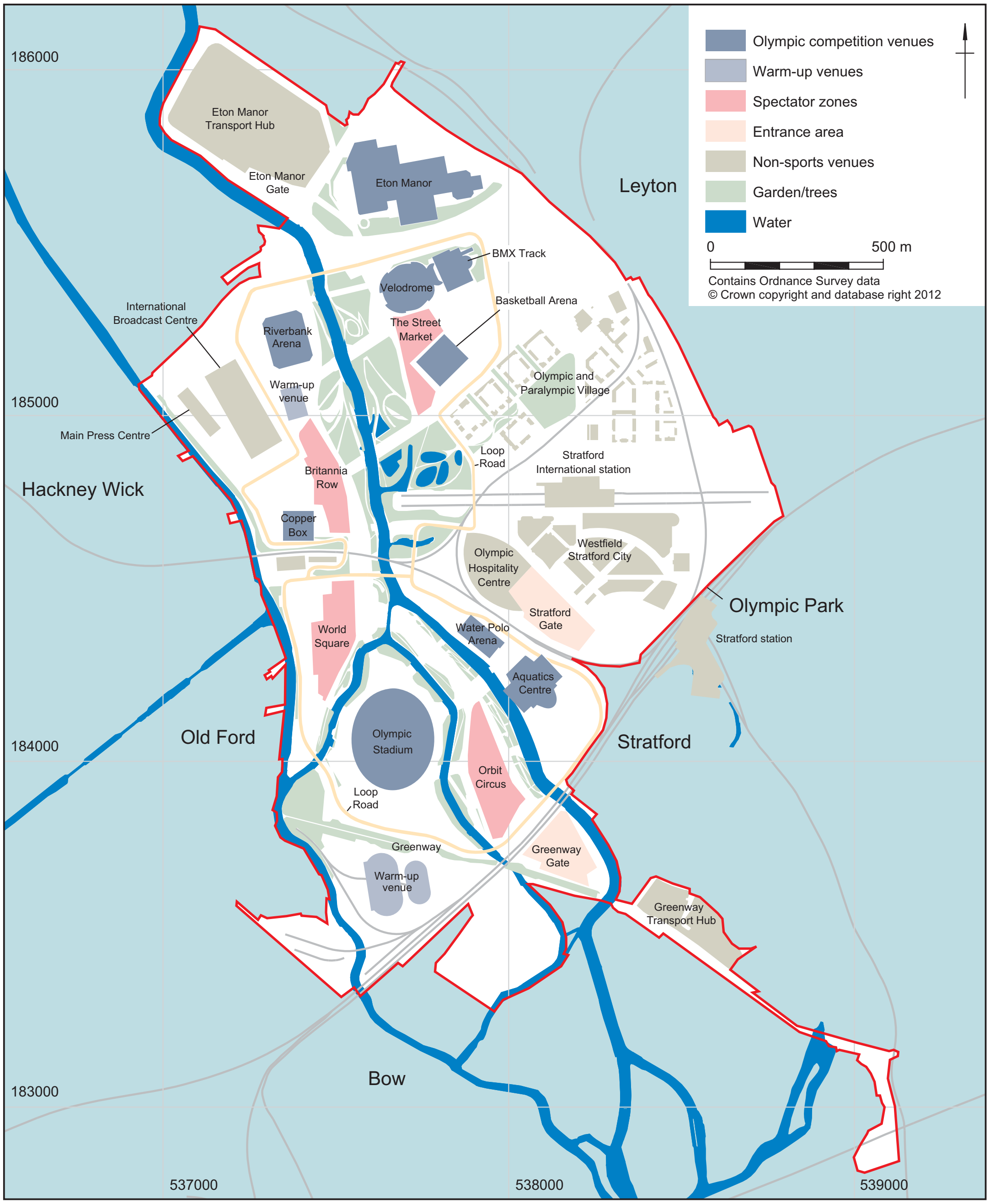


Figure 1.2: London 2012 Olympic and Paralympic venues

shared the results with children, students and teachers, as well as local residents and special interest groups. Outreach sessions, displays and talks enabled them to learn about, and experience directly the uncovering of their community's past. In addition, a Community History project gave local people the opportunity to contribute their own knowledge and memories of the area, and to participate in analysing historical records.

Project Background

The Olympic Park occupies an area of approximately 246 ha at the southern end of the Lea Valley, *c.* 5 km east of central London (Fig. 1.1), extending for *c.* 3.9 km (from NGR 537106 186125 to NGR 539129 182842). It lies largely on the eastern side of the River Lea, but is crossed by a number of other watercourses which diverge from the main river channel then rejoin it downstream. The site falls within four London boroughs – Hackney, Newham, Tower Hamlets and Waltham Forest – with the neighbourhoods of Bow and Old Ford and the south-eastern part of Hackney Wick to the west, and Stratford, West Ham and Leyton to the east.

The Olympic, Paralympic and Legacy Transformation planning applications were submitted by ODA-TPPT (Town Planning Promoter Team) to ODA-PDT (Planning Decisions Team) – the planning authority for the Olympic Park; the four London boroughs were consulted on the applications by the ODA. The applications were supported by an Environmental Statement (ODA 2007a), produced by Capita Symonds and coordinated by Atkins, which included an Archaeology and Cultural Heritage chapter compiled by Museum of London Archaeology Service (MoLAS, now MoLA).

The site covered by the Olympic, Paralympic and Legacy Transformation planning applications was divided into 15 Planning Delivery Zones (PDZs), but did not cover that part of PDZ 9 towards the east of the Park set aside for the Westfield Stratford City development and the Athletes' Village (Figs 1.1–1.2). That area, therefore, (apart from a section of Channelsea River included in the built heritage recording of the waterways) lies outside the scope of the cultural heritage investigations reported here, as do as the adjacent areas of PDZ 9 to be occupied by the Olympic Hospitality Centre, the Wetland Walk, and the Stratford Gate entrance area; these have been subject to separate investigations. The geoarchaeological investigations reported here, however, cover the entire Park, including PDZ 9.

The Project Design for Archaeology and Built Heritage defined five key phases of work associated with the construction of the Park, as follows:

- Phase 1: Detailed desk-based assessments (DDBAs) of each of the 15 PDZs, including the formulation of Written Schemes of Investigation (WSIs) and Method Statements (undertaken by MoLAS-PCA);
- Phase 2: Field evaluation, including built heritage recording, and assessment reporting within the 14 PDZs covered by the planning applications (undertaken by MoLAS-PCA; RPS Planning and Development and AOC Archaeology Group).
- Phase 3a: Archaeological mitigation fieldwork, detailed sampling, analysis assessment and reporting (MoLAS-PCA; RPS Planning and Development and AOC Archaeology Group;
- Phase 3b: Site-wide geoarchaeological/ environmental assessment and analysis reporting (Wessex Archaeology);
- Phase 4: Site-wide integrated post-fieldwork assessment report and updated project design (SWIPEA) (Wessex Archaeology);
- Phase 5: Post-fieldwork analysis, incorporating community history research, and publication/dissemination (Wessex Archaeology; Eastside Community Heritage).
- The archaeological investigations in PDZ 9 (not reported here), were undertaken by MoLAS-PCA (Eastbury and Nicholls 2007; Johnston and Nicholls 2007; Sargent 2007; Barrowman *et al.* 2009; Holden and Langthorne 2010).

The methodology for the fieldwork reported here was outlined in method statements in the Environmental Statement. All the fieldwork was conducted according to project designs approved by the English Heritage Greater London Archaeology Advisory Service (GLAAS) (advisors to local authority planners). These followed the Standards and Code of Practice laid down by the Institute for Archaeologists (IfA) and GLAAS.

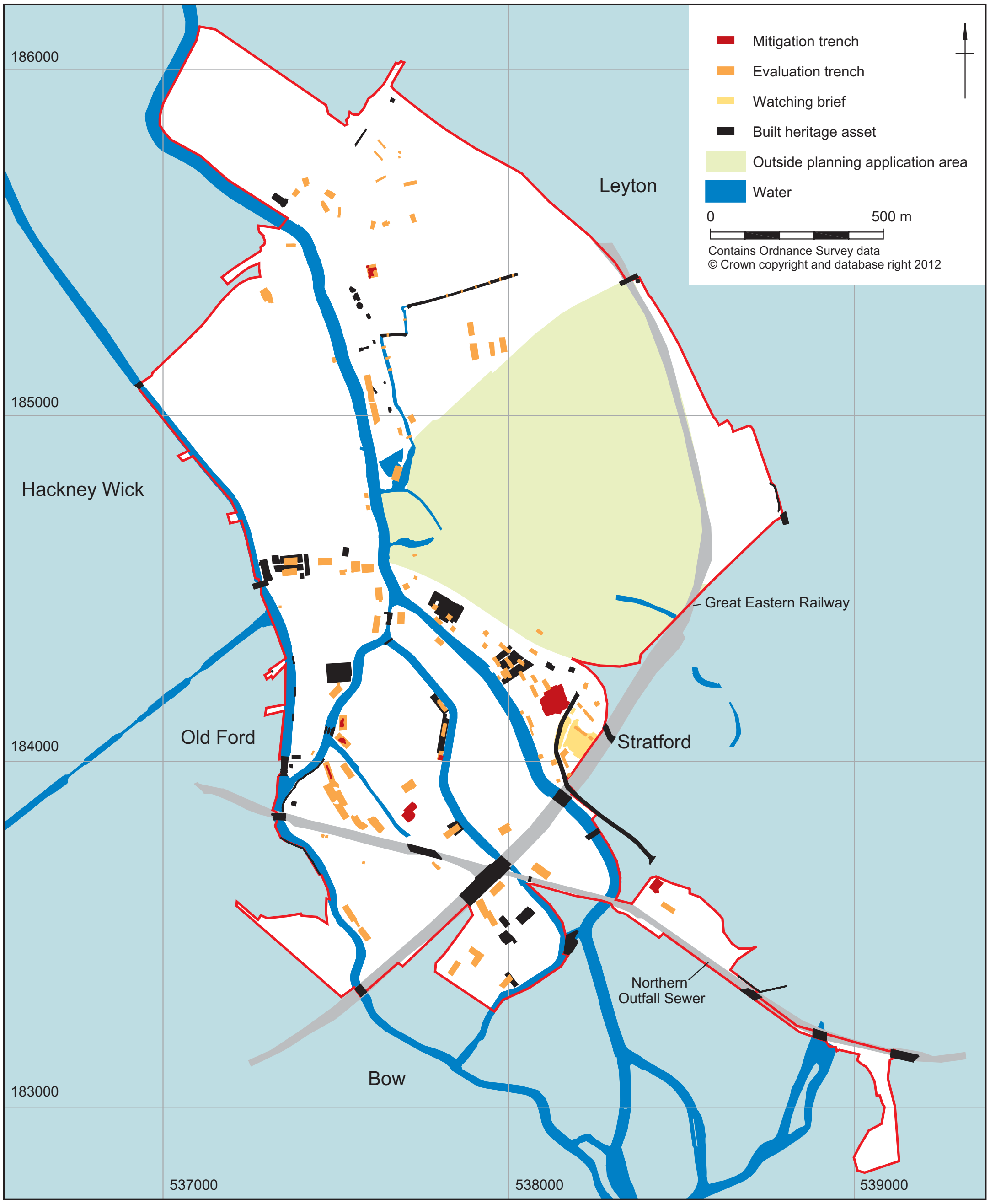


Figure 1.3: Evaluation and mitigation trenches, watching brief sites, and built heritage assets

The individual reports for all the Phases 1–4 works are listed in Appendix 1, and form part of the project archive. Their findings, and any presented in other unpublished and published pre-analysis, interim or summary reports (eg, Fairman 2011; Payne 2011; Corcoran *et al.* 2011) are superseded by those presented in this monograph.

The Fieldwork

Archaeology

A strategic approach, guided by site-wide research objectives (see below), was taken to the positioning of the archaeological trenches within the site. A general WSI for the evaluation of the site was set out in the Environmental Statement Annexure (ODA 2007b), and the trenching necessary in each PDZ was specified in individual method

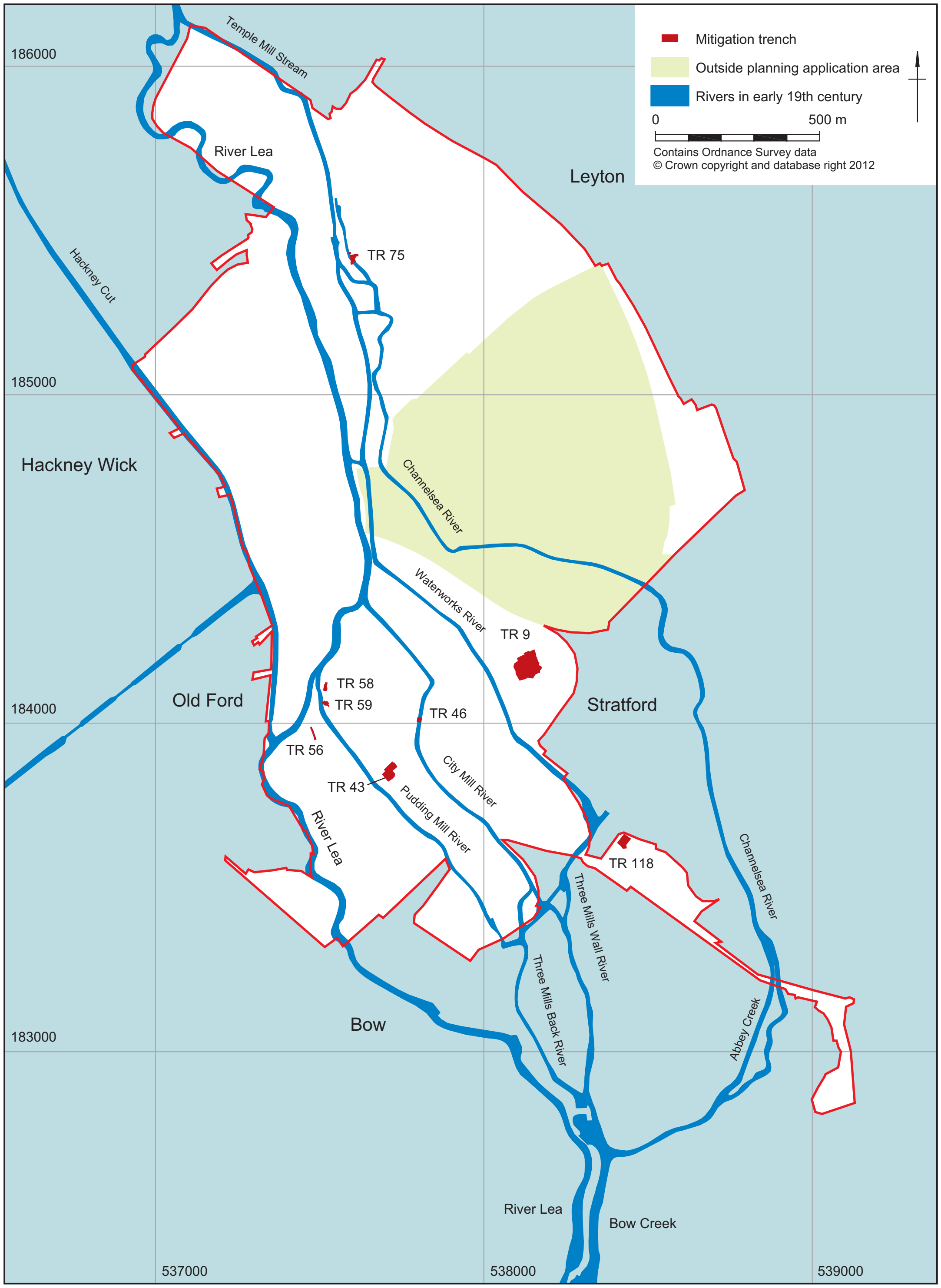


Figure 1.4: Mitigation site locations and early 19th century river channels

statements, based on the results of the individual DDBAs. However, because some parts of the Park were unsuitable for archaeological investigation, due to contamination, ground conditions and the timetable of the construction programme, the layout of the trenches was ultimately based on practical feasibility as well as on the predicted potential for archaeological remains.

Thus 121 evaluation trenches (numbered originally by reference to their PDZ), were excavated across the site (Fig. 1.3), eight of which were further examined in a series of mitigation excavations. In order to simplify their identification, the trenches have been re-numbered as a simple numeric sequence for the purpose of analysis and publication (Trenches 1–121; a concordance table is provided in Appendix 2). Two of the trenches (Trenches 114 and 115), however, lie within PDZ 9 and are therefore not included in this report (see above).

Evaluation

The evaluation reported here was undertaken between February 2005 and January 2009, and the results presented in a series of 26 evaluation reports (see Appendix 1). Included in one of these reports were the results of a small rescue excavation (Trench 24) which was not treated as a mitigation excavation. The evaluation in Trench 75, however, proceeded straight to mitigation excavation, with the result that there is no evaluation report.

Excavation

The evaluation results from eight trenches (Trenches 9, 43, 46, 56, 58, 59, 75 and 118) lead to further mitigation excavations at those locations (Fig. 1.4, Pl. 1.2). These works were undertaken between September 2007 and July 2008, with post-excavation assessment reports produced for each excavation (see Appendix 1). As the majority of these sites produced multi-period results, brief summaries of their locations, extents, and reasons for excavation are given below (Figs 1.5–1.12).

In addition, following the evaluation of Trenches 20–24, a watching brief was carried out as mitigation during the removal of contaminated soils and other groundworks to the south of the junction of Warton Road and Carpenter's Road, Newham, between December 2008 and March 2009; a watching brief report was written.

Plate 1.2: Excavation in a deep stepped trench (Trench 118)

Trench 9

Trench 9 lay between the present courses of Waterworks River and Channelsea River, (Fig. 1.4). The original evaluation trench revealed a concentration of features of Late Bronze Age to Iron Age date, including round-house gullies, post-holes, pits and ditches.

As a result, the trench was further extended to allow full-scale excavation of an area covering *c.* 4800 m² (Fig. 1.5, Pl. 3.4), centred on NGR 538135 184175. This revealed a Middle Bronze Age field system, Late

Figure 1.5: Trench 9 archaeology

Bronze Age pit groups, a round-house settlement and ditched enclosures of Middle Iron Age date, and a Romano-British boundary ditch. There was extensive evidence of prehistoric and historic alluviation. A number of post-medieval/modern features were also recorded.

In prehistory, this site lay on an area of relatively dry raised gravel to the east of the main river channel within the valley, as revealed by the geoarchaeological deposit model. Early maps show the area to have been farmland, drained by a series of ditches, some of which were recorded during the excavation. By 1868 a Photogenic Gas Works had been established at the south-west, extending into the site, and by 1895 the site was fully occupied by the buildings of the Lea Valley Distillery.

Trench 43

Trench 43 lay on the immediate eastern side of the former Pudding Mill River (Fig. 1.4). The evaluation trench revealed features of Late Bronze Age date, including pits, post-holes and an unurned cremation burial, as well as a length of curving ditch assumed to represent a contemporary enclosure. As a result, the trench was extended to approximately 800 m² (Fig. 1.6), centred on NGR 537710 183850. This revealed further late prehistoric features of similar type and date. A series of radiocarbon dates from the ditch and an associated post-hole, however, indicated that the possible enclosure was likely to be of Saxon date.

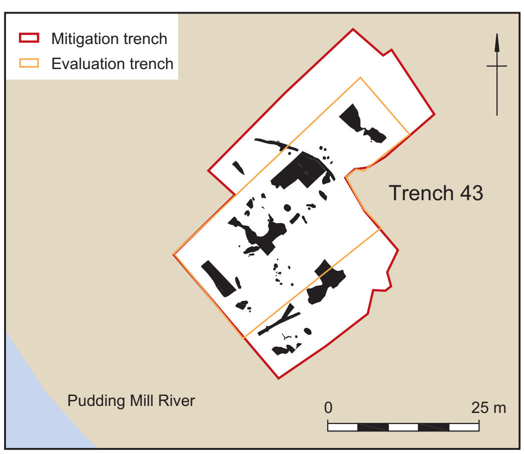


Figure 1.6: Trench 43 archaeology

The geoarchaeological deposit model suggests that in prehistory the site lay on the west side of the main river channel within the valley, possibly on an island with marshy ground to the west along the line of a relict palaeochannel. There was extensive evidence for prehistoric and historic alluviation. Early maps show the area to have been farmland, drained by a series of ditches. By 1896 this area was occupied by a Colour Works factory (dyes, paints etc.).

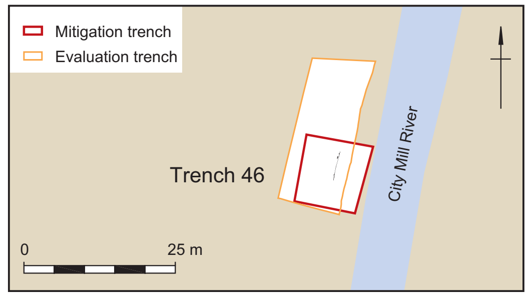


Figure 1.7: Trench 46 archaeology

Trench 46

Trench 46 lay on the western side of City Mill River (Fig. 1.4). The evaluation trench revealed a section of timber revetment. The eastern side of the trench was cut back for 5 m (centred on NGR 573804 184010) to allow the fuller recording of the revetment (Fig 1.7). The OS map of 1868 shows an earthen embankment along the bank of the river, with fields behind it that remained undeveloped until the mid-20th century.

Trench 56

Trench 56 lay between the River Lea and Pudding Mill River (Fig. 1.4). The evaluation trench revealed a prehistoric land surface, an early ditch and, at the trench's southern end, a possible wattle structure. As the archaeological sequence was considered to require further investigation, the trench, centred on NGR 537480 183970, was subject to excavation without being enlarged (Fig. 1.8). This revealed that the possible structure lay within a shallow hollow sealed by a layer containing charred emmer wheat and rye radiocarbon dated to

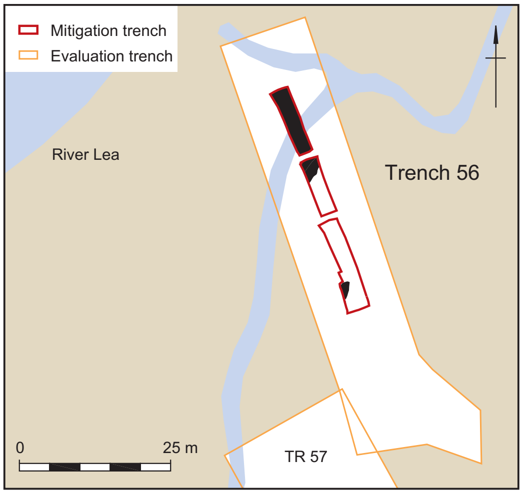


Figure 1.8: Trench 56 archaeology

the Late Saxon/early medieval period; the purpose of the hollow and possible structure, however, was not established.

Joel Gascoigne's 1703 map of Stepney (Fig. 4.11) shows that the northern end of the trench lay over a channel called The Old River, which appears on later maps as a field ditch and, when largely filled in, still marked the borough boundary. The land remained undeveloped through the 20th century, although Queen Mary College Faculty of Engineering was built to the south-east of the trench.

Trench 58

Trench 58 lay west of Marshgate Lane and immediately east of the former course of Pudding Mill River (Fig. 1.4). The evaluation trench revealed a sequence of ditches and water channels, with associated timber structures and wattle linings considered to be of possible Saxon to post-medieval date. As a result, the base of the trench around these features was widened exposing an area of 155 m² centred on NGR 537518 184110, in order to enable fuller investigation (Fig. 1.9).

Radiocarbon dating indicated Romano-British and late medieval dates for the timber structures, and the main channel may have been an early course of a mill stream. By 1850, a field drain on the line of

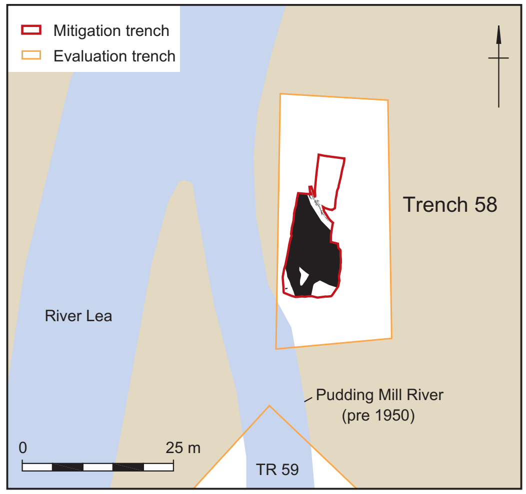


Figure 1.9: Trench 58 archaeology

this earlier stream ran south from a small rectangular building, brickwork from which was recorded in the trench, which lay immediately east of a bi-directional flood-gate across Pudding Mill River. The 1895 OS map shows an earthen embankment along the east side of the river, approximately under the western side of the trench.

Trench 59

Trench 59, *c.* 60 south of Trench 58 (above), lay on the site of a former factory west of Marshgate Lane (Fig. 1.4). The evaluation trench revealed a north-east–south-west aligned ditch of Romano-British date, and a north-south timber channel revetment against which lay the partly exposed, but well preserved remains of a clinker-built boat. In order to fully excavate the boat and

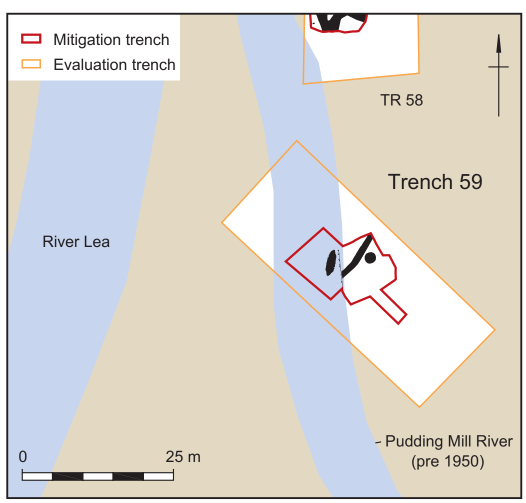


Figure 1.10: Trench 59 archaeology

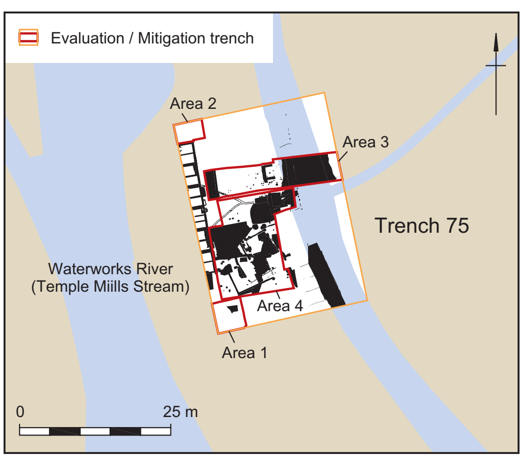
to further investigate the surrounding features, the base of the trench was enlarged to an area of *c.* 135 m², centred on NGR 537520 184060 (Fig 1.10).

The timber revetment, which was exposed for over 7 m, supported the eastern bank of the former course of Pudding Mill River, its pile and plank construction indicating a date between the late 17th century and the early 19th century. This lay next to Nobshill Mill, a wind-powered corn mill that occupied the site for a period in the 19th century. The timber boat, built in the early 19th century as a light rowing boat, possibly a ship's tender or a river taxi, but subsequently twice modified for different uses, was fully excavated and recovered. A brick-lined well, possibly with a barrel lining, which lay east of the revetment, was probably associated with Knobshill Cottage, south of the mill, which survived until the mid-20th century.

Trench 75

Trench 75 lay *c.* 40 m south of the site of the medieval Temple Mills (Fig. 1.4), to the east of Temple Mill Stream. Below the modern ground surface at *c.* 12.5 m above Ordnance Datum (OD) there was up to 9 m of made ground and post-1950 landfill deposits, through which a sheet-piled cofferdam, supported by braces, was sunk to allow excavation of the underlying archaeological deposits (see Pl. 6.5). The initial ground reduction was not archaeologically monitored, but below a depth of 7 m the ground

Figure 1.11: Trench 75 archaeology



was reduced under archaeological supervision. The trench (*c.* 35 m by 25 m) covered 894 m², centred on NGR 537605 185420 (Fig. 1.11). Because a high level of archaeological survival was evident early on during the evaluation, it was decided to proceed directly to excavation. The site was further excavated in four stepped trenches (Areas 1–4).

Alluvium dated to between the Late Bronze Age and the medieval period was recorded in the trench, the earliest archaeological feature being the cut of a medieval water channel, possibly a precursor to Tumbling Bay Stream which diverted water around the watermills. A line of paired timber piles indicate a probable post-medieval building foundation, and the excavation recovered evidence of buildings and associated industrial activity through the 18th and 19th centuries, some of these buildings, confirmed by map evidence. Structures included a mill with a furnace in one corner and timber-lined water channel for a possible water wheel. The front of a short terrace of six worker's cottages was exposed along the west side of the excavation. A sequence of deposits and revetments exposed a significant part of the history of Tumbling Bay Stream. One of the latest features on the site was a cobbled road surface built around the start of the 20th century, providing access to businesses to the south of the site.

Trench 118

Trench 118 lay towards the south of the Park (Fig. 1.4). The geoarchaeological deposit model suggests that it lies close to the early confluence between the main river channel in the valley, and another channel (whose line was later followed by Channelsea River), south of the raised gravel area upon which Trench 9 was located.

The evaluation trench revealed a series of alluvial and dry-land deposits within and on the margins of prehistoric and historic water channels which crossed the trench. Due to the recovery, and apparent association, of sherds of unabraded Early

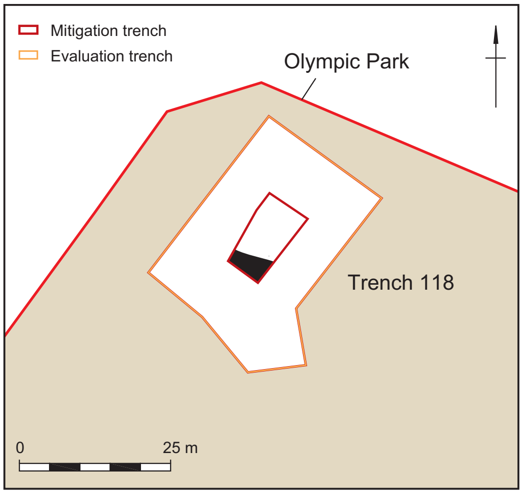


Figure 1.12: Trench 118 archaeology

Neolithic pottery, flint debitage and animal bone (including horse), as well as a small timber stake structure, the base of the trench was extended to cover 234 m², centred on NGR 538428 183640 (Fig. 1.12).

The excavation revealed the clear riverine influence at this location, in the form of a series of channel incisions dating to the Neolithic, the Bronze Age, and the Romano-British and medieval periods. It also exposed additional worked timbers, some of which proved indeed to be of Neolithic date. The Neolithic finds were given added significance by the recovery of a finely made flint axe. The stake structure revealed during the evaluation, however, proved to be of Romano-British date, as did the horse bone. The course of the medieval channel revealed in the trench may reflect that of the early Waterworks River before the 12th century construction of the Bow to Stratford causeway resulted in its diversion.

Built Heritage

Of the 52 recorded Built Heritage Assets (BHAs) within the Park (Fig. 1.3, see Appendix 3), 15 were industrial buildings, and a further three were structures or machinery formerly associated with industrial sites.

The general methodology for the built heritage recording was set out in the Environmental Statement Annexure (ODA 2007b; 2007c). Detailed WSIs provided specifications for the appropriate scope of the individual programmes of work. The level of record considered appropriate for the recording of each BHA was identified as a set of recommendations presented in the DDBA for each PDZ. These were based on the national guidance given in *Understanding Historic Buildings: a guide to good recording practice* (English Heritage 2006), and they provided for an appropriate level of detail.

This ranged from a low-level Photographic survey, through Level 1 (a basic visual record), Level 2 (a descriptive record), or Level 3 (an analytical record) to Level 4 (a comprehensive analytical record). Of the 18 industrial buildings and structures, three were recorded at Level 1, 14 were recorded at Level 2, and a single works premises was recorded to Level 4 (Fig. 1.13). The relatively lower perceived heritage significance of the structures and features associated with infrastructure in the area was reflected in 16 of the assets being recorded by a Photographic survey only; nine being recorded at Level 1; three at Level 2, and only a single asset was recorded at Level 3.

Where appropriate, following the main phase of recording, a watching brief was undertaken during demolition of buildings, to record features previously obscured.

The work was undertaken between September 2004 and October 2009, and resulted in the production of 24 built heritage reports (see Appendix 1). The majority of the records included the results of research of readily accessible primary and secondary documentary sources, in some cases involving the detailed research of individual company archives. The full BHA reports, therefore, remain the most comprehensive record of the individual buildings, which can only be summarised in the following chapters relating to the later development of the Park.

Figure 1.13: Levels of recording undertaken on the built heritage assets

Community History Project

As part of the community's engagement with the investigations, a Community History project was undertaken by Eastside Community Heritage. This involved an Oral History project which captured local people's personal recollections of life and work in the area, as well as the retold memories of earlier generations of the community.

There were also Map and Document workshops where members of the local community were given training in the examination of old maps and historical documents, and shared their personal knowledge of the area. This formed part of the detailed programme of further analysis of the Park's built heritage, and provided a better understanding of the historical and chronological context of some of the recorded buildings. This work, based

Figure 1.14: Locations of geoarchaeology boreholes

at, and using the resources of Newham Archives, resulted in the detailed analysis of the industrial and other premises shown on the four main epochs of historical Ordnance Survey (OS) mapping – 1869, 1896, 1915 and 1950; a fifth epoch based on research undertaken in 1969 has also been included (Addington 1969). Where not indicated on the OS maps, trade and post office directories were researched for information on the type of manufacture, industry or other activity carried out in each premises, and these were colour coded on base maps. This has provided invaluable information about the different industries that were located within the Park area at different times between the mid-19th and mid-20th centuries, and shows, at a glance, how the balance of those industries changed through time (see Chapter 6).

Geoarchaeology

The site-wide geoarchaeological assessment and analysis have entailed the production of a topographic deposit model based on borehole data (Fig. 1.14), in conjunction with a programme of palaeoenvironmental analysis from previously sampled sequences across the site. This has involved the analysis of 265 bulk samples, 270 processed flots and residues and 196 monolith samples from 96 sampled sequences.

The principal aim has been to describe the development of the landscape over the last 12,000 years, and so provide a framework for understanding how humans have interacted with their environment during that time (see Chapter 8). The deposit model assigned deposits to four broad stratigraphic units – Tertiary geology, Pleistocene gravel deposits, Holocene alluvium and modern made ground.

The topographic mapping has given an indication of nature of river flow and incision during the Late Pleistocene, when the current form of the Lea Valley was shaped, within which a number of tributary watercourses are also recognisable. It has also revealed surface topography of the gravel deposits in the Early Holocene floodplain landscape (see Fig. 8.10), which shows a braided (anastomosing) river system separated by elongated gravel islands. The recorded thickness of the Holocene alluvium had been affected by modern truncation and compaction by the varying depths of made ground across the Park.

Geology, Topography and Recent Land-Use

The Park lies on drift deposits comprising alluvium underlain by Lea Valley Gravels that were deposited following the scouring-out of the present valley floor during the late Pleistocene (British Geological Survey Sheet 256, North London). The gravels are the most recent in a series of Pleistocene deposits resulting from past changes in climate, beginning during the Anglian glaciation *c.* 450,000 years ago when the course of Lea Valley was initially formed, and continuing through subsequent glacial-interglacial periods. The underlying Tertiary bedrock is London Clay and Woolwich and Reading Beds.

The topography of the site prior to its present development as the Park was generally flat, sloping imperceptibly from north to south. However, modern developments have created some areas raised up to 13 m above others, and the site is divided by the steep embankments of roads, railways and other infrastructure which crossed it, and the steep-sided channels of the watercourses. While there were green spaces and vegetation along the watercourses and the Greenway (a footpath running along the embankment of the Northern Outfall Sewer), the area was largely built up and industrial in character, although with a significant number of abandoned and derelict sites and buildings.

Research Aims and Project Themes

The Park forms part of a landscape rich in archaeological and cultural heritage potential, and the investigations offered an opportunity to provide some context for finds reported by Hatley (1933) and those made during the construction of the Hackney Cut navigation and the 19th and 20th century reservoirs just up the river. A series of broad research questions were outlined in the Environmental Statement (ODA 2007d), based on priorities established in Museum of London's research framework (Museum of London 2002, 14–7). These concerned the presence of:

- palaeoenvironmental evidence for topographic and climate change preserved in the Lea Valley's alluvial deposits;
- *in situ* remains of prehistoric and later date, preserved within peat or alluvial deposits;
- remains of Roman roads, and evidence of Romano-British, settlement and land-use patterns, and burials;

- Saxon structures associated with the River Lea and its tributaries, and evidence for Saxon land-use, water management and milling;

- medieval features associated with the road along the Eastway (A106);

- post-medieval land-use; and

- The 18th–20th century infrastructure features.

The Lea Valley always offered a range of resources attractive to people living in the area. In prehistory, the topography of the valley would have created a variety of habitats suitable for different forms of economic exploitation. Permanent settlement and cultivation are likely to have been focused on the drier ground of the gravel terraces at the valley sides, while the evolving hydrology of the valley would have seen changes in the way the river itself and its floodplain were exploited both by hunter-gatherers during the Upper Palaeolithic and Mesolithic, and by farmers from the Neolithic onwards. Throughout its history, the Lea Valley was also an important corridor of communication.

The River Lea is London's second river, and its proximity to the nation's capital, to which it formed an eastern buffer zone, as well as the historic boundary between Essex and Middlesex and Hertfordshire, inevitably influenced its character. Much of the valley floor, however, frequently liable to seasonal flooding, may have been marginal land, although drainage and land claim from the Saxon period onwards would have created potentially rich pasture. In addition, the river would have been used to power mills and was essential as a means of travelling and transporting goods through the landscape right up until the 19th century when the area's industrial development ultimately transformed its character.

The aim of this volume is to tell the different stories which make up the history of the lower Lea Valley. It will do this by not only synthesising the varied sources of archaeological, built heritage and community engagement evidence to create a chronological narrative, but also by providing detailed specialist reports on those sources of evidence – artefactual, geoarchaeological and palaeoenvironmental.

Part 2 presents a chronological description of the cultural heritage remains from across the site. This is organised not on the standard framework of archaeological periods, but on broader temporal divisions reflecting the general processes of continuity and change revealed by the evidence. For the later periods the built heritage evidence together with other strands of information (eg, cartographic, documentary sources and community engagement) will be examined alongside the archaeological remains. These periods will reflect:

- the mobile and semi-sedentary communities of the Palaeolithic, Mesolithic, Neolithic and Early Bronze Age (Chapter 2);

- the broad continuity of settled occupation spanning the Middle Bronze Age to the Late Iron Age (Chapter 3);

- the gradual development of the historic agricultural landscape in London's hinterland during the Romano-British, Saxon and medieval periods (Chapter 4);

- the management of the landscape and waterways, the development of industry and infrastructure in the post-medieval and early Victorian periods, including the first phase of modern manufacturing industry (1800–1859) (Chapter 5);

- the rapid and transforming processes of industrialisation in the late 19th/early 20th century (1860–1919), and the subsequent decline of that industrial landscape in the 20th century (1920–1969) (Chapter 6).

The three phases of industrial growth set out in Chapters 5 and 6 (see above) are based on the three periods, identified by the *Victoria County History*, into which the development of West Ham's modern manufacturing industries can be divided (*VCH* 1973, 74–6).

Part 3 provides specialist reports on the residues of human activity (artefacts and environmental remains) (Chapter 7), and the environment (geoarchaeology and palaeo-environment) (Chapter 8).

Part 4 (Chapter 9) draws together the many disparate threads of evidence to illustrate four key themes that are repeatedly suggested by the data. These themes override the simple chronological narrative provided by Chapters 2–6, and offer different perspectives from which to view the complex interweaving of the individual, local and daily routines of life with the wider and more long-term natural, social and economic forces. The themes also give the site's history a wider (local, national and global) relevance appropriate to the unique context of the London 2012 Games. These themes concern:

- the river – charting people's changing perceptions and uses of the River Lea from untamed river to modern amenity;
- the evolving landscape – the interaction between natural and human influences on the evolution of the lower Lea Valley;
- life and work – the changing patterns of daily domestic and economic life over time;
- the London influence – how for 2000 years the history and destiny of the Lea Valley has been determined by its proximity to London.

Scientific Dating

Several phases of scientific dating (optically stimulated luminescence (OSL) and radiocarbon) have been undertaken during the evaluation, assessment and post-excavation analysis. A discussion of them is provided in Chapter 8. The OSL dating was undertaken on six samples within Trench 118 (see Table 8.4).

The radiocarbon results are presented in Appendix 5; selected dates are discussed in the relevant chapters. All radiocarbon dates have been calibrated using IntCal09 Northern Hemisphere calibration curve (Reimer *et al.* 2009) using the program OxCal 4.1 (Bronk Ramsey 1995; 2001). All calibrated dates are quoted using the 2σ confidence range (95.4%) in years AD/BC, with the end points rounded outwards to 10 years (Mook 1986) or 50 years where older than 15,000 years. Some of the radiocarbon dates from earlier phases had been obtained from bulk sediments and root material, which have proved to be problematic. Contamination of the soils and fluctuating ground water conditions may have also affected the results of some samples, notably several dates on bone from Trench 9.

Chapter 2

The Origins and Early Occupants of the Lea Valley

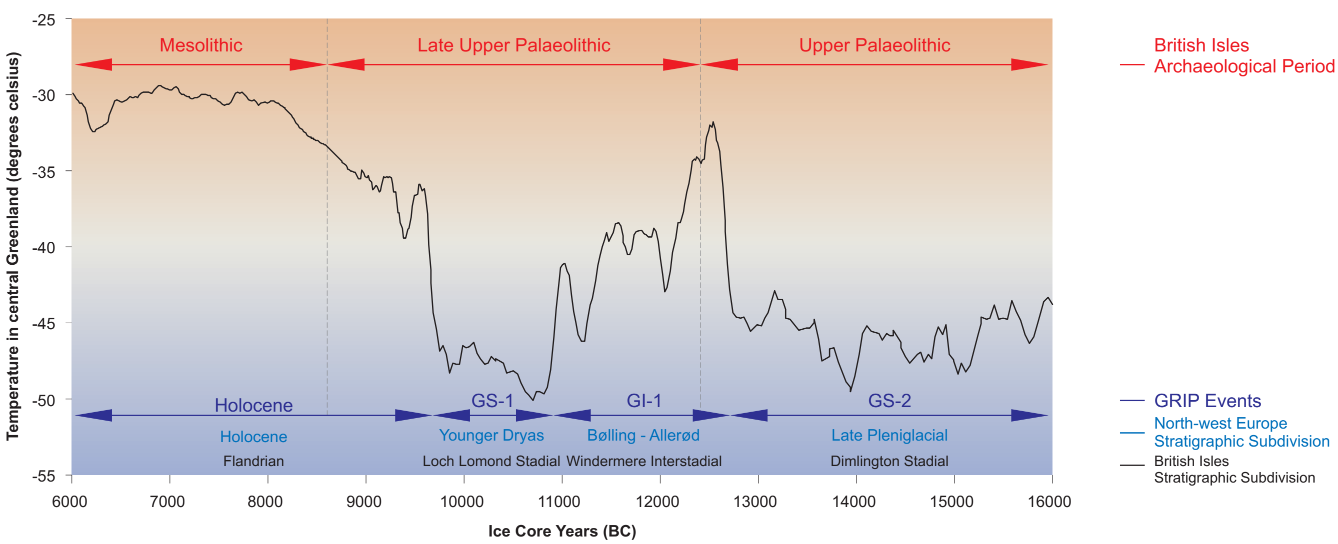
Introduction

Perhaps the earliest evidence for *in situ* hominid activity around the lower Lea Valley is a possible Palaeolithic 'floor', producing flints, bone and antler, recorded in the 1860s on Stoke Newington Common by Worthington Smith (Smith 1884; 1894), possibly dated 339,000–303,000 BP (OIS 9). Most of the evidence for activity in the Lower Palaeolithic (750,000–300,000 BP) and Middle Palaeolithic (300,000–40,000 BP), however, is in the form of redeposited flints tools, such as hand-axes, recovered from the Thames terrace gravel sequence (Bridgland 1994; Merriman 1990; Wymer 1968; 1985; 1999). Although no such evidence was recovered during the Olympic Park investigations, previous finds from the immediate area include hand-axes recorded as having been found west and east of Temple Mills (Fig. 2.1).

The present floodplain of the River Lea was not formed until the end of the Devensian glaciation (see Table 8.1), following which Britain was re-colonised by groups of hunter-gatherers after a long absence due to the cold conditions (see Chapter 8). During this period, a series of dividing and reconnecting channels (anastomosing channels)

Figure 2.1: Selected early prehistoric sites mentioned in the text

Below: Figure 2.2: The Lateglacial event stratigraphy derived from the Greenland Ice-core Project (GRIP), with stratigraphic subdivision of the Lateglacial in north-west Europe and the British Isles, and archaeological periods in the British Isles, based upon Walker (2005, fig. 1.5). Past temperature changes for Greenland are based upon GRIP δ180, taken from Alley (2000) and Cuffey and Clow (1997)



carried the excess waters that ran through area during the summer months, and during extended periods of temperature rise, permafrost melt, and glacial retreat.

There were periods of temperature rise during the warming phase of the Greenland Interstadial 1 (GI-1), *c.* 12,750–10,950 BC. Eroded and redeposited organic deposits known as Arctic Beds, containing tundra plant and faunal remains dating to the last glaciation, have been found in the lower Lea Valley, but were not encountered during the geoarchaeological investigations of the Park (see Chapter 8; Wessex Archaeology 2009).

Archaeological evidence for these periods is sparse. An Early Upper Palaeolithic bifacial leaf point was found at Temple Mills (Jacobi 2007, 289, fig. 49), and another EUP blade-point dredged from the Thames at Long Reach has been identified in an old collection (Jon Cotton pers. comm.). It is likely that the lower Lea Valley was exploited in a similar manner to the Colne Valley where a Late Upper Palaeolithic (12,000–9500 BC) 'long-blade' flint assemblage was found *in situ* at Three Ways Wharf associated with reindeer and horse bones (Lewis and Rackham 2011). Long blade assemblages are also known from Denham in the Colne Valley (Wessex Archaeology 2005); Church Lammas, Staines (Lewis in prep.); and a new discovery at Beam Washlands in Dagenham (Jane Sidell pers. comm.). At Tank Hill Road, Purfleet, some 'long-blade' elements were also identified (Leivers *et al.* 2007). A report of 1915 refers to unretouched flint flakes of 'late palaeolithic appearance' from Temple Mills, but they were 'of no definite type' and doubt must remain as to their date (Wrigley 1915).

The main period of development of the floodplain was at the start of the Holocene, *c.* 9700 BC, when the northern hemisphere glaciers were in full retreat and the temperature rose rapidly (Fig. 2.2). The consequent increase in ecological diversity was favourable for Mesolithic (8500–4000 BC) hunter-gatherers, and temporary settlement and working/butchery sites have been recorded at a number of riverside locations in the Greater London area (Lacaille 1961; Jacobi 1980; 1996: Reynier 1998; Lewis 2000a).

As in the Mesolithic, much of the evidence for Early Neolithic activity (4000–2200 BC) consists of isolated flints (Lewis 2000b). However, work at Yabsley Street, Blackwall (Coles *et al.* 2008), along the A13 (Stafford in press), and Fort Street, Silvertown (Crockett *et al.* 2002), have revealed Early Neolithic remains indicating that activity was originally more widespread and varied. At Yabsley Street, an inhumation burial, in a grave lined with mature oak timbers dated 4230–3970 cal BC (KIA-20157, 5252±28 BP), contained Carinated Bowl pottery, a flint knife and the charred remains of wild plant foods and a small quantity of cereals, while finds from Woolwich Manor Way on the A13 included pottery of the Mildenhall-style decorated bowl tradition and a considerable quantity of charred emmer wheat spikelets (Stafford in press).

Despite the advent of farming, the valley floor may have seen the continued and localised exploitation of the varied resources of the still largely natural landscape, albeit in a changing social context as reflected in economic and material innovations and the construction of large-scale communal monuments in the wider region. Such monuments, combined with the increasing evidence for woodland clearance, cereal cultivation and animal husbandry, point to new patterns of more permanent settlement, and the concerted manipulation and alteration of the environment during the Neolithic.

By the Early Bronze Age (2200–1600 BC) woodland clearance may have created areas of extensive grassland around the valley which, combined with the marshland on the valley floor, provided a variety of resources. The evidence for the continuing use of timber trackways, for example at Woolwich Manor Way (Stafford in press) and Beckton (Meddens 1996; Carew *et al.* 2009), suggests that such structures may have been built to maintain access to traditional grazing lands on the increasingly wet floodplain. The area probably still supported an economy based heavily on pastoralism, with people and animals able to move largely unrestricted across the landscape. This pattern appears to have only to changed to any significant degree with the enclosure of land in the Middle Bronze Age when more permanent settlement and land boundaries were established (see Chapter 3).

Late Pleistocene/Early Holocene

Trench 118

The cuts of two channels, and deposits relating to the Late Pleistocene river system, were identified in Trench 118 (Figs 2.3–2.4), in the south of the Park. Although the cuts were clearly visible in the north-east and south-west sections of the trench, their exact routes were difficult to determine, although both appear to have run approximately north-west to south-east. Deposits comprising channel fills and sandbars, showing channel activity in a period of large climatic fluctuations during GI-1, GS-1 and the Early Holocene, were present overlying the gravels across the base of the trench and several of these contexts were sampled for pollen and waterlogged material.

The older channel (62), which was visible in the north-east of the trench, cut through the Pleistocene terrace gravels (224 and 63), and OSL dates from overlying sandbars (187) suggest that it was already infilled with silty alluvial deposits (223) by the end of the GI-1, *c.* 10,950 BC. The overlying sandbars continued into the south-west facing section of the trench and remained relatively undisturbed for the following 12,000 years (despite successive periods of channel activity to the south-west, as seen and dated in the trench).

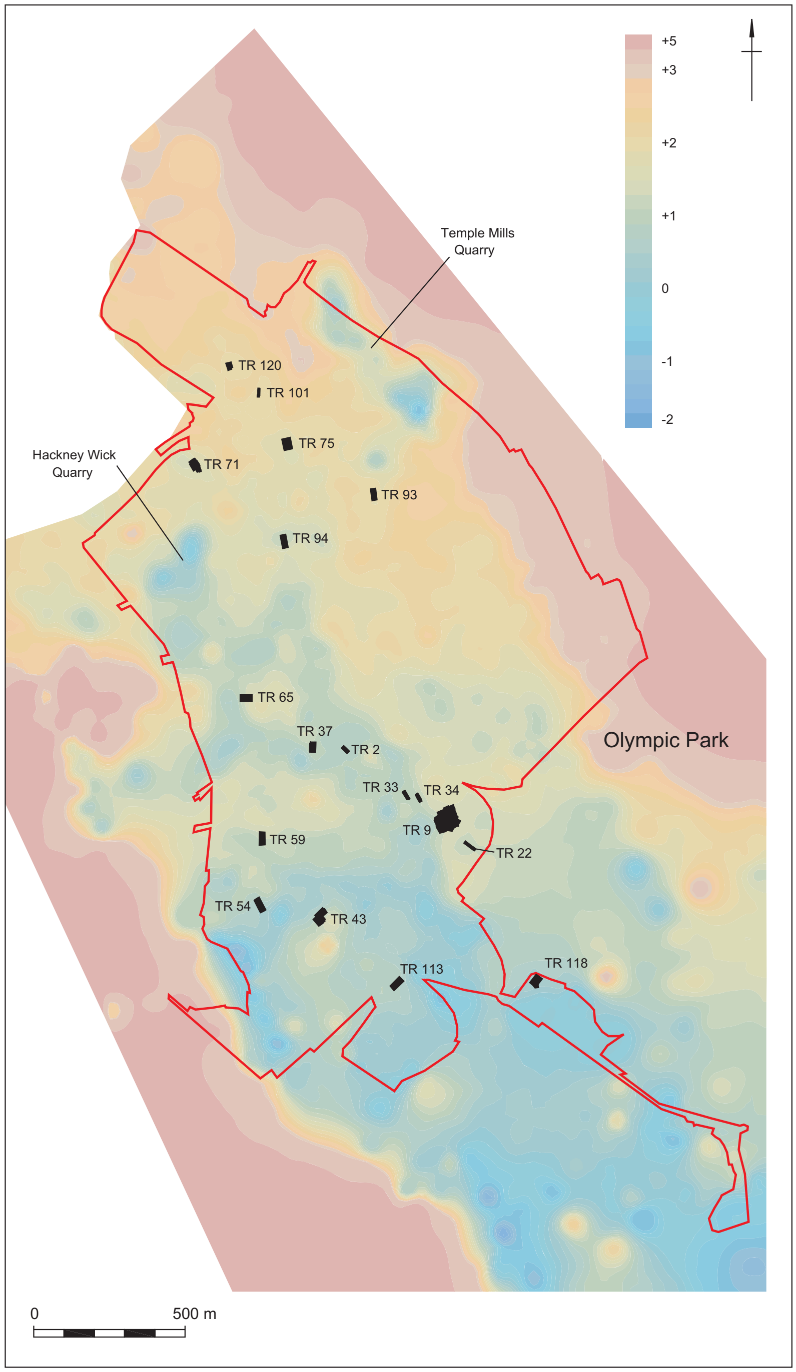


Figure 2.3: Locations of trenches with early prehistoric evidence in relation to the prehistoric topography (surface of Late Pleistocene/Early Holocene gravel deposits)

While the date of layer 223 was confirmed by the OSL dating of the overlying sandbars, it seems probable that deposits sampled in the centre of the trench (198, 196, 197) were of a similar early date, and probably, based on comparison of the pollen spectra obtained from both sequences, part of the same channel activity. A further deposit, comprising a channel-edge mineralogenic alluvium (185), overlay these sandbars and channel deposits and is likely, based on the stratigraphy and the pollen spectra, to date to the end of GI-1 and the beginning of the colder GS-1, between *c.* 10,950 and 9700 BC.

Towards the end of GS-1, these channel deposits, along with the underlying Pleistocene gravel terrace deposits (603), were truncated by a second channel (602) in the south-west of the trench. A series of relatively coarse channel fill and edge deposits (brown sands with rare gravels), which contained material dated to the Early Holocene, Neolithic and Middle Bronze Age, were difficult to distinguish in the field and were ascribed a single context number (580); they are referred to here as '580-complex'.

Two radiocarbon dates from the lower 580-complex in this channel indicate that these lower deposits had accumulated from 10,440–10,040 cal BC (SUERC-34949, 10,325±40 BP) continuing into the warming phase at the beginning of the Early Holocene, 9750–9330 cal BC (SUERC-36287, 10,000±35 BP). This sequence was also sampled extensively for pollen and waterlogged material and two further lines of evidence confirmed that it post-dated the basal channel fills in the centre and north of the trench. One was the preservation of dated plant macrofossils at a similar depth in the south channel, whereas they were absent in the northern channel fills, suggesting the deposits had dried out in the intermediate stage. The other was the rise in meadowsweet (*Filipendula ulmaria*), characteristic of Early Holocene profiles, which was clearly visible in the pollen profile from the southern channel fill, but absent in the two northern sequences.

Mesolithic

The deposit model (see Chapter 8) has provided a glimpse of the buried Early Holocene landscape. The gravel topography shows a series of river channels flowing across the valley bottom in an anastomosing (braided) form, separated by areas of raised gravels offering dry land suitable for habitation (several were the locations of Bronze Age and Iron Age settlements). Not all the channel areas revealed by the topographic mapping would have remained active during this period, as the amount of water flowing through the valley would have reduced as the climate warmed and permafrost disappeared. Several are likely to have become cut off, developing into small bodies of open water and fen.

Several tributaries joined the main river during the Early Holocene, one on the approximate line of the later Hackney Brook entering on the north-west side, and earlier streams entering the floodplain along its eastern margin, at the approximate locations of the later Dagenham Brook, Phillibrook Stream and Channelsea River. As the vegetation colonised the area, and soils developed over the raised gravel areas, a very diverse wetland environment would have developed, with a wide range of resources attractive to Mesolithic communities.

The considerable potential for the preservation of Mesolithic evidence beneath the alluvium of the Thames and its tributaries has long been recognised (eg, Lacaille 1961), and the Lea Valley to the north of the Park has been identified as of particular importance for the survival of Mesolithic remains (Austin 1997). Areas of high potential for Mesolithic remains in the lower Lea Valley have recently been mapped (Corcoran *et al.* 2011, fig. 122), although the thickness of the alluvium and made ground, which makes these sites difficult to locate and even harder to excavate, have clearly contributed to the limited number of finds in this area.

Excavation at Meridian Point, Glover Drive, Enfield, recovered 120 struck flints dominated by flakes and blades, including two Early Mesolithic microliths (Bowsher 1996).

Several axes and a disturbed knapping site have also been recorded close to the Hackney Brook (Corcoran *et al.* 2011, fig. 122). At Fords Park Road, Canning Town, a Late Mesolithic assemblage has been recovered from the surface of a former eyot in the Thames floodplain (Mary Ruddy pers. comm.). Other Mesolithic finds from the lower Lea Valley include those from mixed assemblages at Stratford Market Depot (Bradley 2005) and Prince Regent Lane (Holder 1998). Residual Mesolithic flints have been have recovered from later contexts at a number of locations.

The archaeological evidence for activity in the Mesolithic in the Park itself is limited, consisting of a small number of pieces of diagnostic struck flint. A possible microlith was recovered from the base of Trench 101 (Barrowman and Corcoran 2008; this piece was not examined during the post-excavation analysis and may be a bladelet rather than a microlith), and a broken flake from a large blade core, potentially of Late Upper Palaeolithic date but more likely to be Early Mesolithic, was found redeposited in Trench 118. The latter would be broadly contemporary, therefore, with material from an *in situ* flint knapping site, characteristic of an Early Mesolithic 'broad-blade' industry, identified in gravels pits at Rikof's Pit, Broxbourne, Hertfordshire, in the upper Lea Valley (Warren *et al.* 1934). There, two small areas at the interface of a sandy soil and the overlying peat produced several hundred flakes and cores. At Millmarsh Lane, Enfield, excavation revealed Early Mesolithic peats from which struck flints were recovered (Bowsher 1995). Other finds from the Park included a sharpening flake struck from a flint axe, another from a bladelet core, a notched blade, and a burin, all recovered from Trench 9, located on the eastern edge of one of the river channels.

For a short period at the start of the Mesolithic the hunting strategies may have been similar to those of the Late Upper Palaeolithic, which had largely revolved around the exploitation of herds of reindeer within a cold open environment. However, as the climate warmed and the reindeer migrated northwards, so the hunter-gatherer way of life had to adapt to new conditions. Sea levels rose and the flooding of the rich and extensive lowland plains in the North Sea, known as Doggerland (Gaffney *et al.* 2007), would have pushed hunter-gatherer populations back onto the higher ground of the present coastal and estuarine areas. The Thames, and its tributaries like the River Lea, which would have provided easy routes for movement through the increasingly wooded landscape.

The increasingly rich and fertile floodplain of the Lea Valley may have been an area regularly visited during seasonal rounds of economic exploitation. Fish and wildfowl, and a much wider range of edible plants characteristic of fen and marsh environments, became available, while riverside clearings in the developing woodland (initially sparse birch and pine, to closed pine and, later, mixed deciduous forest) attracted red deer, roe deer, aurochs and pig. The hunting of these more solitary woodland animals would have required new strategies, among which may have been the use of fire to clear vegetation. As well as creating clearings, burning provides a flood of nutrients into the soil, promotes biological diversity, which in turn attracts and concentrates game, and increases the range of plant foods. The analysis of microcharcoal from Temple Mills Depot (Bates and Stafford in press) and Enfield Lock (Chambers *et al.* 1996) has indicated the possible occurrence of such deliberate burning events during the Early Mesolithic, while charred seeds and stems of sedge of a similar date were recorded from Trench 94, although all these could be a result of natural processes such as lightning strikes.

In the Early Mesolithic the environmental data from the Olympic Park site indicates aspen, willow, dogwood and hazel all growing in the valley bottom within the channel areas. There were open areas, as indicated by pollen evidence and the dung of larger herbivores, but the valley was gradually becoming more wooded as the floodplain soils developed and trees colonised these areas.

In damper areas of the floodplain, including the vegetated former channels, alder carr began to dominate the local vegetation. The date of this event is uncertain, with pollen evidence and plant macrofossils from the excavations at Stratford Box (part of the archaeological works in advance of the High Speed 1 at Stratford International Station; Fig. 1.2) (Barnett *et al.* 2011) indicating that this dominance had already occurred by *c.* 6000–5790 cal BC (NZA-32948, 7014±40 BP), while the various collective sequences for the Lea Valley in general suggest that a date of around 7000 BC seems probable (see Chapter 8, Fig. 8.6). For hunter-gathers, from a subsistence perspective, the transition in some of these areas from open marsh to carr woodland would have led to a change in local resources, although fruit and nuts from scrubland species, such as elder, hazel, bramble and sloe, are all likely to have still been collected.

Neolithic

As in the Mesolithic, direct archaeological evidence for Neolithic activity in the Park is very limited, previous finds consisting mainly of a few pieces of flintwork, including occasional axes; the general absence of archaeological features reflects a pattern seen more widely along the Lea Valley. Only a few flints of Mesolithic/Neolithic date were recovered during the investigations (see Leivers and Gittins, Chapter 7), much of which is debitage, although a few tools including a flint axe (Trench 118, Pl. 2.1, see Fig. 7.5) were found.

Just outside the Park, a mixed assemblage including Neolithic flint was previously found at Stratford Market Depot (Bradley 2005), at a location shown in the deposit model to be on a gravel island, probably with channels running either side. Many of the flints recovered are of indistinguishable Mesolithic/earlier Neolithic date, perhaps indicating that the start of the Neolithic saw a substantial degree of continuity from the Late Mesolithic, with the valley landscape little changed and probably exploited in a similar, seasonal manner, possibly still mainly for the procurement of wild resources.

While still dominated by alder carr, the valley floor at the start of the Neolithic is likely to have continued to comprise a patchwork of different ecological zones, including areas of open fen marshland, and drier areas on gravel banks between the river channels. More expansive open areas of grassland were probably rare, with the drier areas of the valley and adjacent terraces supporting vegetation composed of mixed woodland of oak, elm, lime, and hazel.

The impact of people on the vegetation was probably only slight, although some landscape changes can be identified. While there is little direct evidence for clearance, cultivation or indeed pasture in the Early Neolithic from this part of the valley, some indication for such activities has been recovered further south, close to the River Thames. Among the early evidence is a small charred assemblage of cultivated and wild plant foods – charred hazelnut, hawthorn pips, cereal, and emmer chaff – recovered from an Early Neolithic inhumation grave at Yabsley Street, Blackwall (Coles *et al.* 2008); the predominantly Late Mesolithic date of 4230–3970 cal BC (KIA-20157, 5252±28 BP) from the grave is probably due to its being obtained from the grave's oak lining. A much richer deposit of emmer wheat spikelets with occasional fragments of hazelnut shells was found in association with Early Neolithic pottery, flint and burnt flint at Woolwich Manor Way, Beckton (A13, Stafford in press), dated to 3640–3360 cal BC (GU-18954, 4685±45 BP). Soil horizons containing Neolithic flint and pottery are also recorded at Prince Regent Lane, Newham, east of the valley (MoLAS 2000, 79).

Possible evidence for Early–Middle Neolithic clearance in the Park is provided by a tree-throw hole (24), associated with fragments of burnt clay, flints and charcoal, in Trench 120 at the north of the site, which was radiocarbon dated to 3630–3190 cal BC (NZA-32944, 4628±40 BP). The presence of nettle and bramble in its fill suggests an open drier patch in a clearing within alder woodland which quickly became colonised by scrub, although it remains uncertain whether the tree-throw hole was the result of deliberate clearance or natural causes. At Southwark (Sidell *et al.* 2002) and Perry Oaks (Framework Archaeology 2006, 65) Neolithic material has also been recovered from tree-throw holes.

A second tree-throw hole (20), adjacent to but later than tree-throw hole 24, provided a date of 2580–2340 cal BC (NZA-32943, 3960±35 BP), and appears to have formed in denser mixed alder, hazel and elder woodland, suggesting that earlier clearings in this area may have reverted to woodland by the Late Neolithic. Trench 120 is located on the margins of the early channel that flowed south towards the main river channel (its line later followed by the Dagenham Brook, see Chapter 8).

With the continued dominance of wetland vegetation on parts of the valley floor, it is likely that early cultivation and animal husbandry would have been focused mainly on the drier areas flanking the valley. Although no direct evidence was found in the site for either clearance, cultivation or pasture during the Neolithic, possible evidence of Neolithic clearance is indicated by a layer of charcoal-rich alluvium further up the Lea Valley at Millmarsh Lane, Enfield (Bowsher 1995).

Plate 2.1:
Neolithic flint axe

Trench 118

The most potentially informative evidence for Neolithic activity within the Park was recovered from its southernmost part, in Trench 118. This comprised pottery (the only Neolithic ceramics recovered from the Olympic Park investigations, Pl. 2.2, see Fig. 7.1), flintwork, and worked timber

Plate 2.2: Neolithic rim sherd from Trench 118

stakes radiocarbon dated to the Early Neolithic; other Early Neolithic radiocarbon dates were obtained from environmental samples. Together, this range of evidence indicates the significant exploitation of a river- or stream-side location during the earlier part of the Neolithic. It is located near to the Stratford Market Depot site (Hiller and Wilkinson 2005) which also yielded evidence for Neolithic activity.

During the evaluation (Birchenough *et al.* 2008), three sherds of Neolithic pottery were recovered from a gravel horizon (55) overlying the fills of a channel. One was from an Early Neolithic plain open bowl with a distinctive rolled rim and a poorly-sorted, crushed burnt flint temper; the other sherds were from two further bowls. The same layer also produced a small flint assemblage of 11 flakes, and 18 pieces of animal bone, including cattle and deer, although the date of finds from this context was unclear (see below). Their unabraded nature suggested that they had not moved far from their original locations.

As a result of these finds, the base area of the trench was expanded and excavated, during which further evidence of Neolithic activity was found (Fig. 2.4). This included a complete, thin-butted flint axe of Early or Middle Neolithic date (ie, the 4th millennium BC) (Pl. 2.1, see Fig. 7.5) from the south-western end of the trench. The finely made axe, flaked bi-facially but not ground or polished, is slightly worn but appears to be largely unused (Leivers and Gittins, Chapter 7). Other undiagnostic flints – an abraded flake core, a crude scraper on a primary flake, and two other unretouched flakes – as well as a fragment of red deer antler, were recovered from the same apparent deposit.

Establishing the precise contexts for these finds, however, and hence the nature of the riverside activities which resulted in their apparent association, has been challenging and has required a complete reassessment of the depositional sequence in the trench.

Early Neolithic

Most of the Neolithic finds from the south-west end of the trench, including the flint axe, were recovered from the 580-complex – the series of channel fill and edge deposits which, in the field, were ascribed a single context number (see Late Pleistocene/Early Holocene, above). The lower part of the complex comprised not only the aforementioned undisturbed Early Holocene fills, but probably also the Neolithic deposits (relating to the base of 183, below) (Fig. 2.4, Pl. 2.3). The axe was slightly worn but had no significant indication of having been fluvially worked and from this perspective may quite possibly have been deliberately placed.

The identification of a channel dating to this period was, however, problematic, mainly due to truncation of the deposits by later channels, particularly during the Bronze Age (see Chapter 3). Nonetheless, two intact stratified sedimentary deposits were radiocarbon dated to the Early Neolithic. Their results are statistically consistent suggesting they could be broadly contemporary, with context 162 dated to 3520–3360 cal BC (SUERC-34951, 4650±35 BP) and basal layer 183 dated to 3630–3360 cal BC (SUERC-36575, 4680±35 BP). These are probably part of the same deposit, a grey-brown silty clay loam, *c.* 0.1–0.15 m thick, often with thin sandy fine inwashes, which is likely to have formed at the channel edge, and which directly overlay the Late Pleistocene and Early Holocene sands and mineralogenic alluvium (above).

The Neolithic finds from the central and north-eastern parts of the trench came from another composite context (55–complex), described as gravels in the field, which contained both Neolithic finds and animal bone of Romano-British date. It is likely that the 55-complex consists of the dated

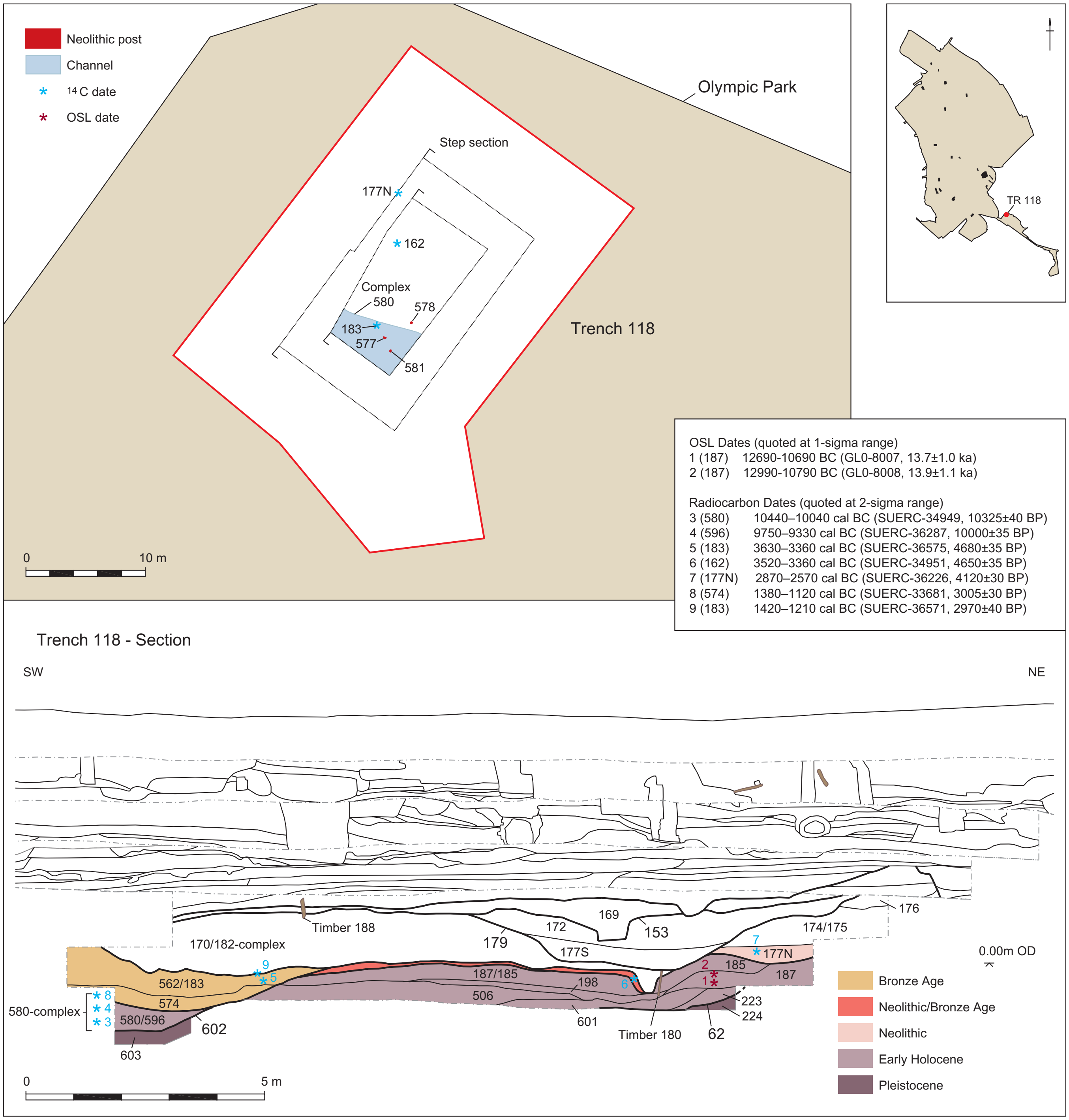


Figure 2.4: Trench 118: simplified plan showing position of early prehistoric channel and Neolithic posts, and south-east-facing section through prehistoric deposits

context 162 (above), and a deposit with a very similar appearance – a Romano-British active sand deposit with frequent flint gravels (182); it probably also contains the Neolithic/Bronze Age clay loams ascribed to context 183, although these are thinner in this part of the trench.

The other significant find from the trench was the group of three timber posts of alder (577, 578 and 581) in the south-western part (Fig. 2.4, Pl. 2.4, Table 2.1). The (truncated) tops of the posts were first located around -0.57 m OD, and as such were significantly deeper than several other stakes/posts that were dated to the Romano-British period

Plate 2.3: Trench 118 (view from south)

Right: Plate 2.4: Neolithic timbers from Trench 118

(see Chapter 4). The three Neolithic posts were in a group (measuring *c.* 3 m by 2 m) and no other worked wood was recovered with them. Posts 577 and 578 were vertical, while 581 lay at an angle, although it has been suggested that it had some scouring on it (Howell and Spurr 2009, 37). The last 10–20 mm of each post had been worked to produce roughly-faceted to rounded points.

It is probable that the posts were driven into Pleistocene gravels (603), as well as the overlying Early Holocene deposits, including the 580-complex and context 506. All three were radiocarbon dated (Table 2.2) and shown to be broadly contemporary, and therefore likely to form part of a single structure. Modelling of the four radiocarbon dates estimates construction around 3640–3520 cal BC (95.4% probability) (Fig. 2.5).

The height of the tops of the posts (-0.57 m OD) meant that any other posts that had been present to the south are likely to have been disturbed or potentially removed by later channel activity (Table 2.2). For example, the base of the Bronze Age channel to the south of the posts lay between -0.7 m and -1.0 m OD. In contrast, the later, Romano-British and medieval channels that cut through the north-east end of the trench, were shallower, meaning that the potential survival of Neolithic posts in that area would have been greater; none were found.

The two radiocarbon dates from the channel deposits (context 162 and the base of

Table 2.1: Depths, length and dimensions of the Neolithic timber posts

Context	Length (m)	Diameter (mm)	Top of post (machining?)	Base of post
Timber post 578	0.69	80–90	-0.57 m OD	-1.26 m OD
Timber post 577	0.81	110	-0.57 m OD	-1.38 m OD
Timber post 581	0.89	70–80 to 150	-0.57 m OD	-1.46 m OD

Table 2.2: Radiocarbon dates on Neolithic material from Trench 118

Context (depth m OD)	Material dated	Lab. code	Date BP	δ13C ‰	Calibrated (95.4%)
Early Neolithic					
Timber post 578	*Alnus glutinosa*	SUERC-36224	4740±30	-25.4	3640–3370 cal BC
Timber post 577	*Alnus glutinosa*	SUERC-36223	4785±30	-28.1	3650–3520 cal BC
Timber post 581	*Alnus glutinosa*	SUERC-33686	4735±30	-28.9	3640–3370 cal BC
Timber post 581	*Alnus glutinosa*	SUERC-36579	4780±35	-28.3	3650–3380 cal BC
From samples					
162 (-0.33 to -0.44)	*Alnus glutinosa* cones	SUERC-34951	4650±35	-26.9	3520–3360 cal BC
183 (-0.53 to -0.77)	*Alnus glutinosa* cones *Corylus avellana* nut frags	SUERC-36575	4680±35	-29.5	3630–3360 cal BC
Late Neolithic					
177N	*Corylus avellana* nut frags	SUERC-36226	4120±30	-29.3	2870–2570 cal BC
580-complex	Red deer antler	SUERC-36289	3935±35	-23.2	2570–2290 cal BC
580-complex	Red deer antler	SUERC-36293	3910±30	-23.1	2480–2290 cal BC

context 183) suggest that the environmental data the deposits contain may provide some information on the general landscape during the latter part of the Early Neolithic (Table 2.2), although they are likely to be later, possibly even up to a century, than the post structure. A slow-flowing channel is indicated by shells of both *Valvata piscinalis* and *Bithynia*, along with seeds of yellow water lily (*Nuphar lutea*), pondweed (*Potamogeton* sp.) and narrow-fruited watercress (*Rorippa nasturtium-aquaticum*). A large number of seeds were recovered, probably associated with an expanse of common club-rush (*Schoenoplectus lacustris*) across most of the channel edge. This wetland vegetation, therefore, dominated the channel, with alder and hazel present on its edge, and with oak and possibly occasional relict stands of pine on the drier parts of the floodplain (Scaife 2009a).

Late Neolithic

Although no archaeology relating to the Middle or Late Neolithic was clearly identified in the trench, the fill (177N) of a channel clearly visible in section in the northernmost corner of the trench (cutting through the Late Pleistocene sandbars) has been dated from hazelnut shell broadly to the Late Neolithic: 2870–2570 cal BC (SUERC-36226, 4120±30 BP) (Table 2.2). Unusually, the channel's base, at about -0.15m OD, was somewhat higher than that of the earlier channels, and indeed of the Bronze Age channel that cuts down to -0.1m OD. The channel is likely to have flowed broadly north-south, but was not identifiable in the north-west facing section, having been probably removed by later, Romano-British and medieval activity. It is possible that it flowed for a relatively short period and very few aquatics and no molluscs were identified in

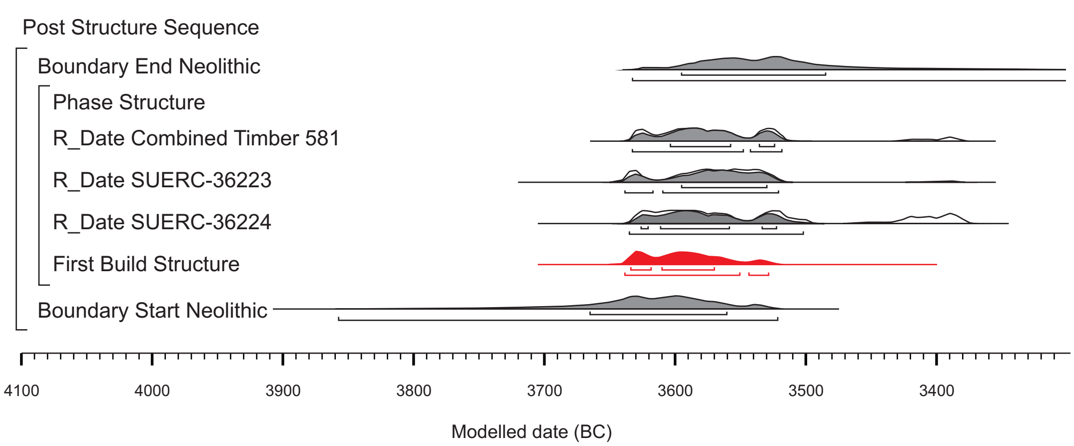


Figure 2.5: Radiocarbon model of selected Neolithic dates from Trench 118

Plate 2.5: Worked antler from Trench 118

its fill. Furthermore, the fill was bioturbated, with probable periods of drying out. The broad environment appears similar to that seen for the Early Neolithic, although slightly less open, with alder, hazel and oak all present.

Two pieces of antler, recovered from the 580-complex, were dated to later in the Late Neolithic: 2570–2290 cal BC (SUERC-36289, 3935±35 BP) and 2480–2290 cal BC (SUERC-36293, 3910±30 BP) (Table 2.2). One had 'chipped' facets on the tip (Pl. 2.5), and the other had possible cut marks (Higbee, Chapter 7). The location of the facets is consistent with use wear, perhaps as a rake or fork, and the cut marks may be the result of cleaning the antler (see Chapter 7). However, no contemporary deposits have been identified in the trench, the closest being the channel containing deposit 177N. In particular, no deposits of this date are associated with the 580-complex. A Middle Bronze Age date has been obtained from animal bone in the upper parts of the 580-complex, where it forms part of a Middle Bronze Age channel fill (see Chapter 3), but given that the antlers date to a millennium before it seems probable therefore that they have been reworked from older deposits.

Discussion

The recovery from Trench 118 of pottery, flints (including the axe), and some form of timber structure (Fig. 2.6), all potentially contemporary within the Early Neolithic, from a very localised position on the edge of a channel, gives each of these finds extra significance, additional to the fact that such finds are relatively rare individually, and moreover comprised the only Neolithic finds from the whole of the Olympic Park excavations.

On its own the flint axe might be interpreted as possibly a votive object deliberately placed in a river channel for symbolic/religious reasons. Such a possibility has many suggested parallels both during the Neolithic and in later prehistoric (and historic) periods. For example, a short distance further up the Lea Valley, a group of three ground flint axes was reported found just below alluvium near Temple Mills in *c.* 1883 (Holgate 1988, 285), and four Neolithic axes are recorded from the River Thames at Blackwall. Many other axes have been found in similar contexts along the River Thames and more widely in Britain and Europe (Adkins and Jackson 1978; Cambell Smith 1963; Koch 1999). Flint offerings appear to have been made into water at the Bricklayers Arms Depot in Southwark where there were wooden structures on the edge of the Bermondsey eyot (Sidell *et al.* 2002).

The flint axe from Trench 118 could have served not only as a functional tool – for example for woodland clearance, and timber constructions – but also would be regarded as an object of social and symbolic value. If it was deliberately placed, it is nonetheless clear that such an act was not an isolated event, but one at a location at which a range of other activities took place. Moreover, given the investment in time and energy needed to construct whatever timber structure the three posts were part of, it appears that the occupation of this site, while possibly temporary, was probably not

Figure 2.6: Reconstruction of the area of Trench 118 in the Early to Middle Neolithic

transitory. This may have been a significant location, regularly visited. Throughout the Neolithic, it is likely that sections of the population were involved in a form of mobile pastoralism, in which such riverside locations would have been seasonally important for the grazing and watering of livestock (as well as for hunting). Trench 118 lies between a nearby gravel island (occupied by the Stratford Market Depot site, Hiller and Wilkinson 2005) and the broad gravel promontory to the west where later, Bronze Age and Iron Age, settlement took place (Trench 9).

Timber structures of Neolithic date are extremely rare and given this structure's location the only comparable possibilities presently known for this period are of timber trackways and/or platforms. The most closely dated structures are those excavated at Belmarsh West (Hart 2010), just south of the Thames. The evidence suggested two potential structures, the second of which produced three statistically consistent dates: 3930–3660 cal BC (Wk-25051, 4982±30 BP), 3950–3700 cal BC (Wk-25052, 5011±45 BP) and 3970–3770 cal BC (Wk-25053, 5075±44 BP). The structures, consisting of tangentially split, predominately alder timbers and logs, had been laid out across the surface of peat. Their precise function and purpose, however, remain unclear; they contained no brushwood, and no conclusive tool marks were observed on any of the timbers or stakes, as were found on those from Trench 118.

A further comparison is the timber trackway/platform at Silvertown, from which a Middle to Late Neolithic date, 3340–2900 cal BC (GU-4407, 4410±60 BP) was obtained (Crockett *et al.* 2002). The structure appeared to comprise of an alder timber 'kerb' pinned in place with alder posts, with further planks and brushwood between.

However, a second date on a worked stake/post that was in close association with the timber 'kerb' fell within the Early Bronze Age, 2280–1940 cal BC (GU-4408, 3700±50 BP), raising issues over the reliability for the dating of this structure.

Several Neolithic trackways in the Somerset Levels have more clearly defined posts, providing a better comparison with those discovered in Trench 118. At the Sweet Track, for instance, posts set in an 'X' shape supported a narrow timber plank trackway, with a further post – a 'railpeg' – used to hold this structure, as well as providing a possible handrail (Coles and Orme 1979). It might be noted that while the posts comprising the 'X' did not penetrate into the basal sediments below the peat, the vertical 'railpeg' was driven into them. Other trackways on the Somerset Levels were less reliant on timber posts of such length, and comprised brushwood or horizontally laid planks, although horizontally laid timbers at the Abbot's Way trackway were 'pegged' in place with posts of similar length.

Although no Neolithic monuments such as causewayed enclosures and cursūs, or burial monuments, are known in the area of the lower Lea Valley, they are all represented in the wider region, and there is no reason to assume that the local Neolithic communities were not integrated within the types of large-scale, long-distance social networks which constructed them elsewhere. The widening scope of activities represented archaeologically in the area is exemplified by the crouched inhumation burial in a timber-lined grave, probably of a woman, associated with Early Neolithic pottery, found close to a palaeochannel at Yabsley Street, Blackwall (Coles *et al.* 2008).

Ritual activity is also represented by an Early Neolithic ring-ditch at Launders Lane, Rainham (Hedges 1980). Although large communal monuments have yet to be discovered in the area, causewayed enclosures are known in Essex at Orsett (Hedges and Buckley 1978), and possibly also at Southall Farm, Rainham (Greenwood *et al.* 2006, 10), and in Kent at Burham, beside the river Medway (Oswald *et al.* 2001), and Kingsborough on the Isle of Sheppey (Allen *et al.* 2008), as well as in the upper Lea Valley at Sawbridgeworth, Hertfordshire (Wilson 1975, 183). To the west, the causewayed enclosures at Staines and Abingdon are located at the confluences of the Thames at its tributaries, and Lewis (2000b, 72) has suggested that the mouth of the River Lea could also have been the location for such a monument.

The Middle and Late Neolithic is less well represented in the area, although a group of three Middle Neolithic pits, one of which contained a Peterborough Ware bowl, dated to around 3000 BC, was recorded at the Lefevre Walk Estate, Old Ford, *c.* 1.5 km west of Trench 118, on the west side of the River Lea (Taylor-Wilson 2000). Peterborough Ware has also been found along the A13 (Stafford in press). Such pits, frequently containing deposits of cultural material including flint, pottery and food remains, are a widespread feature of the Neolithic, sometimes occurring in extensive groups as on the gravel terraces around Heathrow, west of London (eg, Cotton with Johnson 2004; Powell *et al.* forthcoming). While their function, too, is not fully understood, their presence in the Lea Valley provides further confirmation for the continued exploitation of the landscape.

The suggestion that the red deer antler from Trench 118, radiocarbon dated to the Late Neolithic, had been deliberately modified raises the possibility of this location's more long-term use, but there was no other evidence for Late Neolithic activity from the Park. However, the continuing potentially ritual nature of some activities undertaken in wetland locations is provided by the 'Dagenham idol', a Late Neolithic/Early Bronze Age anthropogenic figurine radiocarbon dated 2470–2030 (OxA-1721, 3800±70 BP), carved from Scots pine (*Pinus sylvestris*), found at Dagenham in 1922, buried beside the skeleton of a red deer (Coles 1990, 326; Coles 1998). Small assemblages of Beaker pottery are known from the River Lea floodplain and beyond (Howell *et al.* 2011, 36–7).

Early Bronze Age

There was extensive alder carr in the north-east and south-east Thames floodplain in the Early Bronze Age, and it continued also to dominate the Lea Valley floodplain vegetation. However, there is also some evidence from the environmental sequences in the Park for the expansion of grassland and marsh, and the valley floor may have remained characterised by a patchwork of different ecological zones. While it is possible that such changes were associated with deliberate clearance, it is also possible, given the very low level of archaeological evidence in the Park for this period – just two core trimming flakes of later Neolithic/Early Bronze Age date recovered residually from Trench 9 – that these changes were the result of increased flooding.

The exploitation of the river valley landscape is indicated by a timber structure of upright oak posts on the edge of a stream flowing into the Lea at Innova Park, Rammey Marsh, Enfield. This provided a radiocarbon date of 1760–1610 cal BC (NZA-20912, 3388±30 BP), ie, towards the end of the Early Bronze Age (Ritchie *et al.* 2008). Close by, at Forty Hall, Enfield, remains of a sub-circular timber structure consisting of 16 post-holes inclined towards a central post, was recorded cutting the brickearth; it was sealed by topsoil, in the lower level of which were two sherds of pottery too abraded to date precisely but reported to be of Late Neolithic/Early Bronze Age date (Gibson 1992; Corcoran *et al.* 2011, 180). Other evidence of possible settlement activity, in the form of a hearth containing Early Bronze Age pottery, was found at Yabsley Street, Blackwall (Coles *et al.* 2008).

Conclusion

Were it not for the happy concurrence in Trench 118 of both a significant and intriguing assemblage of Neolithic artefacts – flint axe, pottery and a structure of worked timber posts – and environmental material not only contemporary with these remains but also pre-dating and post-dating them, there would be much less to say about the earlier prehistoric period within the Park. Although a number of trenches elsewhere in the Park also produced significant new evidence for the developing Holocene environment of the lower Lea Valley (see Chapter 8), the generally thin distribution from the wider area of evidence for human activity before the Middle Bronze Age makes it hard, still, to visualise the evolving patterns of economic exploitation and social behaviour undertaken within this environment.

Not surprisingly given the Park's setting in the landscape, the limited evidence from the investigations confirms the use of riverside locations during the Neolithic. This may reflect what we might consider as both the practical concerns of the local population, involving the exploitation of these locations' varied resources and the river as a communication route, as well as its ritual/religious concerns, the occurrence of the finely made flint axe perhaps presaging a pattern of deposition in the river that was to continue through prehistory. The fashioning of timber posts to create some form of river-edge structure clearly indicates an investment in such places, perhaps mirroring the investment of time and resources in adjacent dry-land locations (albeit not visible within the Park and rarely visible elsewhere) that was necessary for the clearance of woodland and the cultivation and harvesting of arable crops.

While the wild resources, on which the Mesolithic groups had relied for their survival, continued to be exploited during the Neolithic, it is unclear to what extent wild foods remained an important component of subsistence, or were merely a supplement to the newly available, domesticated plants and animals. Unambiguous evidence for cultivation is rare, and while the environmental evidence points to an increase in wet grassland, well suited to the grazing of livestock, the development of the agricultural economy through the Neolithic and into the Early Bronze Age, and the related changes in society, remain unclear. Although the sparsity of the evidence can give an impression of such populations living in relative isolation, the presence in the wider region of various forms of communal monument indicates that social interactions occurred over a wide scale, probably facilitated within the Park by the presence of the river as a route of communication. What we can be sure of, however, is that the sudden, high visibility of evidence for settlement, land-use and economy that starts in the Middle Bronze Age probably represents the culmination of the long-term evolution of such social and economic networks.

Chapter 3

Settling the Riverside: Later Bronze Age and Iron Age Fields and Farmsteads

Introduction

As discussed in Chapter 2, there is only limited evidence for activity associated with early agricultural communities in the lower Lea Valley, ie, during the Neolithic and Early Bronze Age, and what there is, beyond largely isolated finds, is frequently located on the edges of stream and river channels, and other wet locations, as at Trench 118. Apart from the small quantities of Middle Neolithic Peterborough Ware and Early Bronze Age pottery, and radiocarbon dates from a number of timber structures, evidence relating to the possible pattern of settlement and agricultural land-use, whether permanent or shifting, prior to the Middle Bronze Age, has to be inferred largely from the distributions of finds, mostly flints, and environmental evidence for clearance and cultivation (see Chapter 8).

Despite this low level of evidence, however, it seems likely that society had been evolving in significant ways, not obviously visible in the archaeological record, perhaps over a long period during the Early Bronze Age. These developments, possibly relating to population growth and/or competition for agricultural land, appeared to have reached a tipping point around 1600 BC, leading to rapid transformations in settlement patterns, agricultural regimes, mortuary practices and social organisation. From the Middle Bronze Age there is clear evidence not only of permanent settlement, as indicated at least by the construction of round-houses (Pl. 3.1), but also of the enclosing and division of the landscape within rectilinear field systems. This marked the start of a process, involving the creation of an increasingly densely occupied and agriculturally organised landscape, which continued throughout later prehistory.

Figure 3.1: Selected later prehistoric sites mentioned in the text

Plate 3.1: Gully of Middle Bronze Age round-house, Trench 24

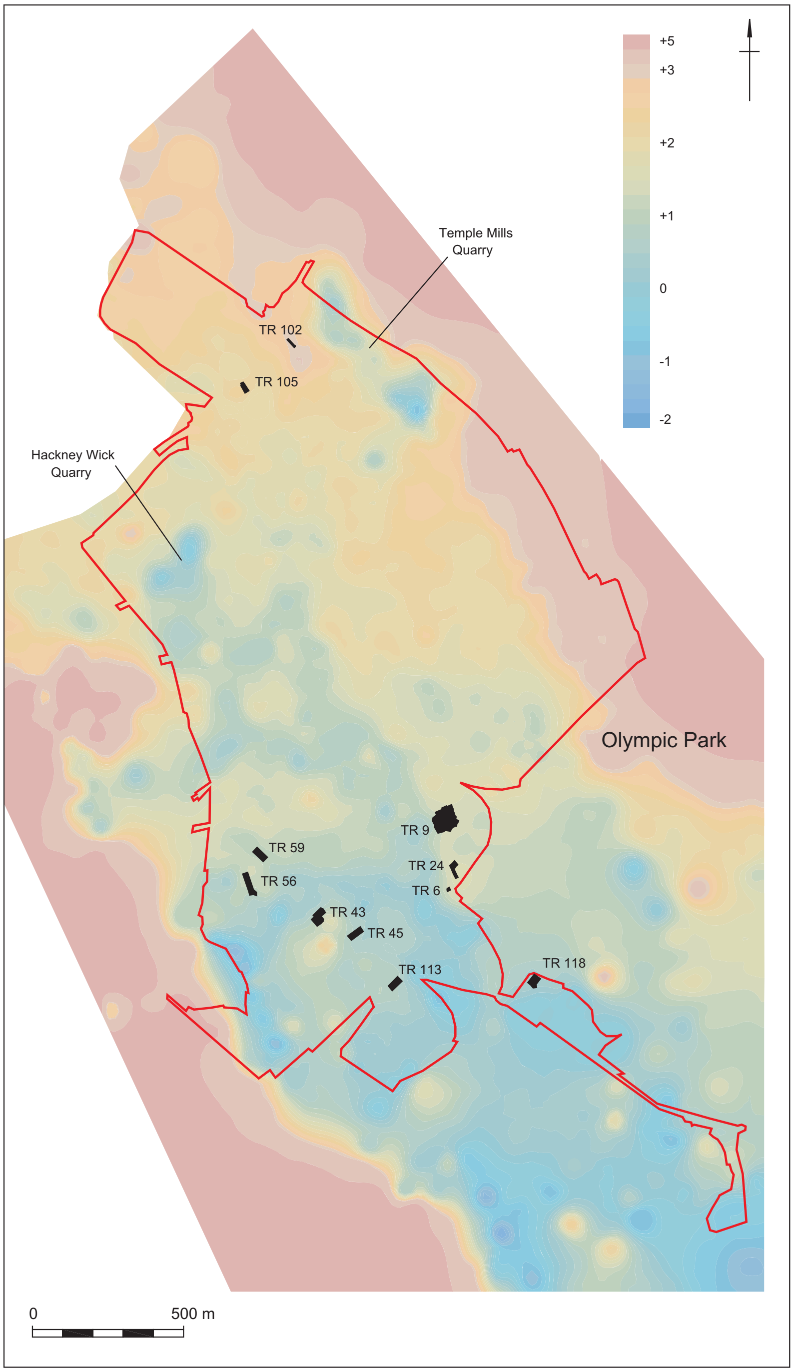


Figure 3.2: Locations of trenches with later prehistoric evidence in relation to the prehistoric topography

While evidence for such field systems has been recorded extensively on the gravels in the Heathrow area west of London (eg, MoLAS 1993; Framework Archaeology 2006; 2010; Powell *et al.* forthcoming), the evidence is far rarer to the east, with much of it dating to later in the Bronze Age (Yates 2001). Some evidence has been recorded in the lower Lea Valley, as well as further up the rivers Lea and Stort (Yates 2007, 30–1, Fig. 3.1), and although the archaeological evidence from the Olympic Park investigations was concentrated in a relatively small area, on opposite sides of one of the main channels of the prehistoric river (Fig. 3.2), it is likely that similar patterns of land-use were considerably more extensive. There is evidence for Bronze Age occupation at Lefevre Walk, on the west side of the valley at Old Ford (Brown *et al.* forthcoming) and Stratford Market Depot (Hiller and Wilkinson 2005, 12–15), and parts of Bronze Age field systems have been recorded in Enfield at Montague Road (Roberts 1999; Bradley 2000) and Innova Park, Rammey Marsh (Ritchie *et al.* 2008). A few Middle Bronze Age cremation burials were found *c.* 1 km to the north-west of Trench 9 (PCA 2010). It may be, however, that the establishment of field systems was far less extensive around the Lea Valley than it was west of London.

While the large-scale excavations in advance of gravel quarrying in the east London Borough of Havering were marked by a general lack of evidence for Middle Bronze Age activity (Howell *et al.* 2011, 37), there continued to be the widespread exploitation of wetlands during this period. This is indicated by the many trackways and other structures along the north side of the Thames and its tributaries (Meddens 1996), including at a number of sites in Beckton (eg, Carew *et al.* 2009), on the A13 at Woolwich Manor Way and Movers Lane (Stafford in press), and at Fort Street, Silvertown (Crockett *et al.* 2002), as well as the metalled causeway at Hays Storage Depot, Dagenham (Divers 1996).

Chronology and Phasing

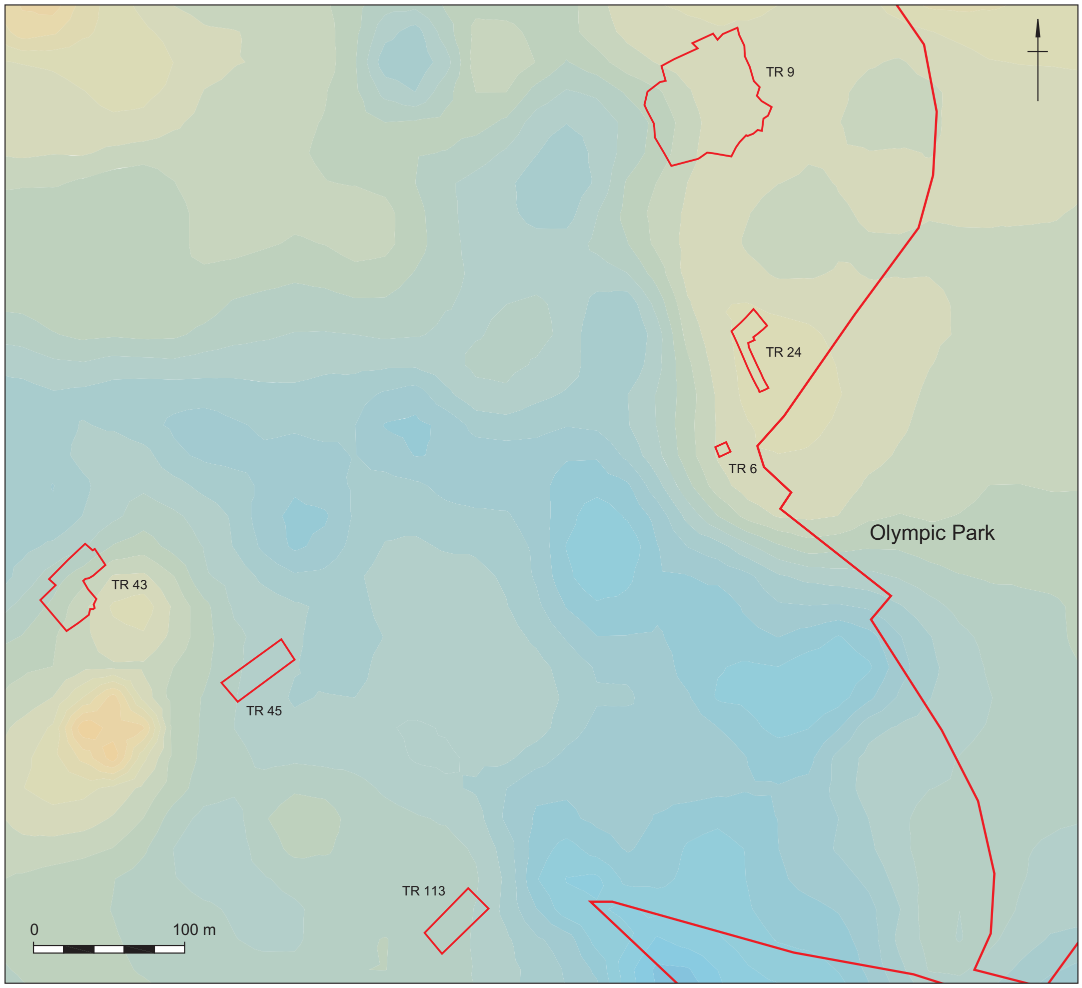
Despite the series of radiocarbon dates which fall within the later prehistoric period (Table 3.1), the provision of a reliable chronology for the later prehistoric activity in the Olympic Park sites – ie, from the Middle Bronze Age through to the start of the Romano-British period – is hampered by the undiagnostic nature, and in most cases the small quantities, of the pottery

Tr.	Feature	Context	Material	Lab. code.	Date BP	δ13C‰	Calibrated (95.4%)
9	Ditch 1920 (cut 1738)	1737	Charred cereal	SUERC-33667	3085±30	-25.1	1430–1270 cal BC
	Cremation grave 1972	1971	Charcoal	SUERC-35323	3075±30	-26.4	1420–1260 cal BC
	Cremation grave 1972	1971	Cremated human bone	SUERC-34930	2845±35	-23.1	1130–910 cal BC
	Cremation grave 2052	2051	Charcoal	SUERC-35324	2840±30	-28.1	1120–910 cal BC
	Cremation grave 2052	2051	Cremated human bone	SUERC-34932	2835±35	-23.4	1120–900 cal BC
	Pit 1730	1729	Charred cereal	SUERC-33677	2820±30	-25.3	1070–890 cal BC
	Pit 2115	2114	Charred cereal	SUERC-33670	2815±30	-22.2	1060–890 cal BC
	Pit 1019	1018	Charred cereal	SUERC-33668	2780±30	-20.8	1010–840 cal BC
	Pit 1322	1321	Charred cereal	SUERC-33669	2780±30	-22.0	1010–840 cal BC
	Pit 1645	1644	Charred cereal	SUERC-33671	2785±30	-23.3	1010–840 cal BC
	Pit 1219	1218	Charred cereal	SUERC-33676	2785±30	-21.3	1010–840 cal BC
	Phase 1 ditch 1384 (cut 1660)	1723	Sediment (acid wash)	Beta-254065	2570±40	-26.4	820–540 cal BC
	Alluvium	80	Sediment (acid wash)	Beta-254059	2380±40	-25.6	750–380 cal BC
	Phase 1 ditch 2222	2181	Sediment (acid wash)	Beta-254068	2350±40	-26.0	730–260 cal BC
	Phase 1 ditch 1213 (cut 1705)	1704	Sediment (acid wash)	Beta-254061	2250±40	-26.4	400–200 cal BC
	Round-house 2355 (gully 1106)	1196	Charred cereal	SUERC-34942	2215±35	-22.3	390–190 cal BC
	Phase 1 ditch 1213 (cut 1705)	1703	Sediment (acid wash)	Beta-254062	2200±40	-25.7	390–170 cal BC
	Phase 1 ditch 1384 (cut 1660)	1724	Sediment (acid wash)	Beta-254064	2200±40	-25.6	390–170 cal BC
	Phase 1 ditch 2222	2221	Sediment (acid wash)	Beta-254067	2180±40	-26.6	380–110 cal BC
	Round-house 2357 (gully 1260)	1259	Charred cereal	SUERC-33672	2195±30	-24.4	370–180 cal BC
	Phase 1 ditch 1213 (cut 1929)	1926	Waterlogged plant	SUERC-33679	2190±30	-30.3	370–170 cal BC
	Alluvium	206	Sediment (acid wash)	Beta-254066	2000±40	27.2	160 cal BC–cal AD 90
	Grave 1852	1810	Human bone	SUERC-33678	2020±30	-20.2	110 cal BC–cal AD 60
43	Alluvium	501	Sediment (acid wash)	Beta-250982	4190±40	-25.0	2900–2630 cal BC
	Alluvium	500	Sediment (acid wash)	Beta-250983	3200±40	-25.7	1610–1400 cal BC
	Alluvium	544	Sediment (acid wash)	Beta-250984	2870±40	-26.7	1200–920 cal BC
	Cremation grave 527	526	Cremated human bone	SUERC-34931	2830±35	-23.1	1120–900 cal BC
	Cremation grave 527	526	Charcoal	SUERC-35326	2810±30	-24.4	1050–860 cal BC
	Pit 587	588	Charred cereal	SUERC-34941	2710±35	-24.3	920–800 cal BC
6	Feature 352	351	Charcoal	SUERC-35319	2200±30	-28.5	380–180 cal BC
24	Round-house gully 23	24	Charcoal	SUERC-35325	3075±30	-27.8	1420–1260 cal BC
	Pit 7	6	Charcoal	Beta-210488	2990±40	-24.7	1390–1050 cal BC
30	Humic silt	54	Organic sediment	Beta-204035	3210±50	-28.6	1620–1400 cal BC
45	Post-hole 32	31	Charcoal	SUERC-35327	2915±30	-25.7	1260–1010 cal BC
	Post-hole 42	41	Charred cereal	SUERC-34940	2860±35	-23.0	1130–910 cal BC
	Post-hole 36	35	Charcoal	SUERC-36232	2860±30	-25.0	1130–920 cal BC
56	Land surface 215/217	215	Organic sediment	Beta-252889	2310±40	-27.1	510–200 cal BC

Table 3.1: Summary of Middle and Late Bronze Age and Iron Age radiocarbon dates

recovered (see Leivers, Chapter 7). While some diagnostic forms have been recognised, particularly from Trench 9, allowing the phasing of some features to the Middle Bronze Age, the Late Bronze Age/Early Iron Age, and the Middle Iron Age, much of the pottery comprises small, flint-tempered body sherds which cannot be confidently assigned to any particular one of these periods. Moreover, the extended period of occupation in Trench 9 has meant that there is a relatively high incidence of residual material in later contexts (as well as instances of intrusive material).

Figure 3.3:
Selected area showing Trenches 9, 22, 24, 43, 45 and 113 in relation to the prehistoric topography



In addition to those features which can be assigned only a general late prehistoric date, many others contained no closely datable material, and had no clear stratigraphical relationships which could have helped in their phasing. Where possible, these have been provisionally phased on the basis of their form, location and contents, either to specific periods or more generally as 'later prehistoric'. Some assistance in the phasing of the late prehistoric activity is provided by the radiocarbon dating, but here too some of the material dated was clearly residual.

Most of the evidence for this period came from Trench 9, which covered almost 0.5 ha, and to a lesser extent Trench 43 which covered *c.* 0.1 ha approximately 460 m to the south-west (Fig. 3.3). As a result, the full late prehistoric sequence of activity for Trench 9 is described first, with references to other locations added where relevant. This is followed by the more limited and less chronologically certain evidence from the other trenches.

Trench 9

A broad gravel promontory on the eastern edge of the main river channel (Fig. 3.3) was chosen for settlement during the Bronze Age and Iron Age. In the eastern part of the site the river gravels were recorded at 2.10 m OD where they were overlain by a dry land surface for much of the site's occupation. The gravels dropped to 1.67 m towards the west where they were overlain by a series of alluvial and fluvial channel fills, some sealing archaeological features, indicating a range of more riparian and wetland environments (Fig. 3.4).

Figure 3.4: Trench 9: prehistoric phases, with locations of illustrated section

Middle Bronze Age

Field system

Two ditches, forming part of a what was almost certainly a more extensive rectilinear field system, was recorded (Fig. 3.5). The eastern field boundary 2354 comprised a line of ditch segments extending for over 60 m from the SSE-NNW, then turning to the ENE. Although cut in places by later features and modern intrusions, at least three separate segments were recorded, identifiable by clear ditch terminals flanking gaps in the ditch. The ditches were up to 1.2 m wide and 0.64 m deep. Two naturally accumulated fills were recorded in some of the deeper sections, but elsewhere single fills were recorded; there was no evidence for a bank associated with the boundary.

It is possible that a less substantial ENE ditch (1743), near the southern terminal of the central segment, whose fill was similar in appearance to that of ditch 2354, is associated with it. A rough line of seven undated possible post-holes, spanning the *c.* 3 m wide gap between the terminals of the two ditches, could represent some form of fenced barrier within the access point between two adjacent plots, although they could equally be of later (Iron Age) date.

A charred barley grain from segment 1920 (cut 1738, context 1737) produced a radiocarbon date in the Middle Bronze Age of 1430–1270 cal BC (SUERC-33667, 3085±30 BP). However, a sample of bone from a cattle skull from segment 1922 (cut 1477, context 1476) produce a date considered unreliable, due to a carbon:nitrogen ratio of 3.6 (see Chapter 8; Appendix 5). The date from the grain is confirmed by the pottery evidence (see Leivers, Chapter 7). Ditch 2354 produced a significant assemblage of Middle Bronze Age pottery and a single Late Bronze Age sherd, along with seven pieces of struck flint, burnt flint and animal bone (cattle and sheep/goat), as well as presumably intrusive slag. The pottery was concentrated around the gap between the northern and central ditch segments (1920 and 1922), with the largest group being recovered from the northern terminal (1436) of the central segment, and further significant group from the most southerly excavated section (1738) of the northern segment. The sherds included a number of Deverel-Rimbury forms, including possible Globular Bowl, Bucket Urn and straight-sided jar.

In both these locations the ditch had a single fill, and it is therefore not possible to determine how this material was incorporated within it, ie, whether by natural processes or through acts of deliberate deposition. The variable condition of the vessels, however, indicates that they had had very different histories prior to deposition. The range of finds from the ditch suggests settlement activity in the area, but little of the area to the east of the ditch was exposed and no contemporary structures and few contemporary settlement features, such as pits or post-holes, were identified elsewhere in the trench. (Fragmentary evidence of a Middle Bronze Age settlement, however, was recorded *c.* 140 m to the south in Trench 24, see below, Fig. 3.13). It is not uncommon to find cultural materials being selected for deposition within ditch terminals, and the pottery from (or from near) the terminals flanking a break in ditch 2353 might indicate that this was a significant access point.

A comparable ditch (1284) lay on exactly the same alignment, *c.* 35 m to the WSW of ditch 2353. This ditch was initially exposed during the evaluation (as 79 in the initial extent of the trench, and as 219 in the trench's southward extension), when five slots were cut through it; a further slot was cut during the excavation. It extended over at least 37 m (possibly up to 54 m if another length of ditch (1283) at the north is part of the same feature) and it was of similar dimensions to ditch 2354, measuring *c.* 0.8–1.2 m wide, and averaging *c.* 0.3 m deep but dropping in places to 0.75 m, giving the impression of small cuts cut into the base, perhaps holding timber posts.

The ditch's position was probably determined by the eastern edge of a water channel (1185) which lay *c.* 15 m to its west-south-west. The course of the channel, a section of which was excavated (but not to its full depth), is indicated in the topographic map (Fig. 3.3). To the west of London, Middle Bronze Age rectilinear field systems have been shown to cover much of the land between and beyond the Rivers Colne and Crane, which like the Lea are south-flowing tributaries of the Thames (Framework Archaeology 2006; 2010; Powell *et al.* forthcoming). It is unclear, however, even in these much more extensively recorded field systems, to what extent they encroached on and enclosed the land immediately flanking the river channels. This probably depended on the local environmental and other conditions, such as the presence of wetland areas along the river edge and the degrees of control over and access to the river. At Kingsmead Quarry, Horton, Berkshire, further west, there were possible trackways running along the edge of the field system flanking a river channel (Chaffey *et al.* forthcoming).

Although the form, position and orientation of ditch 1284 indicate its association

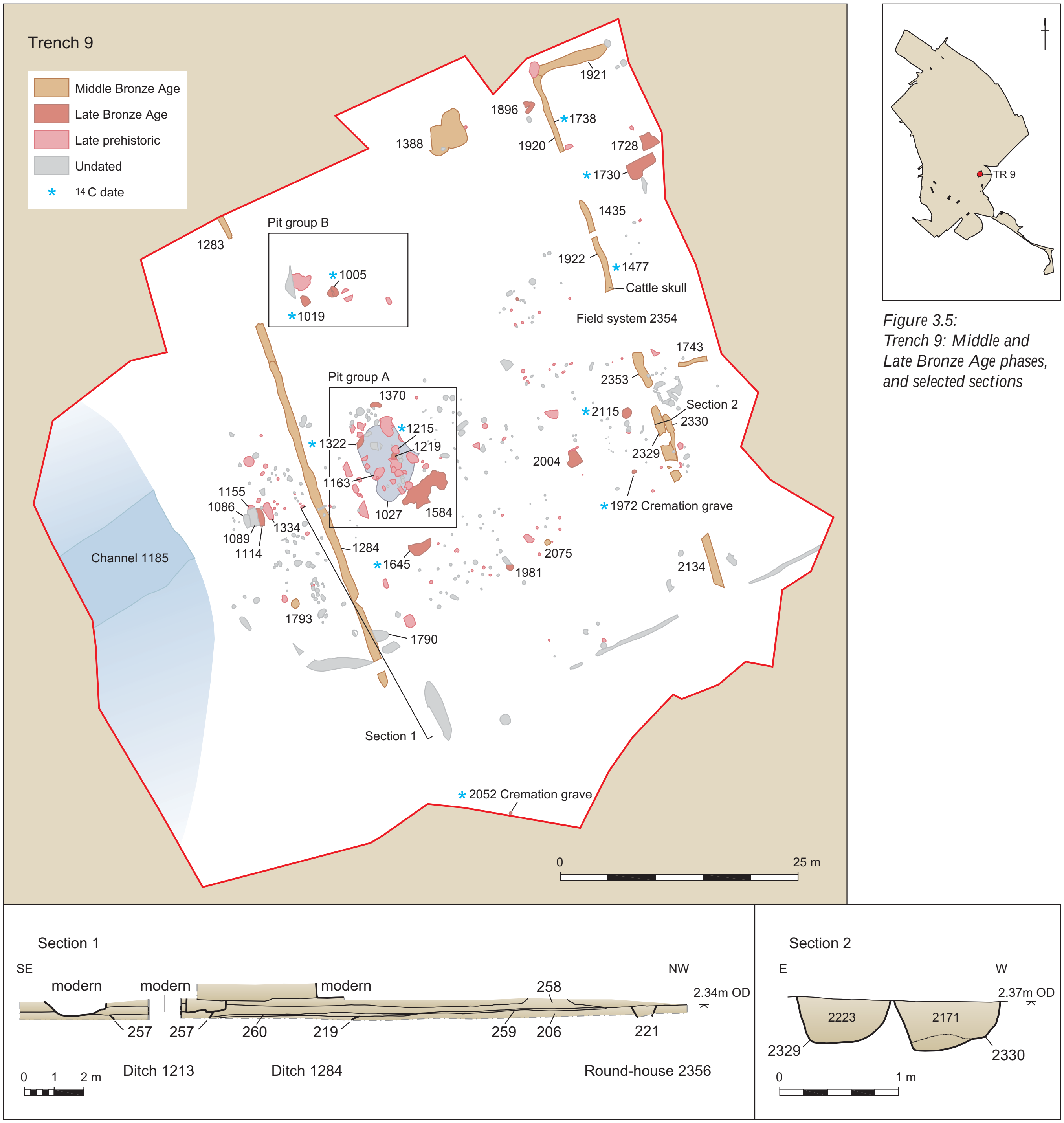


Figure 3.5: Trench 9: Middle and Late Bronze Age phases, and selected sections

with the field system, the dating evidence from it is more ambiguous than that from ditch 2353. Its small pottery assemblage, comprising fragmentary Late Bronze Age and Middle Iron Age sherds, suggests a Middle Iron Age or later date, as would the presence of further Middle Iron Age pottery from the thick layer of alluvium (80) into which the ditch was cut towards its northern end (this equated to layer 206 in the southern part of the trench from which no finds were recovered) (Fig. 3.5). Two radiocarbon dates were obtained from the alluvium, although such dates for sediments need to be treated with caution (see Chapter 8). A sample of organic sediment from layer 80 produced a date falling broadly within in the Early Iron Age of 750–380 cal BC (Beta 254059, 2380±40 BP), while a sample from layer 206 produced a date of 160 cal BC–cal AD 90 (Beta 254066, 2000±40 BP), ie, between the Middle Iron Age and the early Romano-British period. It should be noted, however, that the alluvium and the ditch fall within an area of concentrated Late Bronze Age and Middle Iron Age activity, with ditch 1284 passing through at least one Iron Age round-house. It is certainly possible, therefore, that intrusive later material became incorporated within earlier deposits, particularly in an area of heavy human traffic on damp, low-lying ground.

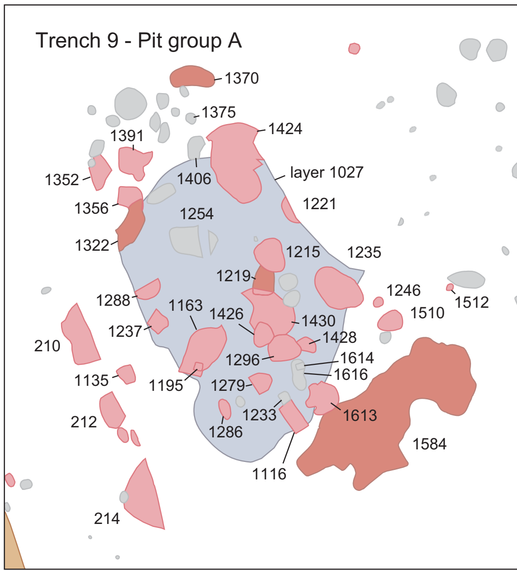
There is also some ambiguity in the ditch's stratigraphic relationships. It is evident from the western section of the evaluation trench (Fig. 3.5, Section 1) that it (219) pre-dated the construction of the Middle Iron Age enclosure (257 = 1213, below) (Fig. 3.4), potentially by a significant period, since it was sealed by alluvial depsoits up to 0.65 m thick that were laid down before the enclosure ditch was dug. Moreover, while it was reported (Bazley *et al.* 2008, 22) that ditch 1284 (219) cut a Middle Iron Age round-house gully (221 = 2356, below), the evidence for this relationship is unclear; the gully terminal of an adjacent but broadly contemporary round-house (2357, below) was recorded cutting ditch 1284.

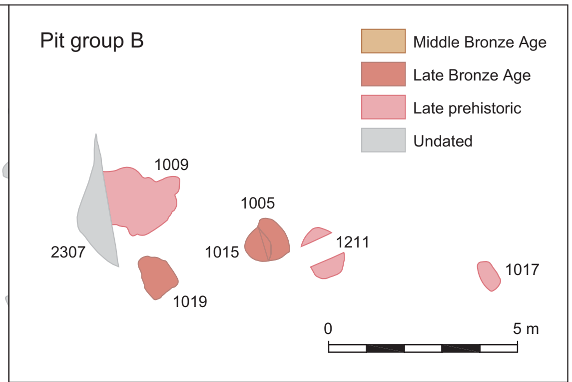
Ditch 1284 was also recorded as cutting an Iron Age pit (216/1560/1790), but here too there is some uncertainty about this relationship. As fully excavated the pit was 0.68 m deep, and contained three fills, the lowest of which (1933) contained one possibly Late Bronze Age sherd and a complete antler. The antler appeared to have been deliberately placed on the base of the pit; a sample of it was submitted for radiocarbon dating, but the result is considered unreliable due to a carbon:nitrogen ratio of 16:1 (see Chapter 8; Appendix 5). The middle fill contained no finds, but the upper fill (1789) contained a further four sherds of Middle Bronze Age date (plus a further two, possibly of Late Bronze Age date, that had been recovered during the evaluation – context 215). The pit may, as recorded, have pre-dated the ditch, and on the basis of the interpretation of the ditch presented here, this would suggest a Middle Bronze Age (or earlier) date. Alternatively, it is possible that it cut the ditch, and therefore is of Late Bronze Age or Iron Age date, in which case it is likely that the Middle Bronze Age pottery eroded into it from the exposed ditch fill.

Only 31 sherds of Middle Bronze Age pottery were recovered from the rest of the excavation (*c.* 9 % of the total by weight, of which six were residual in an Iron Age ditch, 1384 below). Approximately half of the sherds (20/266 g) were from the uppermost of three fills in a large feature (1388), measuring *c.* 4 m by 5 m and up to 0.4 m deep (possibly a cluster of intercutting shallow pits), towards the north of the trench, which also contained four pieces of struck flint, burnt flint and animal bone (including cattle and sheep/goat). In addition, two individual pits contained Middle Bronze Age pottery. Pit 2075 produced three sherds, along with struck flint and burnt flint, while a single sherd came from pit 1793, which had a piece of waterlogged timber post (1828) at its base.

Late Bronze Age

Although Middle Bronze Age pottery, animal bone and stuck flint were found within the ditches of the field system at the east of Trench 9 (2354), few other features and no structures of that date were recorded on the site, and it is possible, as suggested above, that the focus of settlement activity lay on what may have been drier land to the east, or to the south around Trench 24. Episodes of flooding, some of them probably occurring during this period, are indicated by localised alluvial deposits. As well as fills (1118 and 1124) in top of channel 1185 at the west of the site, one alluvial deposit (1561)





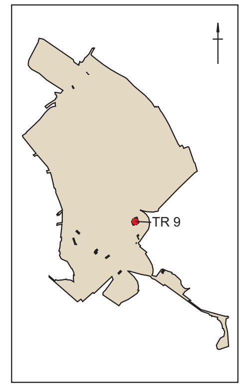


Figure 3.6:
Trench 9: Plans of pit groups A and B

sealed Middle Bronze Age pit 1790 but was cut by Middle Iron Age ditch 2326 (below), while another (2310) sealed Middle Bronze Age pit 1793 and a number of the adjacent undated pits and post-holes, but was cut by further, similar features in the same area.

Phasing

Activity on the site continued in the Late Bronze Age, as indicated by the presence of Late Bronze Age, post-Deverel-Rimbury pottery. Much of the later prehistoric pottery assemblage (see Leivers, Chapter 7), however, comprised small body sherds in flint-tempered fabrics of the type used from the Middle/Late Bronze Age into the Middle Iron Age, the latter period (see below) being represented by a clear phase of settlement activity, and ditch and enclosure construction. Only a relatively small number of features contained sherds displaying diagnostic Late Bronze Age forms. Similarly, only a few contained sherds in the sandy fabric and diagnostic forms that would indicate a certain Middle Iron Age date. This leaves a considerable number of features which cannot, on the ceramic evidence alone, be more precisely dated.

Nonetheless, a distinction is evident in the feature types from which the diagnostic Late Bronze Age and Middle Iron Age pottery was recovered and, when combined with stratigraphic evidence, allows a more inclusive provisional phasing (Fig. 3.5). Even so, many features, principally small pits and post-holes, can only be dated with any confidence to a general later prehistoric phase, and an even greater number contained no dating evidence at all.

Pits

The features containing the diagnostic Late Bronze Age pottery are of a limited type and distribution across the site, comprising principally a number of relatively large pits and other features towards the centre of the site (Figs 3.5–3.6). Two of the pits (1322 and 1370) formed part of a distinct group of irregular pits covering an area *c.* 8 m by 10 m (pit group A), some of which contained pottery of less diagnostic late prehistoric date, while others contained no dating evidence but are almost certainly associated (Table 3.2). Charred wheat grain from pit 1322 (context 1321) produced a radiocarbon date of 1010–840 cal BC (SUERC-33669, 2780±30 BP), as did charred cereal grain from pit 1219 (context 1218) (SUERC-33676, 2785±30 BP). The cluster was cut to the west by a Middle Iron Age ditch (Fig. 3.4), whose western edge cut a further three pits recorded during the evaluation, which are probably also associated with the group. Some of the pits intercut.

Many of the pits in group A were sealed by an extensive layer of grey/black gravelly silt (1027) (see Fig. 3.4) containing a further large quantity (*c.* 4.5 kg) of Late Bronze Age pottery, along with five pieces of fired clay

Table 3.2: Possible Late Bronze Age pits (pottery in bold includes diagnostic LBA sherds)

Pit	Width (m)	Depth (m)	Fills	Finds/dating
Pit group A				
210	1.6 x ?	?	209	Pottery, burnt flint
212	0.9 x ?	0.3	211	Pottery, burnt flint, animal bone
214	1.9 x ?	0.1	213	Pottery
1116	0.4 x 0.8	0.25	1115	Pottery (5/50 g)
1163	1.0 x 1.5	0.22	1162	Pottery (45/1430 g), 5 flints
1215	0.6 x 0.9	0.20	1214	Pottery, struck flint, animal bone
1219	0.6 x 0.6	0.18	1218	^{14}C date from charred cereal grain: 1010–840 cal BC (SUERC-33676)
1221	0.6 x ?	0.17	1220	Pottery (5/44 g), 2 flints
1235	1.0 x 1.2	0.1	1234 1262	Pottery (19/278 g), 1 flint Pottery (2/19 g)
1237	0.4 x 0.8	0.13	1236	Pottery (9/80 g), 1 flint
1279	0.5 x 0.9	0.10	1280	Pottery (1/13 g), 1 flint
1286	0.3 x 0.6	0.07	1285	Pottery (4/17 g)
1288	0.7 x 0.7	0.17	1287	Pottery (8/88 g), burnt flint (11 g)
1296	0.7 x 0.8	0.19	1295	Pottery (8/60 g)
1322	0.9 x 1.2	0.19	1321	**LBA pottery** (16/203 g), fired clay (perforated slab) (30 g), ^{14}C date from charred wheat grain: 1010–840 cal BC (SUERC-33669)
1352	0.6 x 0.8	0.21	1351	Pottery (4/42 g), 1 flint, animal bone (cattle, pig)
1356	0.4 x 0.8	0.20	1355	Pottery (5/31 g)
1370	0.5 x 0.9	0.18	1369	**LBA pottery** (5/291 g), 2 flints
1391	0.9 x 1.0	0.13	1392	Pottery (3/30 g)
1424	1.1 x 1.7	0.20	1423	Pottery (27/156 g), 3 flints, burnt flints (146 g)
1426	0.6 x 0.6	0.16	1425	Pottery (11/212 g)
1428	0.4 x 0.5	0.09	1427	Pottery (5/40 g)
1430	1.1 x 1.5	0.22	1429	Pottery (22/219 g), 3 flints, fired clay (slab), animal bone (incl. cattle, pig)
1510	0.5 x 0.6	0.06	1509	Pottery (2/11 g)
1612	0.9 x 0.9	0.14	1611	Pottery (9/80 g), 1 flint
Pit group B				
1005	0.5 x 1.2	0.25	1004	Pottery (15/100 g), burnt flint (100 g)
1009	1.9 x 2.1	0.25	1008	Pottery (84/1635 g), burnt flint (1211 g)
1015	0.8 x 0.8	0.20	1014	**LBA pottery** (90/400 g), 3 flints, burnt flint (657 g)
1017	0.5 x 0.8	0.10	1016	Pottery (24/130 g), burnt flint (23 g)
1019	0.9 x 1.2	0.18	1018	Pottery (8/200 g), 2 flints, burnt clay (49 g), burnt flint (1603 g), ^{14}C date from charred cereal grain: 1010–840 cal BC (SUERC-33668)
1211	0.9 x 1.3	0.12	1210	Pottery (3/30 g), burnt flint (106 g), animal bone (cattle, sheep/goat)
Isolated pits				
1896	1.2 x 1.3 2 pits?	0.3	1895	**LBA pottery** (29/544 g), fired clay (loomweight and perforated slab), animal bone (incl. cattle)
1981	0.7 x 0.7	0.19	1980	**LBA pottery** (36/260 g), burnt flint
2004	1.4 x 1.5	0.36	1941 1942	**LBA pottery** (42/720 g), burnt flint **LBA pottery** (25/365 g), fired clay (perforated slab), burnt flint
2115	1.0 x 1.1	0.24	2114	**LBA pottery** (23/250 g), burnt flint
1728/1730	5.0 x 2.5	0.44	1727/1729 1768	Pottery (4/84 g), burnt flint –
1827	3.0 x 1.7	0.17	1826	Pottery (15/84 g), 1 flint

perforated slabs, animal bone, burnt clay, struck flint and burnt flint. The clay slabs (also recovered from other Late Bronze Age contexts, below), are broadly similar to those found on contemporary sites along the Thames (see Leivers, Chapter 7); they are of uncertain function but may have been used as oven furniture in pottery production or in salt-making.

Layer 1027 appeared to fill a shallow irregular hollow (1101) up to 0.3 m deep, possibly caused by trample or traffic over the pits truncating their upper levels. It is unclear, however, whether this truncation happened during the period of the pits' use in the Late Bronze Age, or later, in the Middle Iron Age (below), when there was concentrated settlement activity in this area (Fig. 3.8). The later date is suggested by the fact that two lengths of curved gully (1260 and 1146), probably representing Middle Iron Age round-houses, were also apparently sealed by layer 1027 (although it is possible that these were not recognised cutting this layer). Moreover, in addition to Late Bronze Age pottery, layer 1027 also contained 51 sherds of Middle Iron Age pottery (although, again, it is possible that this material, representing less than 14% of the total pottery by weight, is intrusive).

The pits in group A varied in size and shape, but all were shallow (average 0.16 m), although in some cases this was due to truncation caused by the activity resulting in layer 1027. The pits are of uncertain function, although they were clearly not intended for storage, and are more likely to represent a working or small-scale extraction area for clay or gravel. One of the pits (1215) was recorded as a possible hearth, on the basis of the presence in its grey/black fill of ashy material and charcoal, but there was no evidence of *in situ* burning and this material may simply be hearth waste.

Some contained moderate quantities of pottery, and occasional flints, pieces of animal bone, and burnt flint (Table 3.2). The largest quantity of material was recovered from pit 1163, which contained over 1.4 kg of pottery (over 40 % of the total from the pits), five struck flints, and 13 animal bone fragments including cattle and sheep. A square post-hole with a charcoal-rich fill containing a further sherd was recorded cutting the base of the pit. However, the post-hole's stratigraphical relationship with the pit and its fill was unclear, and its form suggests a relatively modern date (as applies to a number of similar post-holes in the same area). Further, sub-circular post-holes, some also containing pottery, were recorded among the pits but they formed no obvious structure.

Immediately south-east of pit group A, and probably associated with it, there was an irregular shallow hollow (1584) which contained a further 101 sherds (again including diagnostic Late Bronze Age forms) along with animal bone, struck flint, burnt flint and slag. This was cut at the south by modern features, to the south of which another shallow feature (1645), possibly part of the same hollow. Feature 1645 contained further pottery, struck flint and burnt flint, and a sample of charred barley grain produced a radiocarbon date also of 1010–840 cal BC (SUERC-33671, 2785±30 BP).

A number of adjacent spreads of gravelly soil, *c.* 9 m west of pit group A, may be of similar or related character (Fig. 3.5). Three of these contexts (1086, 1089 and 1114, west to east) were recorded as a sequence of adjacent but stratigraphically separate layers up to 0.3 m thick, but they barely overlap and together appear to form a single deposit, although a similarly shaped shallow feature (1155) partly underlay layer 1089. To their east there was a further deposit which was described as the fill of a possible tree-throw hole (1334), but at only 0.07 m thick it may be an extension of this larger deposit. Together these contexts covered an area of *c.* 2 m by 3 m, and although they lay within the curve of a Middle Iron

Plate 3.2:
Very small Late Bronze Age vessel

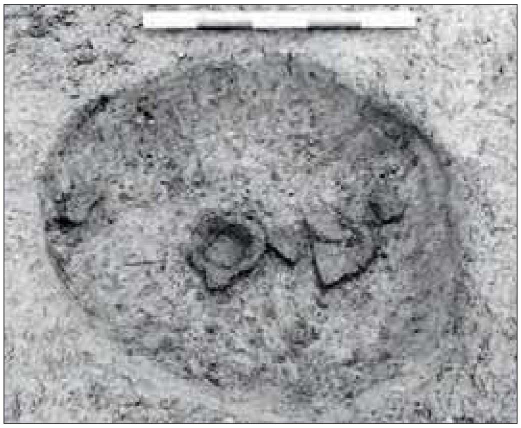


Plate 3.3:
Placed pottery in Late Bronze Age pit 1981, Trench 9

Age round-house gully (Fig. 3.4), they had no recorded stratigraphical relationship to it. Instead, they produced nine sherds of pottery, including (from layer 1114) a tiny, thin-bodied, fingered conical bowl or cup that is almost certainly of Late Bronze Age date (Pl. 3.2; Fig. 7.2, 17, below).

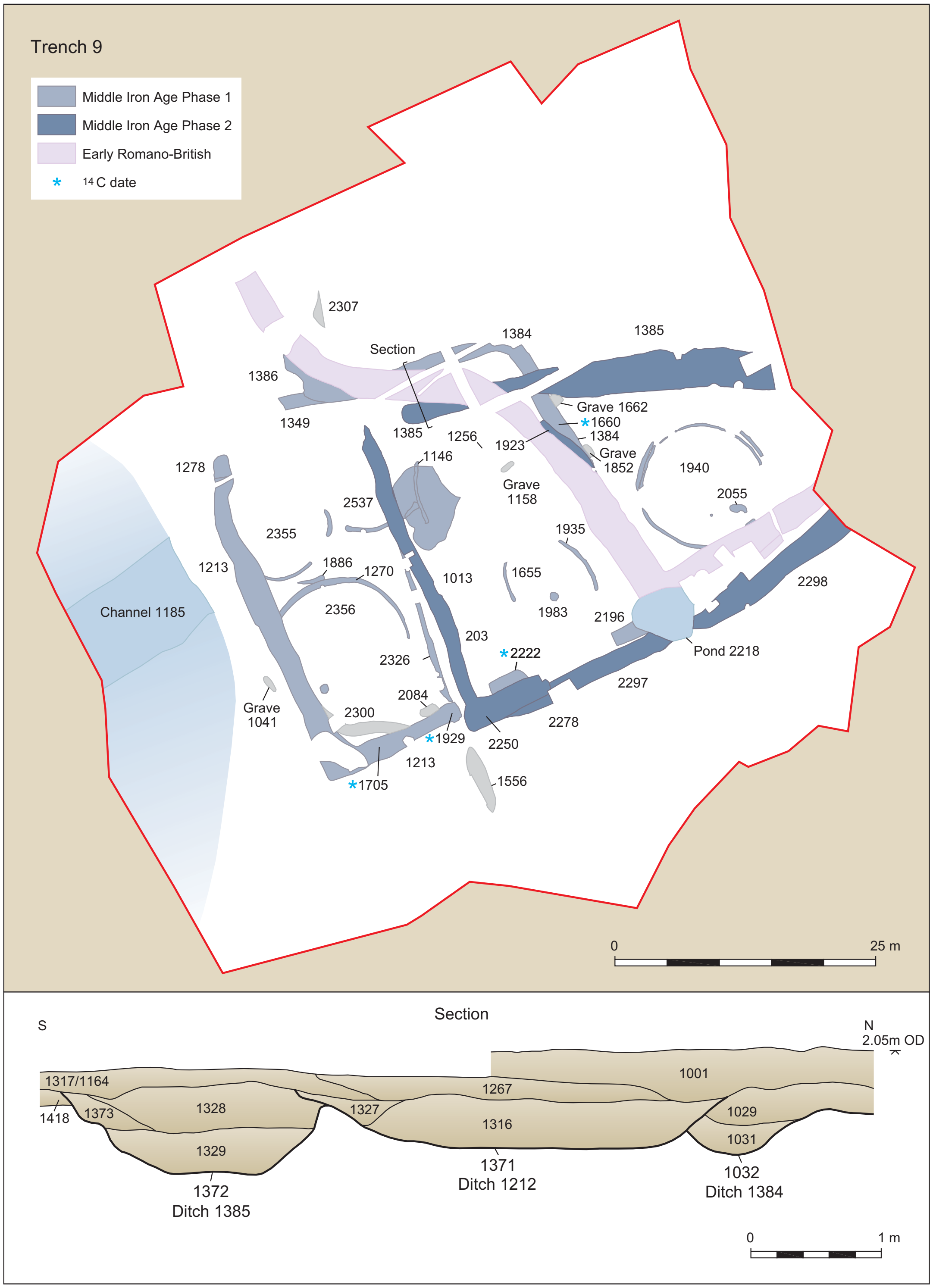
In addition, an approximately east-west cluster of six pits (pit group B) lay *c.* 13 m to the north of pit group A (Table 3.2). These were of similarly variable shape and shallow dimensions to those in pit group A, and may also have had comparable functions, although it is notable that, in addition to moderate quantities of possible Late Bronze Age pottery, all contained burnt flint (a few flints and a small quantity of burnt clay was also recorded), perhaps indicating some specific activity in this area. Pit 1019 had a single black soil fill containing localised concentrations of burnt flint, as well as a piece of a fired clay perforated slab, and a rich assemblage of charred plant remains, mostly cereal; a sample of charred cereal grain produced a radiocarbon date again of 1010–840 cal BC (SUERC-33668, 2780±30 BP). There were no undated pits (or any other potentially contemporary features) in this area.

Four other more isolated features (1896, 1981, 2004 and 2115) (Fig. 3.5) contained pottery that was clearly Late Bronze Age in date (Table 3.2), but it is likely that some of the isolated pits containing less diagnostic late prehistoric sherds are also of this date. Charred wheat grain from pit 2115 (context 2114) produced a radiocarbon date in the Late Bronze Age of 1060–890 cal BC (SUERC-33670, 2815±30 BP). In addition to the pottery, pit 1896 (in fact probably two features) also contained a fragment of a fired clay cylindrical loomweight and two fragments of fired clay perforated slab. While the locations of these objects in the pit were not recorded, a number of large sherds on the base of the pit 1981 appeared to have been deliberately placed (Pl. 3.3).

A radiocarbon date in the Late Bronze Age was also obtained from charred cereal grain from the upper fill of a large irregular feature (1730) on the eastern edge of the site (Fig. 3.5): 1070–890 cal BC (SUERC-33677, 2820±30 BP). It is likely that this was the same as feature 1728, from which it was separated by a modern pipe trench. Both had been dug to a depth of *c.* 0.4 m, ie, to the top of the river gravels, and may have been used for the extraction of the overlying clean clay-silts.

Settlement

A number of curving gullies on the site indicate the positions of round-houses (Fig. 3.7), some of which, containing small quantities of undiagnostic flint-tempered body sherds, are potentially of Late Bronze Age date. However, none of these features contained diagnostic Late Bronze Age forms, while some did contain distinctly Middle Iron Age sherds, as did some of the enclosure and other ditches with which many of the gullies appeared to be spatially related. This suggests, although not conclusively, that none of the round-houses are of Late Bronze Age date.



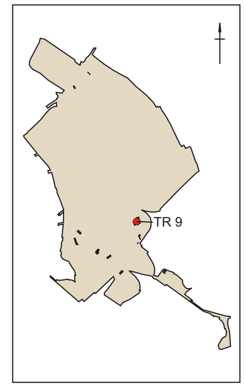


Figure 3.7: Trench 9: Middle Iron Age phases, with position of Romano-British ditch, and section through Iron Age and Romano-British ditches

It is possible that settlement structures of Late Bronze Age date are to be found among the many later prehistoric and undated post-holes on the site (Fig. 3.5). While some potential arcs of post-holes might indicate circular structures, none of them are particularly convincing. It is hard, therefore, despite the incorporation within the pit fills of materials (pottery, animal bone, burnt flint, struck flint and charred plant remains) that are characteristic of settlement activity, to characterise the nature of Late Bronze Age activity on the site. It may be, as suggested for the Middle Bronze Age (above), that the focus of settlement lay off the site, and that the Late Bronze Age features and material represent edge-of-settlement activity, some of it involving the use of fire, and including the extraction of clays and gravel, and the dumping of settlement waste.

The pits lay between the two ditches of the Middle Bronze Age field system (above), the majority of them being closer to the western ditch (1284, Fig. 3.5). There is no evidence that either ditch had been maintained up to this period, and it is unlikely that they remained as active field boundaries, although their lines may have survived as relict hedge-lines or other visible features, and therefore had some influence of the layout and distribution of Late Bronze Age features, as well as agricultural practices. The animal bone assemblage is dominated by cattle and sheep/goat, with pig and horse also present, but there is also evidence for the hunting of deer (see Higbee, Chapter 7). There is no evidence that slaughter and butchery were undertaken outside the settlement context.

Few of the weed seeds recovered from environmental samples are from species with strong ecological characteristics. However, the presence, within the charred plant assemblage from pit 1019, of seeds from species such as spikerush (*Eleocharis* sp.) that are associated with the cultivation of wetter soils (see Chapter 7), raises the possibility that cultivation was taking place on parts of the valley floor immediately surrounding the area of settlement activity.

Cremation burials

Two possible unurned cremation graves were recorded on the site (1972 and 2050, Fig. 3.5). One (1972) was located within the general distribution of later prehistoric features towards the east of the site, the other (2052) on the southern edge of the site in an area with only modern features.

Grave 1972 lay *c.* 3 m west of Middle Bronze Age field boundary ditch 2354 (Fig. 3.5). The circular grave was *c.* 0.4 m in diameter and just over 0.1 m deep with a curved profile. It contained 3.7 g of cremated bone from a possible female aged *c.* 30–40, within a matrix of charcoal-rich silt (1971); she had suffered a possible fractured rib. A sample of the cremated bone produced a radiocarbon date in the Late Bronze Age of 1130–910 cal BC (SUERC-34930, 2845±35 BP). A significantly earlier date, of 1420–1260 cal BC (SUERC-35323, 3075±30 BP), was obtained from oak charcoal from the grave. Analysis of the charcoal associated with this cremation showed only the presence of oak, probably used within the pyre (see Challinor, Chapter 7) and no twig wood or definite sapwood was identified. Given the discrepancy in the radiocarbon date from the cremated bone compared to the charcoal it is quite possible that the dated heartwood came from a tree that was greater than 300 years old.

Grave 2052, which was 0.3 m in diameter and 0.2 m deep with steep sides and an uneven base, contained 156.2 g of cremated bone from an individual aged *c.* 13–16, within a matrix of charcoal-rich silt (2051). Samples of the cremated bone and of the wood charcoal (hawthorn) produced almost identical radiocarbon dates in the Late Bronze Age, of 1120–900 cal BC from the bone (SUERC-34932, 2835±35 BP), and 1120–910 cal BC from the charcoal (SUERC-35324, 2840±35 BP).

Middle Iron Age

As discussed above, relatively few features contained pottery that was of diagnostic Middle Iron Age form or fabric, so that the identification of some features belonging to this phase is necessarily tentative. Nonetheless, the occurrence of such sherds in a number of ditches and round-house ring gullies suggests, when combined with spatial, stratigraphic and radiocarbon dating evidence, that the Middle Iron Age saw the establishment of what appears to have been

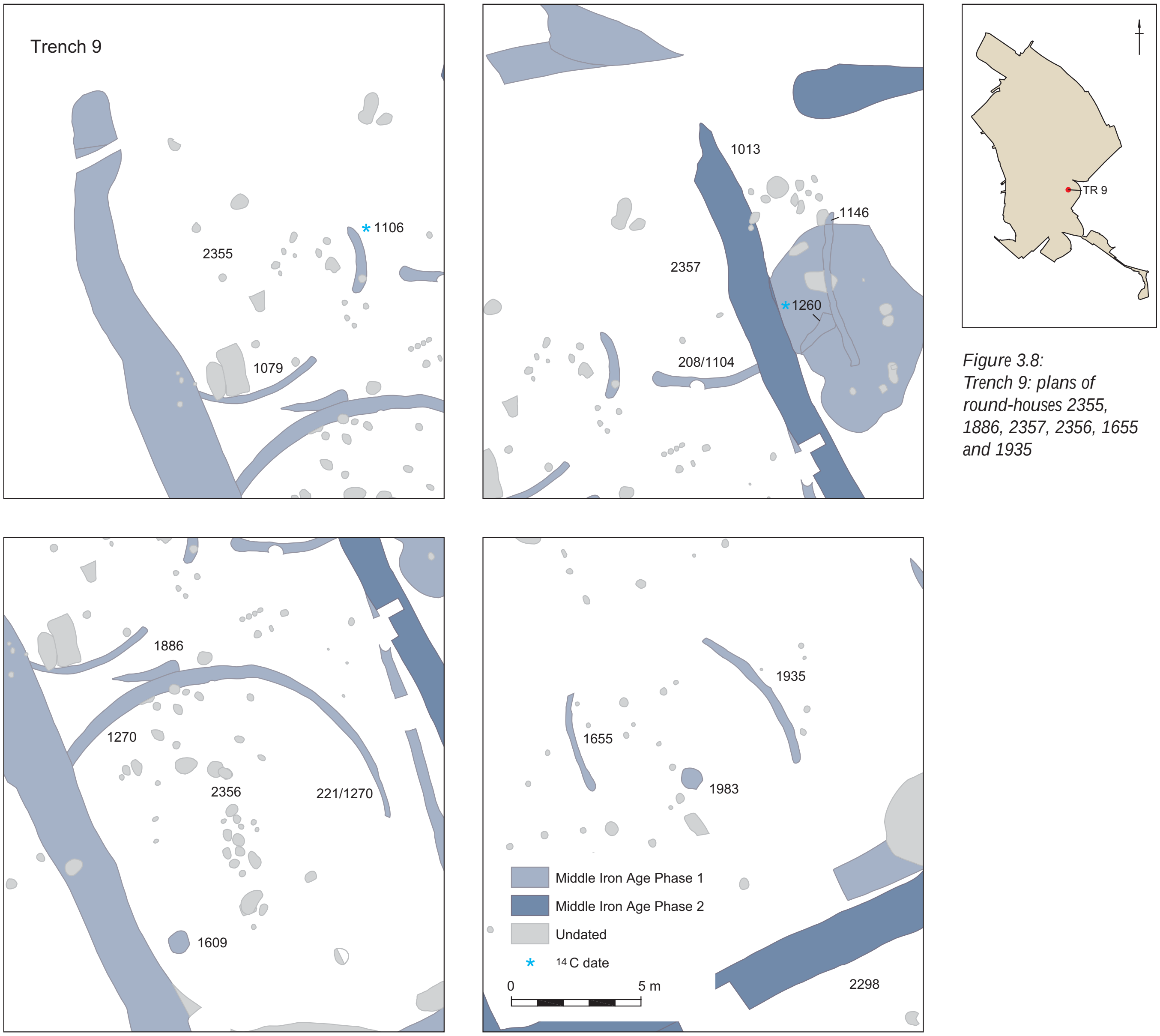


Figure 3.8: Trench 9: plans of round-houses 2355, 1886, 2357, 2356, 1655 and 1935

a permanent settlement at the site, and its subsequent containment within two phases of ditched enclosure (Fig. 3.7).

Settlement

The building of two of the round-houses within less than 5 m of the former edge of the stream channel (1185) at the west of the site suggests that, despite episodes of flooding probably during the Late Bronze Age (see above) the establishment of a settlement here may have been made possible by changes in the channel's course. Both gullies (2355 and 2356) were cut at the west by enclosure ditch 1213 (below), and the projected lines of other gullies overlap with other enclosure ditches. This suggests that the settlement had initially been unenclosed (although any remaining watercourse to the west could have acted as the boundary). Some of the other round-houses, however, appear to be positioned in relation to the enclosure ditches, of which two phases are evident. In only two cases are there stratigraphical relationships between the gullies of different structures. As a result, only limited phasing of the different round-houses is possible, either in relation

Table 3.3: Summary of Middle Iron Age round-houses in Trench 9 (Figs 3.8, 3.9)

Round-house	Diam. (m)	Orient-ation	Ring-gullies	Width (m)	Depth (m)	Description	Finds/dating
2355	11.2	SE	1079, 1106	0.5	0.2	Undated post-holes in interior, and in entrance, and one in base of gully 1106	Pottery (20/55 g), burnt flint, animal bone, ^{14}C date from charred cereal grain: 390–190 cal BC (SUERC-34942)
2356	12.6	–	221, 1270	0.6	0.3	Undated post-hole and small pits in interior, and one Middle Iron Age pit (1609)	Pottery (18/113 g), burnt flint, animal bone
2357	12.8	?SSW	208, 1104, 1260	0.7	0.3	Western terminal (208) cut Middle Bronze Age ditch 1284, eastern gully (1260) revealed below layer 1027	Pottery incl. Middle Iron Age (22/290 g), ^{14}C date from charred wheat grain: 370–180 cal BC (SUERC-33672)
1146	14.7	–	1146	0.3	0.12	Revealed below layer 1027	Pottery (10/95 g), animal bone
1655	9.6	–	1655	0.3	0.1	Middle Iron Age pit 1983	Pottery (1/6 g), struck flint, burnt flint
1935	12.1	–	1935	0.8	0.4	–	Pottery (17/137 g), struck flint, burnt flint, animal bone
1940	int 11.5 ext 12.4	?ESE	1817, 1819, 1854, 1977, 2010, 2028, 2030, 2127	0.3	0.3	Formed in places of two concentric gullies, up to 0.3 m apart, with no clear stratigraphical relationship between them; Middle Iron Age pit (2055) just inside entrance contained skeleton of young goat	Pottery incl. Middle Iron Age (63/555 g), struck flint, burnt flint

to each other or to the enclosure ditches. Details of the round-houses are summarised in Table 3.3.

In most cases only short lengths of gully were visible (Figs 3.8–3.9), with only round-house 1940 at the east having more than half of its circuit (of two concentric gullies, Figs 3.7, 3.9–3.10, Pl. 3.4) surviving. In some cases it is far from certain that lengths of gully did represent round-houses, such as, for example, a 2.6 m long, slightly curving gully (1886) with an apparent terminal at the east but petering out at the west, its southern edge cut by round-house 2356 (Fig. 3.7). Like many of the other gullies, it contained pottery (including diagnostic Middle Iron Age sherds), animal bone and burnt flint. The short lengths of the gullies also made it hard to determine the orientations of the round-house entrances, although all could have conformed to the south-easterly orientation typical for the Iron Age.

Within the areas defined by the ring gullies there were numerous undated small features (probably mostly post-holes), although generally in no greater concentration than were found outside them. Some of these may indicate posts forming parts of these structures, but is no cases was there a clear relationship.

Pits within the interiors may also not have been directly associated with the round-houses. Within round-house 2356, for example, there was both a Middle Bronze Age pit (1793), and a Middle Iron Age pit (1609) (Fig. 3.8). Pit 1983, between gullies 1655 and 1935, contained 18 sherds of Middle Iron Age pottery and burnt flint, and may have been associated with the interiors of either potential structure (Fig. 3.8).

However, immediately inside the southern entrance terminal to round-house 1940 there was an oval pit (2055) which contained the complete articulated skeleton of a young goat (2014), along with 25 sherds of Middle Iron Age pottery and burnt flint (Fig. 3.9). A sample of the goat bone submitted for radiocarbon dating did produce a Middle Iron Age (SUERC-33661) result as predicted, although the date is considered unreliable due to a high carbon:nitrogen value (see Chapter 8; Appendix 5). However, there is a strong likelihood that the deposit is associated with the round-house. While bones identifiable as goat are very unusual in the archaeological record for this period, comparable bone deposits of probable symbolic significance have been noted in similar locations within round-houses at a number of sites in eastern England (see Higbee, Chapter 7). A similar pit (1256), not obviously associated with a round-house, contained part of a sheep skeleton; here too radiocarbon dating failed to produce a reliable result.

Ditches and enclosures

As mentioned above, the gullies of two round-houses were cut by the Middle Iron Age enclosure ditch 1213 (first phase), and the projected line of another (2357) may have overlapped with the ditches on the same enclosure's north side (Fig. 3.7). Unless round-houses were built over, or even right up against the lines of silted up ditches, which seems unlikely, this would indicate that these four features at least are likely to have pre-dated the construction of the enclosure. Two main phases of enclosure construction can be identified (Fig. 3.7), although their precise layout is slightly obscured by the early Romano-British ditch (1212, below) which cuts across them.

Phase 1 enclosure

The Phase 1 enclosure is sub-square in shape, measuring internally *c.* 31 m square, with one axis aligned NNW to SSE, the other perpendicular to it. (For ease of description the sides will be referred to as *north*, *east*, *south* and *west*.) There was no evidence for a bank either inside or outside the enclosure ditch. On the west side the ditch (1213) turned in slightly at its northern end where there was a rounded terminal (1278). Here the ditch was *c.* 1.9 m wide and 0.6 m deep with an irregular profile; further south the dimensions remained much the same (up to 0.8 m deep) but the profile became more regular, having moderately steep, flat or slightly concave sides and a wide flat base.

Between two and four fills were recorded in the western excavated sections, the uppermost of which extended *c.* 1–2 m to the east of the ditch's defined inner edge, in one section appearing to fill a shallow cut *c.* 0.2 m deep. A similar poorly defined linear feature, less than 0.1 m deep, was recorded on the inside of the enclosure's south-west corner and to the immediate east (2300) (Fig. 3.7).

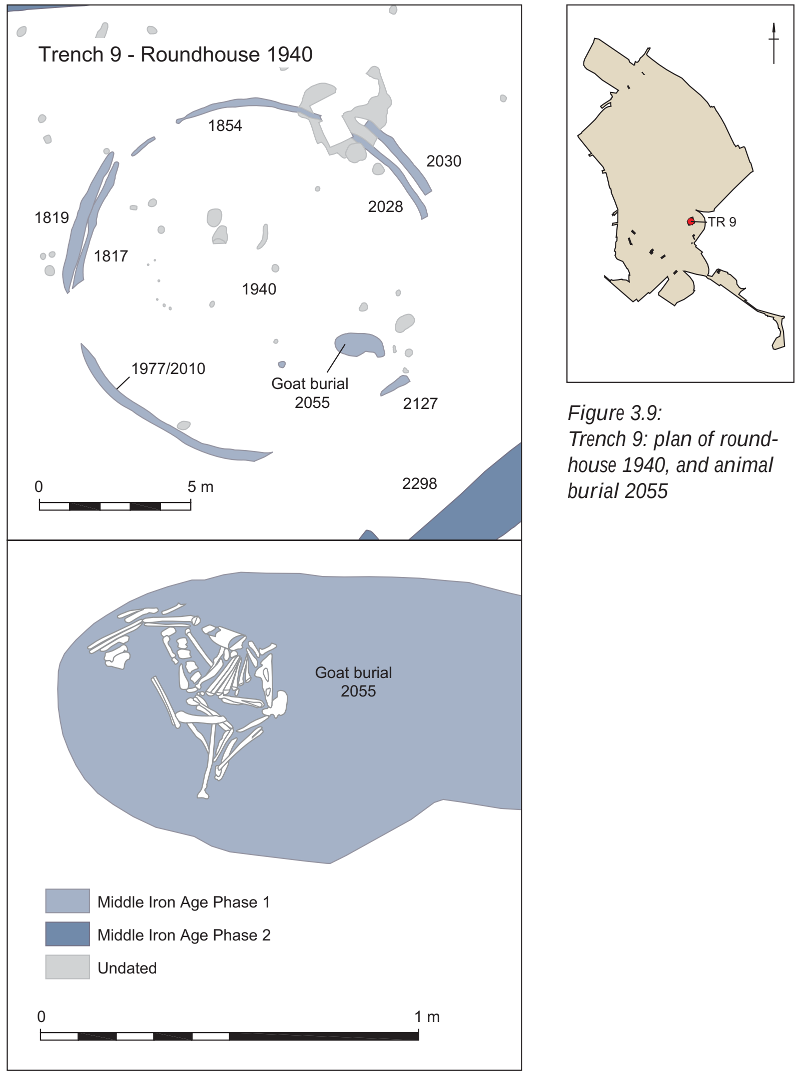


Figure 3.9: Trench 9: plan of round-house 1940, and animal burial 2055

The ditch made a sharp right-angled turn at the south-west corner, although its inside edge was not clearly defined due to modern truncation. It ended at a squared terminal (1929) *c.* 14 m east of the corner. After a 3.5 m gap there was a further *c.* 3.7 m long segment (2222) up to 0.9 m deep, then a 9 m gap before another squared ditch terminal (2196). It is possible that there was initially a single gap, *c.* 16 m wide, defined by the two distinctly squared terminals (1929 and 2196), within which segment 2222 was subsequently inserted.

However, their broad contemporaneity is suggested by a series of radiocarbon determinations all falling within the early part of the Middle Iron Age. Sediments from the

Plate 3.4: Middle Iron Age round-house 1940 under excavation, Trench 9

upper half of the ditch's fill sequence (cut 1705) close to the its south-west corner, produced two dates – of 400–200 cal BC (Beta-254061; 2250±40 BP) and 390–170 BC (Beta-254062, 2200±40 BP), while a water-logged sloe stone (*Prunus spinosa*) from terminal 1929 produced a date of 370–170 cal BC (SUERC-33679 2190±30 BP). A fourth date, on sediment from the lowest fill of segment 2222, produced a date of 380–110 cal BC (Beta-254067, 2218±40 BP) (Table 3.1). (A fourth, earlier date of 720–260 cal BC (Beta-254068, 2370±40 BP) from a higher fill (2181) in the segment 2222 clearly derives from redeposited material.)

The eastern ditch (2196) was traced for only *c.* 3 m before its line was obscured by a large shallow hollow, or 'pond' (2218), *c.* 5 m by 6 m and 0.2 m deep, which cut and obscured the ditch's intersection with a number of other ditches at the enclosure's south-east corner. It appears likely, however, that the ditch turned at a right-angle to the north (as ditch 1384), its line obscured for the first 18 m by early Romano-British ditch 1212 (below). Where fully exposed on the enclosure's eastern side, ditch 1384 (cut 1660) was *c.* 1.6 m wide and 0.7 m deep, with a sequence of three fills, the lowest of which (1724) produced a radiocarbon date on sediments of 390–170 BC (Beta-254064, 2210±40 BP), identical to that from segment 2222. (In this section too, an earlier date on sediments of 820-540 cal BC (Beta-254065, 2590±40 BP) from a higher fill (1723) must derive from redeposited material, as must six sherds of Middle Bronze Age pottery.)

Ditch 1384 had a slightly curving turn at the enclosure's north-east corner, west of which it was 1.4 m wide and 0.6 m deep. It then extended west for *c.* 12 m before being again cut by the Romano-British ditch, to the west of which its line is uncertain. It seems most likely that it continued to the west, as ditch 1349, although on a slightly different alignment. Only a short length of ditch 1349, partially exposed in section measuring *c.* 1.3 m wide and at least 0.4 m deep, was recorded, its western end cut by modern features, although presumably it ended at some point within *c.* 7 m of ditch terminal 1278. An alternative is that, immediately west of the Romano-British ditch, it turned towards the north as ditch 1386, where its line was again cut by the Romano-British ditch. Ditch 1386, which cut the eastern end of ditch 1349, was *c.* 2 m wide and 0.3 m deep and so had a much shallower profile than the rest of the enclosure ditch. It may however, represent a modification to what appears to have been an entrance at the enclosure's north-west corner.

Figure 3.10: Reconstruction of the area of Trench 9 in the Iron Age

The fills of ditch 1384, which all appear to have accumulated through natural processes, produced diagnostic and probable Middle Iron Age pottery, (as well as residual Late Bronze Age sherds), along with struck flint, burnt flint, a piece of a possible fired clay triangular loomweight (from section 1705), a piece of slag, and animal bone. A number of pieces of waterlogged timber were also recovered from ditch terminal 1929 and segment 2222, some of the latter displaying evidence of wood-working, including an oak stud end (squared tenon post) (2180) of a type found in timber-framed buildings in Roman London (see Goodburn, Chapter 7; Fig. 7.10, 2). This was recorded below the ditch's primary fill but it is unclear whether it had been driven into the natural, and if so from what level and at what date, and therefore whether it had some structural function related to either of the adjacent gaps in the ditch. Also on the base of the ditch was the base or lid of a bentwood box or tub (2212) which can be paralleled in the Iron Age, the Romano-British period, and later (see Goodburn, Chapter 7; Fig. 7.10, 3). In addition, an undated pit (2084) just west of terminal 1929 contained two pieces of worked timber lying on the base and forming a T-shape. The pit, with two fills, measured 0.9 m by 1.9 m and was 0.5 m deep.

A possible internal subdivision of the enclosure may be marked by a less substantial ditch (2326) which extended north for over 15 m from terminal 1929, approximately parallel to the enclosure's western side. At its north end it was cut by Phase 2 ditch 1013 (below) which converged on it at a very shallow angle. Ditch 2326 was up to 0.7 m wide and 0.2 m deep, with up to two fills, and produced 23 sherds of probable Middle Iron Age date (and one possible Late Bronze Age sherd).

A *c.* 6 m length of undated ditch (1556) appeared to continue the line of ditch 2326 from a possible terminal 3 m south of the enclosure, although at 1.6 m wide it was considerably wider, if of similar (0.2 m) depth. Its alignment suggests it could belong to this phase; alternatively it could be associated with the Phase 2 ditches (below), or be entirely unrelated to the Middle Iron Age ditches. It contained two sherds of late prehistoric pottery.

Phase 2 ditches

While identifying the Phase 1 enclosure is facilitated by its square shape, the layout of the Phase 2 ditches is less regular and coherent, and it is possible that not all these ditches were laid out at the same time but represent a series of modifications, some possibly undertaken soon after the construction of, and during the use of, the Phase 1 enclosure. The reason for the eventual abandonment of the Phase 1 enclosure is not clear, although the fact that the westernmost Phase 2 ditch (1013) lay *c.* 15–16 m to the east of the western side of the Phase 1 enclosure, and therefore further from the edge of the stream channel, may indicate that changing ground conditions had some influence.

The initial changes appear to have involved modifications to the south side of the Phase 1 enclosure, involving the blocking of the two entrance gaps on either side of ditch segment 2222, although establishing the sequence of events is hampered by uncertainties (evident in the field records) about the stratigraphical relationships between the features. The following interpretation is based largely on the relationships as initially recorded.

The narrower western gap appears to have been blocked by a feature (2250), *c.* 6 m long and up to 0.7 m deep, which extended east from a point just short of Phase 1 ditch terminal 1929. In a longitudinal section (not illustrated), it had a lower fill of dark organic clay (2225), containing two probably residual sherds of Late Bronze Age/Early Iron Age pottery (along with cattle bones), and an upper fill (2280). The upper levels of the feature, however, appear to have been cut along its full length by ditch 2297, here *c.* 3 m wide, which extended to the east (and narrowed to 1.8 m), blocking the wider, eastern gap in the Phase 1 ditch (between 2222 and terminal 2196). Here, above the primary fill, there was a layer of clay silt up to 0.25 m thick lying against the northern side, which could have derived from the erosion of an internal bank, possibly constructed across the gap.

Ditch 2297 produced six sherds of Middle Iron Age pottery, along with two residual Late Bronze Age sherds. As it approached the south-east corner of the Phase 1 enclosure (and hollow/pond 2218) its southern edge turned slightly towards the north, suggesting that it followed the line of the earlier enclosure. If so, it is possible that its northwards line is represented by ditch 1923, which was completely cut by a later (Romano-British) ditch for up to 14 m (although at one point recorded in section below it), then partly exposed in plan where the Romano-British ditch curved off its line, revealing the position of its terminal. Ditch 1923, therefore, recut the Phase 1 ditch (1384) on the eastern side of the early enclosure, but turned slightly inwards off that line as it approached its terminal. Near its terminal, which was positioned *c.* 3 m south of Phase 2 ditch 1385 (below), it was *c.* 1 m deep and an estimated 1.7 m wide, with up to five fills which produced five sherds of probable Middle Iron Age pottery.

As well as turning to the north at the south-east corner of the Phase 1 enclosure, the line of ditch 2297 appears also to have been continued eastwards by ditch 2298. This ditch, which like ditch 2297, appeared to turn northwards as it approached hollow/pond 2218 from the east, was exposed in section near the eastern edge of the site, where it was 2.8 m wide and 0.7 m deep, with moderately steep concave sides and a flat base.

As mentioned above, the westernmost of the Phase 2 ditches was ditch 1013. This extended north from the western end of feature 2250, parallel to, but east of, the western side of the Phase 1 enclosure. Here, again, some of the relationships are unclear. During the evaluation, this ditch (as feature 203) was described as a modern intrusion (Bazley *et al.* 2008, 23), although the grounds for this are unclear, since it was cut from the same level as the other prehistoric features. At its south end it passed through the narrow entrance gap in the Phase 1 ditch, but did not extend to the south of ditch 2297. Towards the north it converged on, and appeared to cut ditch 2326. It appeared to peter out at the north, although a short unexcavated length of possible north-south aligned ditch (2307), *c.* 10 m further north, may represent its continuation on a slightly different line.

The northern component of this arrangement of Phase 2 ditches consists of east-west ditch 1385, which is on a slightly different axis to the other ditches. Its western, rounded terminal was *c.* 2 m wide and 0.6 m deep with moderately steep irregular sides and a flat base. Further east, however, after cutting across the line of the Phase 1 enclosure ditch, it widened to *c.* 3.5 m and was 0.8 m deep. The ditch contained up to seven fills, none of them indicating the presence of an associated bank; these produced 34 sherds of late prehistoric pottery, some of it of Middle Iron Age date but including also a residual, Late Bronze Age component.

Together, these Phase 2 ditches appear to represent a slight eastward shift in the location of the enclosure, although the western half of the earlier enclosure may well still have remained in use. The western side of the Phase 2 enclosure matches the earlier enclosure in its length, orientation and probable entrance (3.5 m wide) at the north-west corner. It also appears to have had an internal division, represented by ditch 1923, with a 2.6 m wide access point at its northern end, which could represent a functional division between the settlement area to the east, containing rebuilt round-house 1940, and a possible stock area to the west (Fig. 3.10). Unlike the Phase 1 square enclosure, however, the north and south sides of the Phase 2 enclosure converge to within 13 m towards the eastern side of the trench, and it is not clear whether the enclosure was closed at the east, or possibly had another entrance, just beyond the limit of excavation, faced by the round-house entrance.

Inhumation Burials

The only four inhumation burials recorded during the entire Olympic Park excavations were all found within 40 m of each other in Trench 9, three of them within 7 m of each other (graves 1041, 1158, 1662 and 1852, Figs 3.7, 3.11). None of the graves contained any grave goods by which their date might be ascertained, and two had no stratigraphical relationships. Bone from all four burials was therefore submitted for radiocarbon dating, but only one was successful, the others having insufficient carbon (see Chapter 8).

The grave with what appears to be the clearest stratigraphical relationship was a north-east–south-west aligned grave (1662) containing the flexed inhumation (1663) of a male aged *c.* 45–60, laid on the right side with the head to the north-east (Fig. 3.11, Pl. 3.5). The apparently sub-rectangular grave,

Plate 3.5: Inhumation burial 1663 (grave 1662), Trench 9

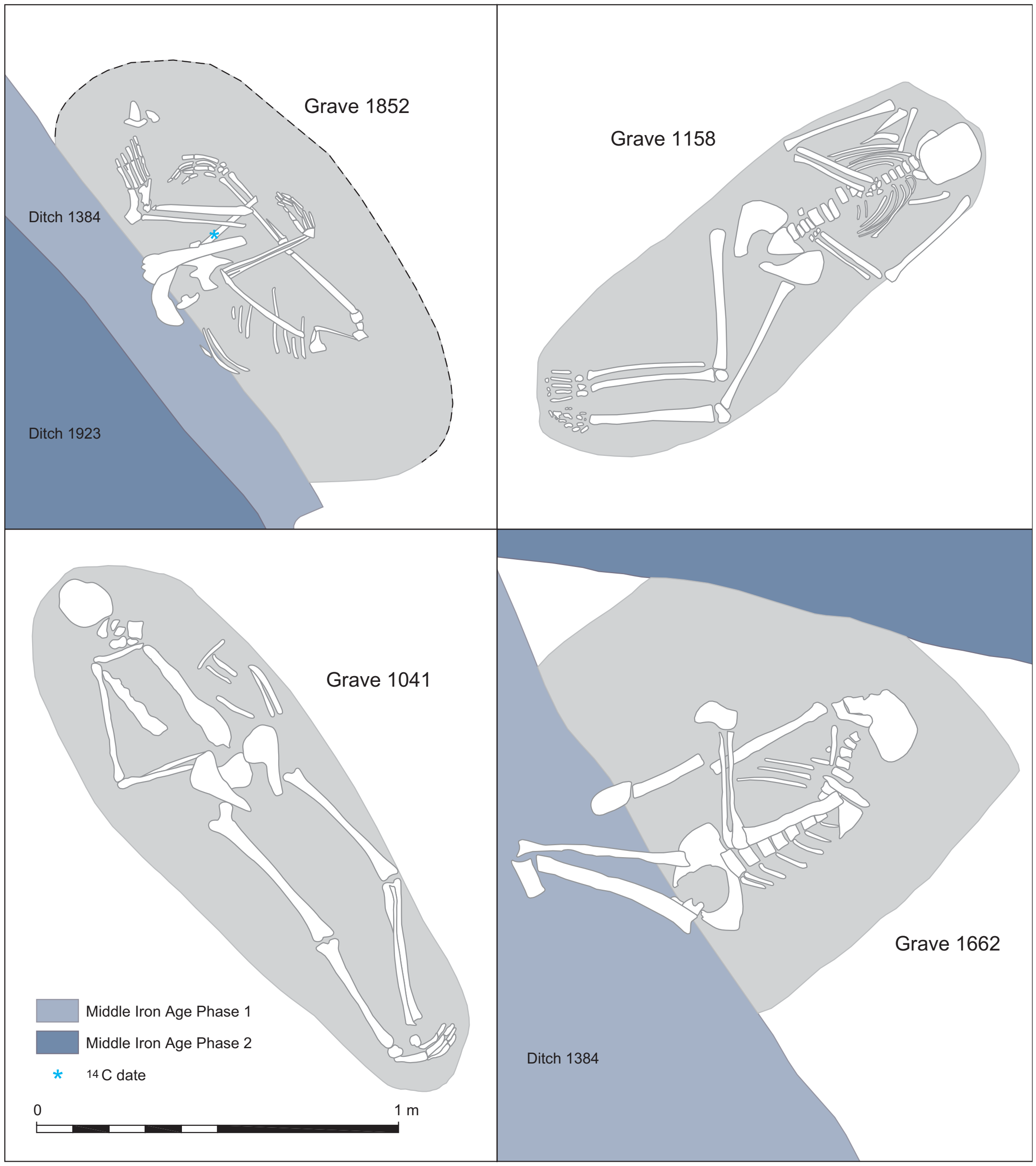


Figure 3.11: Trench 9: plans of inhumation graves

which was 1.1 m wide and 0.3 m deep with near vertical sides and flat base, was cut at its south-west end by the outer edge of Phase 1 enclosure ditch 1384, and at its northern corner by Phase 2 ditch 1385. The skeleton was truncated below the knees, although a matching left tibia was recovered within ditch 1385's secondary fill (1723) in the adjacent excavated slot (1660), between 0.2 m and 0.6 m above the base of the ditch. In the absence of other dating evidence, and given the date range for known activity on this site, this grave could date to anywhere from the Middle Bronze Age to the Middle Iron Age. While six sherds of redeposited Middle Bonze Age pottery were also recovered from the ditch slot 1660, there is no good reason to deduce that these derive from the grave.

Less than 5 m to the south-east, also on the edge of ditch 1384, was grave 1852, which was so heavily truncated that its cut was not visible, and the upper part of the skeleton (1810), including the skull, was missing. The crouched skeleton, of a female aged *c.* 35–40, was laid on its right side with the head to the south-east. Although the skeleton overlapped marginally with the edge of ditch 1384 (as planned), no relationship with the ditch was recorded, and the skeleton does not appear to have been cut by the ditch. A sample of the bone produced a radiocarbon date, falling largely within the Late Iron Age, of 110 cal BC-cal AD 60 (SUERC-33678, 2020±30 BP). Unspecified Iron Age pottery recorded by the excavator around and under the skeleton may be residual material, the grave lying within the area of the Middle Iron Age settlement, and within the Phase 2 enclosure.

The third grave (1158) in the close group of three was, like grave 1662, aligned north-east–south-west; it lay within both the Phase 1 and Phase 2 enclosures. However, the skeleton (1156), of a possible female aged *c.* 25–35, was laid supine with the legs slightly flexed to the left in order to fit within the relatively short grave. The grave was only 1.5 m long, and up to 0.5 m wide and 0.2 m deep, with rounded ends, near-vertical sides and a flat base. The grave fill (1152) contained five probably residual late prehistoric sherds.

The fourth, more isolated grave (1041) lay just over 1 m outside the ditch of the Phase 1 square enclosure on its west side (1213). It was *c.* 1.8 m long, 0.6 m wide and 0.1 m deep, with rounded ends, slightly curved and concave sides and a flat base, and contained the extended skeleton of a male aged over 40 (1057) laid face down; he had a well-healed fracture in his left hand. The grave's NNW–SSE alignment (almost parallel to the enclosure ditch) might indicate that it was positioned in relation to the enclosure. However, it was recorded as cutting through an alluvial deposit (1531), *c.* 0.25 m thick, which extended across the silted up the ditch, and the adjacent sections across the ditch show no noticeable depression in the surface of 1531 along the ditch line.

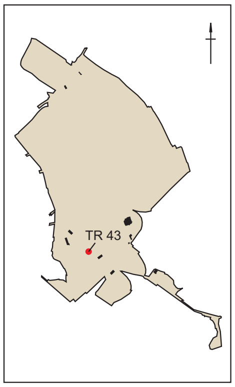
These four inhumation burials, which vary significantly in their size, shape and orientation, and in the positions in which the bodies were laid in the graves, but which are frustratingly similar in their absence of grave goods, are clearly not all contemporary. With features on this site dating from the Middle Bronze Age through to the early Romano-British period (see Chapter 4), the graves could have a similar (and potentially significantly longer) date range. Certainly grave 1662 almost certainly pre-dated the cutting of the Phase 1 square enclosure; it could therefore be associated with the Middle and Late Bronze Age phases of activity on the site, or with the phase of pre-enclosure Iron Age settlement. The more isolated grave 1041, in contrast, clearly post-dates the abandonment of the Phase 1 enclosure, apparently by a significant period given the depth of alluvium that had accumulated over the infilled ditch. This could make it broadly contemporary with, or perhaps later than, the Late Iron Age radiocarbon date obtained on the skeleton from grave 1852. Grave 1158 remains floating within the sequence. Despite the problems with their dating, these graves represent an important potential addition to known late prehistoric burials in the area, including inhumation burials of Early Iron Age and possibly Late Iron Age date at West Ham (Boyle 2005) and Southwark (Werner 1998) (see McKinley Chapter 7).

Trench 43

Late Bronze Age

Late prehistoric activity was also recorded in Trench 43, approximately 460 m to the south-west of Trench 9 (Figs 3.2, 3.3 and 3.12). Here, although the small quantities of pottery were not sufficiently diagnostic to allow more precise dating than between the Late Bronze Age and Middle Iron Age, three radiocarbon dates, one from a post-hole/fire pit and two from a cremation grave, appear to place the late prehistoric activity firmly within the Late Bronze Age.

The topographic map suggests that the site may have lain on a raised gravel island with river channels to either side (Fig. 3.3).



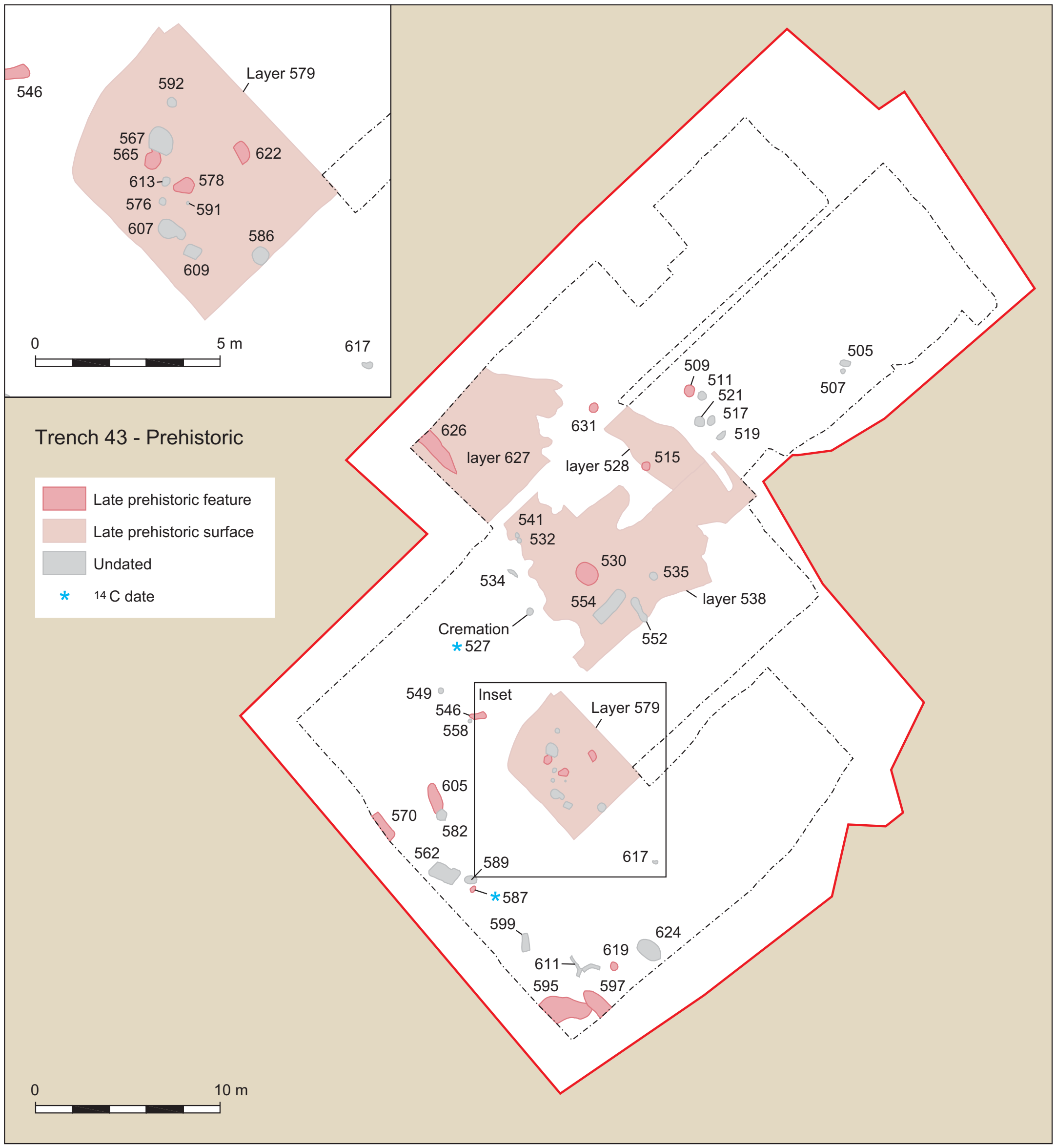


Figure 3.12:
Trench 43: plan of late prehistoric and undated features

A range of features, including pits, post-holes and stake-holes, and a cremation burial, cut into a remnant land surface and an underlying layer of dark grey alluvium (501) or, where these were not present, into the underlying river gravels (Fig. 3.12). Layer 501, which was present across most of the site, was in places up to 0.3 m thick, apparently laid down during an extended period of over-bank flooding across the valley floodplain. Five sherds of late prehistoric pottery, along with burnt flint, a flint flake, a cattle tooth and carbonised weed seeds, were recovered from the layer, possibly worked down through biological processes from the overlying layers.

Overlying layer 501 were a number of localised deposits of a silty or sandy clay soil which appear to represent the partial survival of a remnant land-surface from a period when flooding had abated and the site had dried out. In the central part of the site, layer 538 contained flecks of charcoal, while towards the north layer 627 contained 15 sherds of late prehistoric pottery, two pieces of struck flint and burnt flint, with an additional sherd and piece of burnt flint from adjacent layer 528.

Cremation grave

Among the general distribution of the features there was a small sub-circular cremation grave (527, Fig. 3.12), *c.* 0.4 m in diameter and 0.1 m deep with vertical sides and a concave base. It had a charcoal-rich fill (526) containing 250 g of cremated bone from a probable female aged *c.* 25–40. A sample of the cremated bone, and another of field maple charcoal (*Acer campestre*), produced radiocarbon dates in the Late Bronze Age of 1120–900 cal BC (SUERC-34931, 2830±35 BP), and 1050–860 cal BC (SUERC-35326, 2810±30 BP), respectively, both closely comparable to the dates obtained from the two cremation burials in Trench 9 (see above; Table 3.1).

'Round-house'

In the central southern part of the site there was a vaguely curved cluster of 13 possible post-holes and stake-holes that coincided with, and cut, an area of alluvium (579). This layer was distinguished from layer 501 by its higher level of flint and pebbles, which may represent the remnants of an occupation surface, possibly compacted into the alluvium by trampling.

Table 3.4: Post-holes of possible round-house in Trench 43

Feature	Fill	Diam. (m)	Depth (m)	Finds
565(N)* 565(S)	564	0.45 0.45	0.20 0.20	Late prehistoric pottery (1 sherd, 7 g)
567	566	–	0.30	Pottery fragments (not recovered)
576	575	0.20	0.20	–
578	577	0.50	0.40	Late prehistoric pottery (5 sherds, 25 g), burnt flint (52 g)
586	585	0.45	0.20	–
591	–	0.25	0.10	–
592	–	0.20	0.10	–
607(NW)* 607(SE)	593	0.50 0.30	0.20 0.10	–
609	608	0.40	0.15	–
613	612	0.20	0.10	–
622	621	0.50	0.12	Late prehistoric pottery (7 sherds, 11 g), burnt flint (120 g)

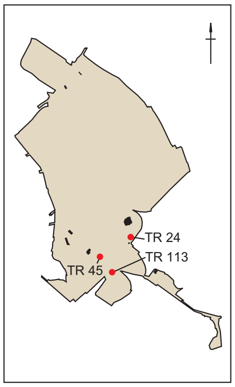
* Pairs of post-holes given single cut and fill numbers

The post-holes and stake-holes were of varying size (Table 3.4), although all were circular or sub-circular in plan, with steep vertical sides breaking sharply to uneven or concave bases. Their fills comprised soft, dark grey silty clays with varying degrees of sand and gravel inclusions and sparse charcoal flecks. Six of the post-holes and two of the stake-holes lay on or close to the arc of a circle *c.* 5 m in diameter, the rest lying within this circle, and pit/post-hole 622 lying towards its centre.

The post-holes in the arc, however, were not evenly spaced and while this does not rule out their association within a single structure, the nature of that structure is far from clear. The small quantities of finds from the features, and a recorded concentration of burnt flint between post-holes 567 and 578, could indicate low-level domestic activity within what may have been a relatively small and rudimentary round-house, but some other, possibly non-domestic function for this far from regular arrangement of features is also possible. If they do represent some form of structure, the presence of post-holes and the absence of a curved gully suggest a different method of construction to that used for the Middle Bronze Age round-house in Trench 24 (below) and the Middle Iron Age round-houses on Trench 9 (above), and so could feasibly indicate a Late Bronze Age date. A cluster of post-holes in Trench 45 (although there associated with a short curved gully) produced two radiocarbon dates in the Late Bronze Age (Fig. 3.13).

Other features

A range of other, more dispersed features of varying size and form (some of them heavily truncated and disturbed by modern activity) were distributed across the rest of the site (Table 3.5). As with those in the 'round-house' cluster, a significant number remain undated. They were initially all assumed to be of probable late prehistoric date. However, radiocarbon dates from two sections of ditch, initially interpreted as forming part of a late prehistoric enclosure surrounding many of these features, and



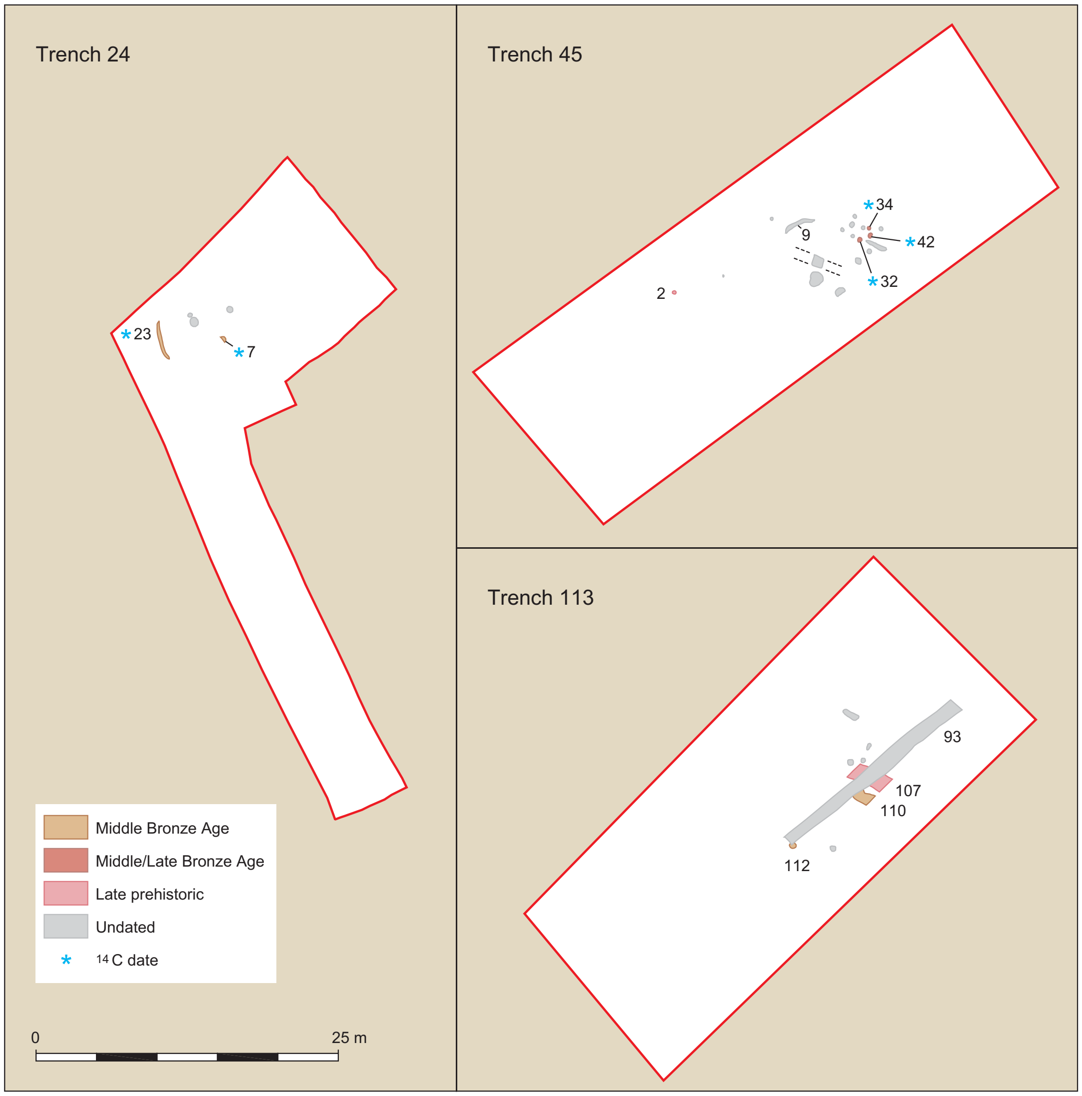


Figure 3.13: Later prehistoric features in Trenches 24, 45 and 113

another date from a post-hole set within one of the ditches, have shown the enclosure to be of Saxon date (see Chapter 4). It is possible, therefore, that some of the undated features, particularly some of the other post-holes which appear to be closely related spatially to the ditches, are also of Saxon date – although no Saxon finds were recovered from this site.

Over half of these features contained finds, consisting mainly of small quantities of late prehistoric pottery and burnt flint (Table 3.5). Some of this material, such as that in pit 605, which includes pottery, animal bone, burnt flint and fragments of burnt clay and charcoal, may represent deliberate dumps of domestic hearth waste; in other cases the material may have become incorporated in the fills through natural processes. Small pit or post-hole 587 contained abraded fragments of burnt clay (possibly daub), as well as charred barley grain which produced a radiocarbon date, at the end of the Late Bronze Age, of 920–800 cal BC (SUERC-34941, 2710±35 BP).

There were two lengths of ditch in the southern corner of the site, including, one (595) with an irregular approximately east-west line, continuing to the west, the other (597) continuing to the south-east. Although the eastern end of ditch 595 overlapped with the edge of ditch 597, the relationship between them was not clearly established. Ditch 597, which was 0.8 m

Table 3.5: Other discrete features in Trench 43

Feature	Fill	Dimensions (m)	Depth (m)	Finds
Containing finds				
505	504	0.5	>0.30	Burnt flint
509	508	0.5	–	Late prehistoric pottery (2/2), burnt flint (196 g)
511	510	0.4	0.28	Burnt flint (12 g)
515	514	0.5 diam.	0.50	Late prehistoric pottery (1/3), burnt flint (59 g), charcoal
521	520	0.5	0.35	Burnt flint (89 g)
530	529	1.1 x 1.2	0.20	Late prehistoric pottery (3/20), burnt flint (157 g)
534	533	>0.3 x 0.6	–	Post–medieval pottery (intrusive)
546	547	0.4 x 0.9	0.30	Late prehistoric pottery (1/29)
554	555	0.7 x 2.3	0.20	Burnt flint (58 g)
570	569	>0.5 x 1.6	0.10	Late prehistoric pottery (1/6)
587	588	0.2 x 0.4	0.05	Burnt clay fragments, ^{14}C date on charred grain: 920–800 cal BC (SUERC–34941)
605	606	0.5 x 1.6	0.10	Late prehistoric pottery (3/23), animal bone, burnt flint (31 g), burnt clay fragments, charcoal, iron slag (29 g) (intrusive?)
617	616	0.2 x 0.25	0.10	Burnt flint (26 g)
619	618	0.4	0.10	Late prehistoric pottery (7/21), burnt flint (89 g)
631	630	0.5 diam.	0.20	Late prehistoric pottery (1/3), burnt flint (81 g)
Containing no finds				
507	506	0.25	>0.20	–
517	516	0.4 x 0.5	–	–
519	518	0.5	–	–
535	536	0.4 diam.	0.10	–
549	548	0.3 diam.	0.05	–
552	553	0.5 x 1.5	0.30	–
558	559	0.2 diam.	0.10	–
562	563	>0.9 x 1.6	–	–
582	581	0.6 diam.	–	–
589	590	0.4 x 0.7	0.20	–
624	623	1.0 x 1.4	–	–

wide, appeared to end at a rounded terminal at the north-west, while ditch 595 was 1.4 m wide at the west but narrowed significantly towards the east. Neither was fully excavated, so their depths were not established, but their uppermost fills produced small quantities of pottery. Immediately north of the ditches were two short lengths of angled gully (611) forming an approximate T-shape, and a possibly associated post-hole (619). The gullies, possibly natural features, were not excavated although a fragment of pottery was recovered from their fill.

There was also a possible ditch (626), truncated at its south-eastern end, that was traced for 2.7 m from the northern edge of the site, cutting occupation layer 627. It was up to 0.8 m wide and 0.25 m deep, and its single fill produced one sherd of late prehistoric pottery.

Onset of flooding

The onset of wetter conditions, perhaps related both to sea level, drainage gradient and flow rate changes, as well as to the migration of the adjacent river channels, culminated in the resumption of flooding across the site, a number of phases of which were identified within the layers of alluvium that extended across the site and sealed the late prehistoric features. Three layers (500, 545 and 544), together up to 0.7 m thick, were recorded; these contained environmental evidence for variations in the severity and duration of the flooding, from seasonal to episodic. However, despite indicators for the temporary drying of the land surface, with soil formation and even the establishment of grassland, there is no archaeological evidence for the significant reoccupation of this site late in the prehistoric period; the only finds consisted of a small quantity of burnt flint recovered from layer 500 and a single sherd of late prehistoric pottery from a lens (615) within layer 545.

Table 3.6: Summary of other late prehistoric evidence

Trench	Features/contexts	Finds/dating	Description
6	Linear feature (352)	^{14}C date on hazel charcoal: 380–180 cal BC (SUERC-35319) Middle Iron Age pottery, struck flint, animal bone, mixed charcoal (oak, ash, alder/hazel, blackthorn)	Feature cut a buried land surface and was sealed by alluvium
24	Round-house gully (23) 4 post-holes/pits	^{14}C date on charcoal from gully: 1420–1260 cal BC (SUERC-35325) Fired clay; 1 sherd late prehistoric pottery ^{14}C date from charred material in pit 7: 1390–1050 cal BC (Beta-210488)	Features cut into dry land surface (4) containing 2 sherds late prehistoric pottery; sealed by alluvium (3) (Fig. 3.12, Pl. 3.4)
30	Worked timbers 47–9 and 56	^{14}C date on humic silt (54): 1620–1400 cal BC (Beta-204035)	Timber from possible structure, including 2 planks with tool marks, found close together (but separate from driftwood) between a layer of sand (55), representing the active stream channel, and Middle Bronze Age humic silt (54) representing the transition to a marshy backwater
35	94	^{14}C date on charred cereal: 760–410 cal BC (NZA-32949) ^{14}C date on horse bone: 750–400 cal BC (SUERC-36296)	Horse bone with cut marks suggesting skinning, at interface of gravel (95) and peaty silt (94)
45	14 post-holes 2 pits 2 short gullies, one (9) curving with *c*. 6 m diameter 1 NW–SE ditch	2 sherds late prehistoric pottery from post-hole 2; burnt flint from gully 9 ^{14}C dates – on charcoal in post-hole 32: 1260–1010 cal BC (SUERC-35327); on charcoal in post-hole 34: 1130–920 cal BC (SUERC-36232); on charred barley grains in post-hole 42: 1130–910 cal BC (SUERC-34940)	Features cut sandy deposit (17); (Fig. 3.12)
56	Possible prehistoric land surface (215/217)	Late prehistoric pottery (19 sherds/139 g) ^{14}C date on organic sediment in 217: 510–200 cal BC (Beta-252889)	Land surface overlain by loose sand and humic silt suggesting encroachment of river channel. These layers cut by a Romano-British ditch
59	Possible prehistoric land surface (313/314)	Late prehistoric pottery (114 sherds/720 g)	35 of the sherds were from a layer of soft tufaceous sand (314), sealed by thin layer of alluvium (313) cut by an Romano-British ditch; remaining sherds reworked into post Romano-British layer (312)
113	2 ditches (107, 110) Sub-rectangular feature 5 post-holes	Ditch 107 – late prehistoric pottery (3 sherds); plus residual Mesolithic/ Early Neolithic flint; 2 further sherds (and struck and burnt flint) from overlying alluvium (104)	Parallel ditches 107 (1.6 m wide, 0.4 m deep) and 110 (1.1 m wide, 0.4 m deep with rounded terminal at NW) and one post-hole (112) cut possible land surface (105). Sealed by alluvium (104) that was cut by remaining features, and contained timber stake with possible axe marks. These in turn were sealed by further alluvium (103) that was cut by post-medieval ditch (93) (Fig. 3.12)

Discussion

The relatively thinly spread evidence for Late Bronze Age activity on the site suggests that any occupation here may have been intermittent, possibly seasonal, or marginal to any settlement nearby. While the undiagnostic nature of much of the pottery prevents precise dating, the potential span of the barely overlapping radiocarbon date ranges from the cremated human bone in grave 527, dated to 1100–900 cal BC, and the carbonised cereal grains in pit 587 dated 920–800 cal BC, suggests that the activity was not short-lived, or at least that the site was revisited, for whatever reasons, on a number of occasions.

It is evident, however, that once this river valley location, slightly raised above the surrounding floodplain, was no longer subject to repeated flooding, it became dry, habitable and potentially workable land, even if largely surrounded by wetlands for part of the year. The waterside location would have been well suited for habitation, providing ready access to the river channels, the floodplain and the valley sides, for arable and pastoral agriculture, for the exploitation of natural resources and for communication. The presence of short lengths of ditch (595 and 597 at the south, and 626 at the north) potentially broadly contemporary with the settlement features, hints at the wider organisation of the landscape, although this is very tentative. As it turned out, changing conditions eventually saw the long-term resumption of flooding and the site's apparent abandonment.

Other Late Prehistoric Evidence

A number of other trenches across the Olympic Park produced evidence for activity of Middle Bronze Age to Middle Iron Age date. In most cases only a few features were recorded, and the material was not considered of sufficient significance to require further mitigation excavation. However, it is notable (Fig. 3.3) that these fall within the same general area within the southern part of the Olympic Park as the occupation evidence in Trenches 9 and 43, and in two of the trenches (Trenches 24 and 45) there was evidence for possible settlement structures spanning the Middle–Late Bronze Age. This evidence is summarised in Table 3.6.

Discussion

It is unclear exactly how the Middle Bronze Age fields laid out in Trench 9 were used. However, the radiocarbon dates from the ditches were obtained from both charred cereal grain (barley) and animal bone (cattle skull) reflecting the mixed nature of the farming economy; bones of sheep/goat were also recovered. This is consistent with findings from the wider Lower Thames area as a whole, as well as further up the Lea Valley. The importance of animal husbandry is suggested, for example, by the incorporation of a droveway within the field system at Innova Park, Enfield, flanked by enclosures and running down towards the stream channel (Ritchie *et al.* 2008, fig. 4). The wetlands of the valley floor would have been a valuable resource for a mixed arable/pastoral economy, particularly during the summer months when it would have had the added advantage of keeping grazing animals away from crops cultivated on the drier land flanking the valley (Carew *et al.* 2009, 19).

The apparently deliberate deposition of cultural materials (pottery and cattle skull) within the ditches close to their terminals suggests that these features had more than simply functional significance. A similar feature was noted in an excavation at Ruston Street, Old Ford, where, along with finds of Middle–Late Bronze Age pottery, and worked and burnt flint, one ditch contained a complete (but broken), deliberately placed Deverel-Rimbury tub-shaped vessel (Taylor-Wilson 2000).

Despite the potentially extensive nature of the field systems, the direct evidence for Middle Bronze Age settlements is sparse, with relatively low levels of diagnostic finds, and features thinly dispersed across the site, and only fragmentary evidence of settlement structures. While only individual round-houses of either Middle or Late Bronze Age date were identified at any one location, the proximity (*c.* 140 m, Fig. 3.3) of that in Trench 24 to the field system in Trench 9 suggests that the settlement pattern may have comprised either single or very small groups of round-houses dispersed across the agricultural landscape, a pattern which has parallels in the Heathrow landscape west of London (Framework Archaeology 2010).

Significant parts of the valley would have remained as wetland. Although evidence for the exploitation of such areas within the Park was rare – a number of worked timbers of possible Middle Bronze Age date in Trench 30 – there is widespread evidence for the intensive exploitation of wetlands, continuing from the Neolithic and Early Bronze Age, in the London area, including along the north side of the Thames and its tributaries, in the form of trackways built of timber piles, planks and brushwood, and other structures (Meddens 1996). These include trackways at a number of sites in Beckton (eg, Carew *et al.* 2009), and on the A13 at Woolwich Manor Way and Movers Lane (Stafford in press), as well as at Fort Street, Silvertown (Crockett *et al.* 2002).

Such trackways can be viewed as primarily functional structures, facilitating both the movement between dry areas in an otherwise wetland environment, as well as the exploitation of the marshland itself, for hunting, fishing and fowling, and the collection of marshland's plant resources such as for food, basketry, thatch etc. However, in the same way that the establishment of field systems is likely to have reflected issues of land tenure as well as agricultural concerns, so may the construction of trackways and other waterside structures have been the visible assertion of territorial rights to wetland areas. There may also have been other less 'practical' aspects to the uses of such structures, relating to ritual and religious beliefs.

North of the Olympic Park, the Bronze Age timber structure at Innova Park, Enfield (Ritchie *et al.* 2008) appears to have been relatively long-lived, originating in the Early Bronze Age but being added to and/or repaired over time, and with the latest radiocarbon date, of 1380–1050 cal BC (NZA-20906, 3145±35 BP) spanning the start of the Late Bronze Age. It comprised (in part) lines of closely spaced stakes along the eastern side of a length of north-south stream, running west of and parallel to the River Lea channel, and was interpreted by the excavator as a possible channel revetment. However, its localised nature and its association with midden deposits from which items of decorative metalwork were recovered, may indicate a more complex, and less practical function, relating to its waterside location.

A timber 'platform' was recorded on the edge of a stream channel at Atlas Wharf, Tower Hamlets (MoLAS 2000, 23, 99 – TH5). A number of timber pile structures were recorded during the construction of the Banbury, Maynard, Warwick and William Girling reservoirs in the 19th and 20th centuries; the recovery of Bronze Age finds from these sites, including the base of a bronze cauldron from among the piles at Maynard Reservoir, led to the interpretation of these structures as wetland dwellings, or 'crannogs', although they are not securely dated (Iron Age and Romano-British finds were also recovered) (Hatley 1933). However, the nature of some of the finds from the reservoirs, and others recovered during the dredging of the River Lea for navigation purposes, point to one of the dominant aspects of late prehistoric activity along the Thames and its tributaries – the apparently deliberate deposition of metalwork (Needham and Burgess 1980, fig. 4; Bradley 1990, 108; Yates 2007, 30–1) (possibly a continuation of practices seen with the deposition of flint and stone axes in the Neolithic). Finds from the River Lea included items of high status metalwork such as rapiers, axes, spearheads, swords and a Bronze shield, with finds from close to the Olympic Park including a hoard of socketed axes, spearheads, ingot fragments and other items found at Devons Road, Tower Hamlets in 1901 (MoLAS 2000, 99 – TH4), a tanged spearhead from below Bow Bridge (*ibid.*, 98 – NH3), and a socketed axe at Stratford (*ibid.*, 98 – NH1).

While much of the Late Bronze Age metalwork from the River Lea is of high status, perhaps indicating that it was an important communication route between two politically dominant regions – the Thames Valley and the East Anglian Fens (Yates 2007, 31) – this is not matched in the settlement evidence from along its banks, including within the Olympic Park. Nonetheless, the clusters of pits in Trench 9, and the evidence from the plant remains of cultivation of areas with both dry and wet soils, suggest the increasingly intensive exploitation of the landscape for settlement, agriculture, and other economic activity.

It is possible that high status settlements, such as at Runnymede Bridge on the Thames west of London (Needham 1991), and substantial enclosures such as at Queen Mary's Hospital, Carshalton, south of the Thames (Adkins and Needham 1985), and

Marks Warren Farm, Chadwell Heath (Greenwood *et al.* 2006, 38), have their parallels along the lower Lea Valley, but any such sites have yet to be discovered. Nonetheless, a smaller circular enclosure surrounding a single large round-house, at Oliver Close, Leyton (Bishop 2006) just north of the Olympic Park, is an example of a type of site seen more widely in the region, such as at South Hornchurch, Essex (Guttmann and Last 2000), or slightly larger (and further east) at Mucking (Bond 1988).

There appears to have been a hiatus in occupation of the Olympic Park in the Early Iron Age, a phenomenon also noted west of London. There is a comparable dearth of evidence for Early Iron Age settlement activity more widely in the area (Wait and Cotton 2000), such as in the Heathrow area (Framework Archaeology 2010; Powell *et al.* forthcoming), while the area of Bronze Age settlement at Innova Park was not reoccupied until the Late Iron Age (Ritchie *et al.* 2008, 21).

Within the Olympic Park, however, the location of Bronze Age activity in Trench 9 had been re-occupied by the Middle Iron Age, first by a small open settlement of a type typical of the period (Wait and Cotton 2000). This lasted long enough for a number of its round-houses to be rebuilt but was eventually replaced, perhaps due to increasingly wet ground conditions, by a small square enclosure. It is possible that this was constructed for holding livestock rather than for human settlement, although a similar enclosure at Hunt's Hill Farm, Upminster appears to have held up to two contemporary round-houses (Howell *et al.* 2011, fig. 3.5).

Despite the Early Iron Age hiatus, the Middle Iron Age evidence can be seen as in many respects equivalent to that in the Middle and Late Bronze Age, but with an increasingly developed hierarchy of settlement. There were no finds from the Olympic Park to indicate that the Trench 9 site was a high status settlement. It appears that this valley floor farmstead remained at a distance, physically and socially, from the centres of status and power, such as the small (*c.* 4 ha) Early/Middle Iron Age enclosure at Loughton Camp in Epping Forest (Cowper 1876), and another to the north at Ambresbury Banks (Pitt Rivers 1881; Cotton 1975). South of the Thames there was a small defended enclosure at Charlton (Elliston Erwood 1916). The role of such sites, however, would eventually have been supplanted by the larger, proto-urban centres such as the major Iron Age riverside fort that has been identified at Woolwich Power Station (Philp 2010), and the unparalleled, 24 ha fortified settlement at Uphall Camp, Ilford (Greenwood 1989; 2001), similar to an *oppidum*. The latter site, built in the 2nd century BC on a well-drained gravel knoll at the confluence of River Roding and a stream (Loxford Water), contained numerous round-houses, four-post structures and penannular livestock enclosures.

Conclusion

Whatever the pattern of settlement and land-use that existed along the lower Lea Valley in the Early Bronze Age, the archaeological visibility of the Middle Bronze Age activity appears to indicate a major change in the relationship between local communities and their landscape. The division and enclosure of significant parts the landscape, represented by the field system, marks a break with the past, and introduced notions of visible land tenure. While perhaps not a long-lived feature of the landscape, the field system nonetheless transformed it from an open and, to a large extent (at least along the valley floor) still untamed landscape, into one under social control, systematically exploited as an agricultural resource into and through the Iron Age. The presence in Trench 9 of burials of different dates – Late Bronze Age cremation burials, at least one inhumation burial pre-dating the Middle Iron Age enclosure, and one of Late Iron Age/early Romano-British date – suggests that this place in the landscape may have been viewed an historical location for burials, in addition to its long-term economic and settlement function, even after it may have become too wet for habitation.

While the range of settlement and farming activity represented at Trench 9, by field and enclosure ditches, pits and post-holes, round-house gullies, and cremation and inhumation burials, appears to indicate only the intermittent occupation of this site, the fact that it was repeatedly returned to, and reused in a variety of ways, between the Middle Bronze Age and the Late Iron Age, points to the long-term attractiveness for such riverside locations for settled farming communities. The topography, at least at the start of this period, would still have been sufficiently varied – between the river channels, the slightly higher sand and gravel islands between them, and the gravel terraces along the valley sides – to mark out such areas as best suited to permanent habitation.

The Middle Bronze Age field system appears not to have been maintained into the Late Bronze Age, but the settlement evidence, particularly from Trench 9, indicates the continuation of unenclosed settlement of relatively low status, with evidence of mixed agricultural and craft activities. Moreover, the undiagnostic character of much of the later prehistoric pottery, and the presence of a large number of undated features, raise the possibility of a more continuous occupation of the Trench 9 site (and the surrounding areas of similar topography) from the Late Bronze Age to the Middle Iron Age. However, although Early Iron Age dates were obtained from both charred cereal and horse bone in Trench 35, the overall spread of radiocarbon dates suggests that there may have a significant hiatus in the settlement pattern during the Early Iron Age within the Olympic Park site, as seen elsewhere in the region.

The concentration of Middle Iron Age features in Trench 9, including more than one phase of round-house construction, gives the impression of settlement stability. Given that the resources of the valley floor would have been readily accessible also from the permanently dry valley sides just a short distance to the east, it may that this site on the valley floor was chosen because, at least initially, it was habitable throughout the year. However, within this increasingly volatile wetland landscape, the settlement may have ranged from year-round to seasonal, the latter possibly reflecting an element of transhumance to the agricultural economy, although this could not be established. It is clear that the site was becoming increasingly prone to flooding during the period of occupation, and it may in fact have witnessed the relatively rapid transformation from open riverside settlement, through at least two main phases of enclosure of primarily, perhaps solely, agricultural function, to eventual abandonment by the Late Iron Age, and the start of the Romano-British period.

Chapter 4

The Development of London's Hinterland: the Romano-British, Saxon and Medieval Periods

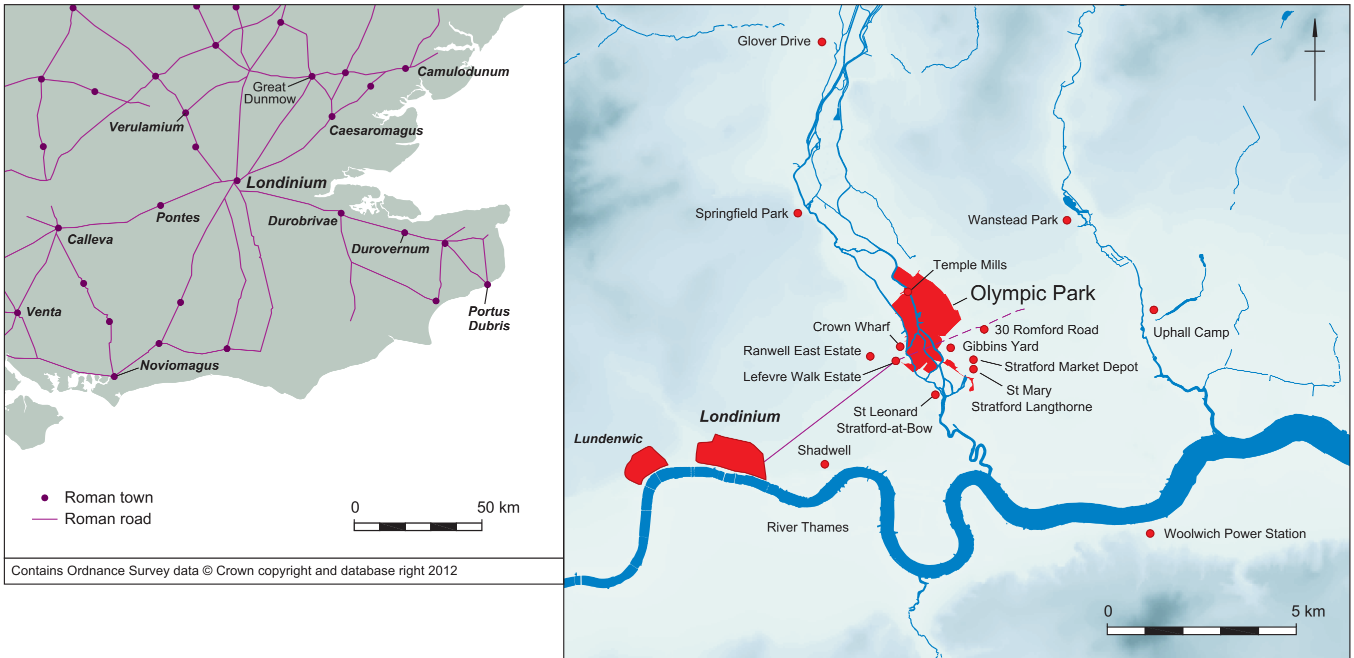


Figure 4.1: Roman road network, selected Romano-British, Saxon and medieval sites mentioned in the text

Introduction

From the establishment of the Roman settlement at *Londinium* in *c.* AD 50, which had become the province's capital by the end of the 1st century, the identity, character and status of the lower Lea Valley was inevitably affected (although to varying degrees over time) by both its proximity to London and its position on the route between *Londinium* and the original capital at *Camulodunum* (Colchester) (Fig. 4.1). This chapter considers the evidence from the Olympic Park for how the lower Lea Valley developed as part of London's hinterland during the Romano-British, Saxon, medieval and post-medieval periods.

However, despite the fact that the site is known to have been crossed by an important Roman road, to have had numerous Saxon and medieval mills, and to have fallen within the lands of major medieval religious houses, the investigations across the site produced very little archaeological evidence for activity in these periods (Fig. 4.2).

This was a period over the course of which the physical shape of the valley changed. Natural forces, such as a rise in the basal water level and reduced river gradient and flow rates (due to estuarine expansion in the Lower Thames), combined with the results of human activity, such as more extensive cultivation within the river's catchment, caused increasing alluvial deposition on the valley floor, blanketing the prehistoric topography. It was also a period during which the river was not just exploited, but for the first time actively managed. Its channels were modified to facilitate navigation, to control flooding, and to better power the mills processing the products of agriculture, grinding corn and fulling cloth.

Yet even while these changes were taking place, the land itself, largely unsuited to settlement, retained a consistency of character and use – as marginal agricultural land, too wet for cultivation but offering, at least for part of the year, potentially rich grazing land. What industry did develop within the valley was localised and closely associated with the mills, well in advance of the period of rapid industrial encroachment that took place from the middle of the 19th century (Chapter 5).

Romano-British

While *Londinium* itself appears not to have been established on the site a major pre-Conquest settlement and centre of power, in the manner of many other important Roman towns, the presence within the wider area of large riverside settlements and possible *oppida*, at Woolwich Power Station and Uphall Camp, suggests that the Lea Valley was no isolated backwater at the start of the Roman period but is likely to have been part of a landscape subject to competition for control between powerful local and regional groups.

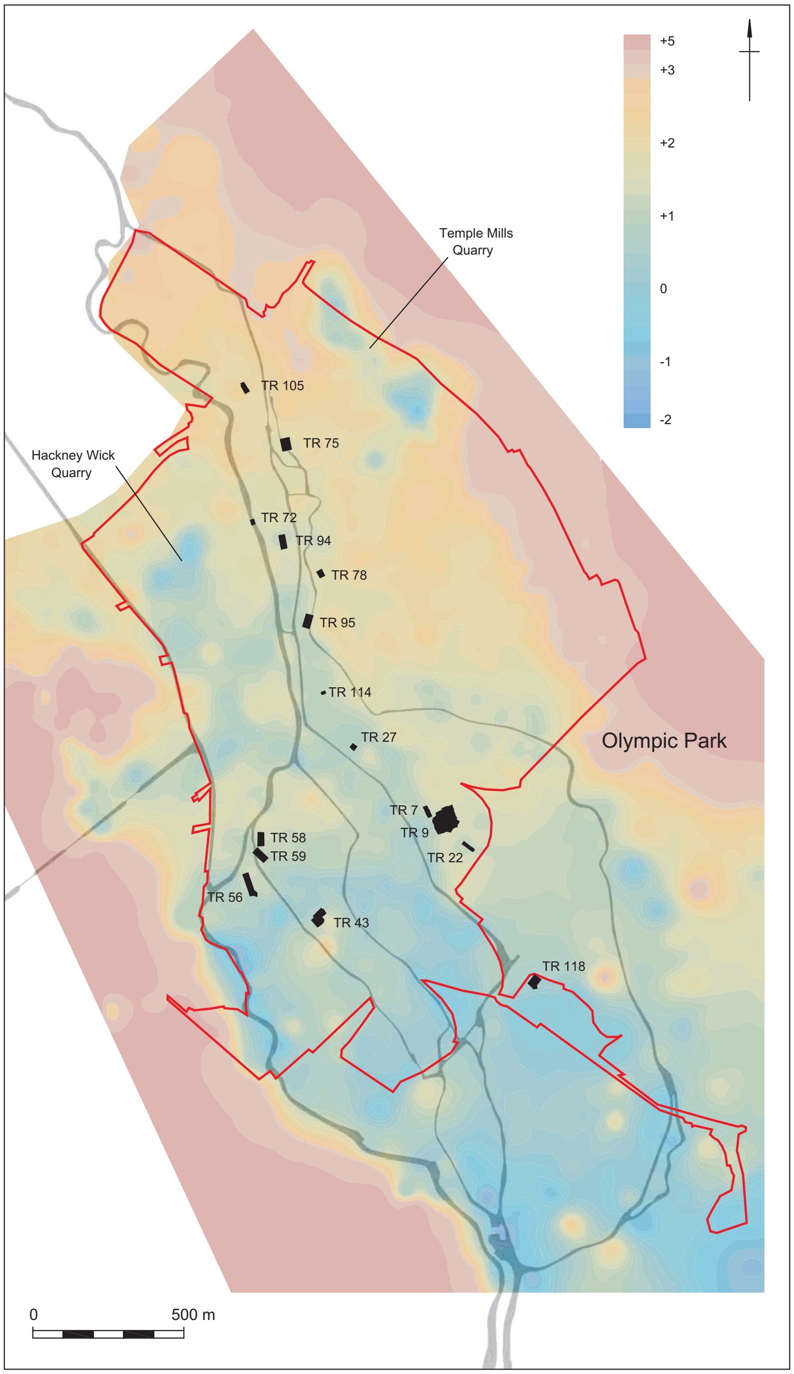


Figure 4.2: Locations of trenches with Romano-British, Saxon and medieval evidence, in relation to prehistoric topography and post-medieval river channels

Following the Roman Conquest in AD 43, the valley would have witnessed significant changes resulting from the imposition of Roman rule, and the social and economic changes resulting from it. Among the most visible of these, perhaps, would have been the construction of the Roman road running from the early military base and capital, and later *colonia* at *Camulodunum* (Colchester), which crossed the valley within the Olympic Park as it approached *Londinium* just 5 km to the south-west (Figs 4.1, 4.3).

The establishment, within a decade of the Conquest, of this new trading settlement around a crossing over the River Thames, would have been a major influence not only on agricultural production within the town's immediate hinterland, but also on the use of the River Lea as a communication route to and from the Thames estuary. It is possible that the River Lea marked the eastern extent of *Londinium*'s *territorium*, the area of land outside the city but controlled by it, as opposed to the agricultural hinterland beyond, where the wider settlement pattern appears to have been characterised largely by local farmsteads (Perring 1991; MoLAS 2000).

It might be expected, therefore, that the excavations within the Olympic Park site would reveal some evidence for these changes, perhaps in the form of new types of buildings and roads, new forms of agricultural and industrial activity, and new patterns of trade and commerce. In fact, what was noticeable about the very limited evidence found for this period (Fig. 4.2) was its continuity with that uncovered at the end of the prehistoric period, revealing that the valley floor, at least, appears to have continued as marginal agricultural land through the Romano-British period (and beyond).

The evidence in the late prehistoric period for increasing alluvial deposition as a result of overbank flooding suggests that by the start of the Romano-British period the gravel topography revealed by the deposit model would have had an ever-decreasing influence on the hydrology of the valley (Fig. 4.2). Fine sediments deposited in the channels and across the floodplain, combined with elevated water levels and the tidal influence at the southern end of the river, would have allowed the river channels to cut new and shifting courses across the valley floor. It remains unclear to what extent these courses are reflected in those of the later historic channels. Studies at Crown Wharf Ironworks (Stephenson 2008), Omega Works (Spurr 2006) and Stratford Box (Barnett *et al.* 2011) immediately adjacent to the Olympic Park all show truncation of the underlying sediments by those of Romano-British date, implying that this sedimentation and channel movement was happening across much of the floodplain.

Although there are suggestions that the tidal head migrated downstream during the Romano-British period (Milne *et al.* 1983), so reducing the impact of tidal flooding, the overall character of the valley, comprising marsh and open wet grassland, may have changed little from the Late Iron Age, with settlement pushed back from low-lying stream- and river-side locations. It is probably for this reason that the evidence for valley floor activity in the Romano-British period is so limited, with much of the artefactual evidence, comprising either isolated or redeposited finds, being quite widely and thinly distributed across the Olympic Park site. It is likely that settlement, communication and economic activity was closely focused at specific locations along the valley edge, particularly at points where roads crossed the valley.

The Roman Road

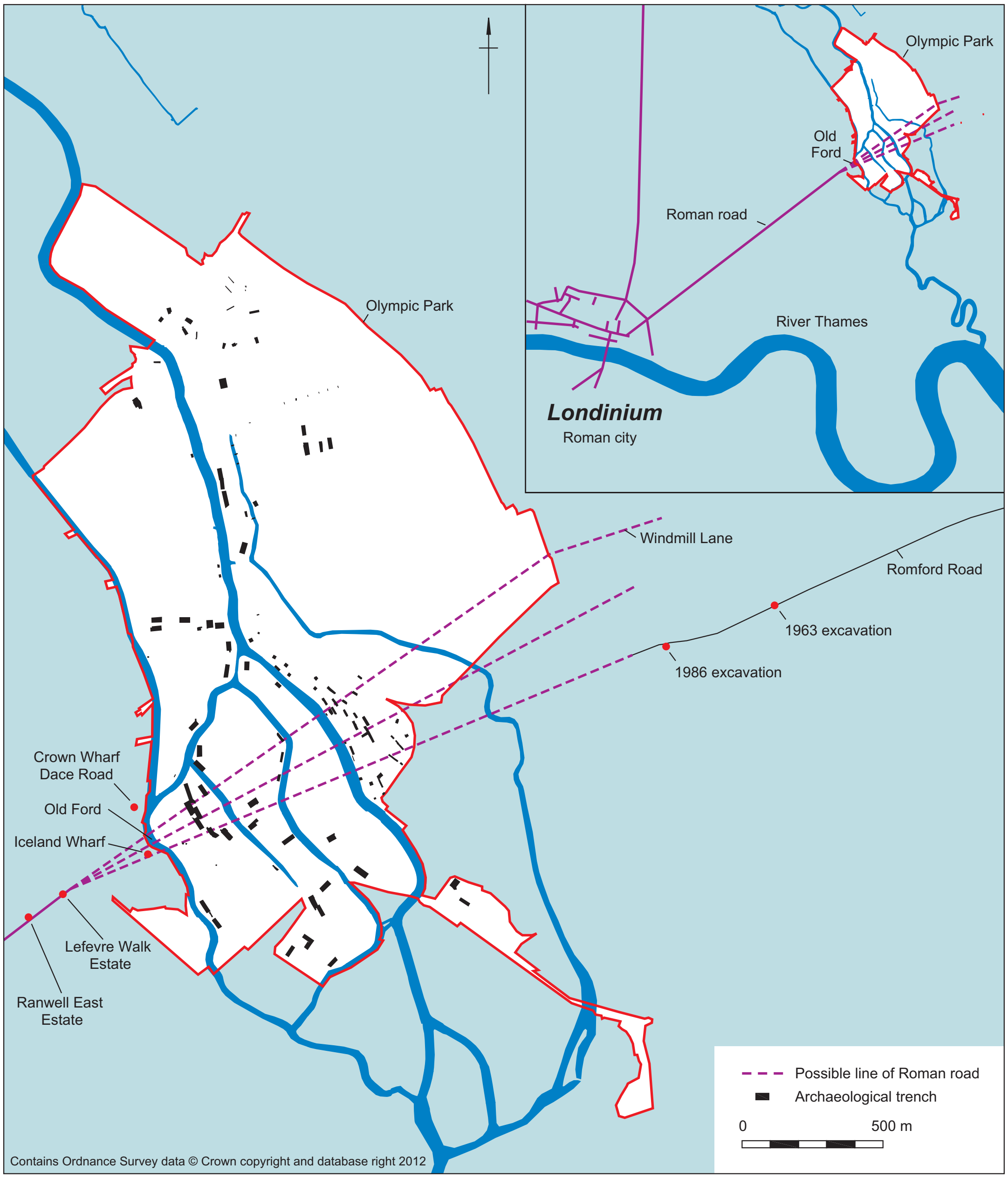
Unlike other Roman towns in the south and south-east, such as *Caesaromagus* (Chelmsford), *Durovernum* (Canterbury), *Venta Belgarum* (Winchester), *Calleva Atrebatum* (Silchester), *Verulamium* (St Albans) and *Noviomagus Regnorum* (Chichester), *Londinium* was not an Iron Age tribal capital, and therefore not linked into significant pre-Roman land routes of communication. However, the strategic location of the new settlement meant that by the 2nd century AD *Londinium* had not only developed as a major city and port, but also, in the years following the Boudiccan uprising, had replaced *Camulodunum* as the capital of the Roman province, and lay at the centre of a network of roads radiating out from it (Fig. 4.3).

The projected lines

The road to *Camulodunum*, recorded in the *Antonine Itinerary* as both *Iter V* and *Iter XI*, passed through Aldgate at *Londinium*'s north-east corner, and would have crossed the River Lea, within the Olympic Park, near Old Ford. The evidence for its course has recently been reviewed by Gary Brown (Brown 2008). An early projection of the road's line across the valley, based on suggestions by Margary (1955, 215; Environmental Statement fig. 13.8), has recently been revised slightly northwards by a number of excavations on the gravel ridge on the west side of the valley at Old Ford (Fig. 4.3).

These include the excavation at Lefevre Walk Estate which revealed a 65 m length of the Roman road (Brown 2008). Here, the road zone was 25.5 m wide and marked by relatively shallow and narrow ditches with banks on their outer edges, and with quarry pits on either side. The line of the *agger* was defined by a broad scoop cut through the brickearth down to the natural

Figure 4.3: Possible lines of the Roman road in relation to the archaeological trenches, and associated sites, with inset showing road network north-east of Londinium



gravels, filled with a domed ridge of redeposited brickearth *c.* 0.5 m thick and up to 11.2 m wide. The central carriageway, *c.* 5 m wide, was capped with a metalled surface of rammed gravel, on either side of which, at a lower level, there were subsidiary metalled trackways, probably for pedestrians and livestock. The road was probably built *c.* AD 50 but does not appear to have been maintained after *c.* AD 400.

There is considerable uncertainty, however, about the line of the road on the east side of the valley. The straight line of the High Road, Ilford, appears to mark its line further east, but there is uncertainty as to its course closer to the valley. One generally held view is that it underlies Romford Road which follows a slightly irregular line between Ilford and Stratford, where it joins the road from the later river crossing at Bow. Observations in 1963 in a utility trench across Romford Road revealed two metalled surfaces under 5 m wide separated by layers of dirty gravels; although interpreted as a Roman road it was relatively narrow and not securely dated

(Marshall 1964). In 1986, a wider road (*c.* 30 m wide), comprising successive layer of sand and gravel, was exposed further to the west on Romford Road, but here too the dating evidence was limited to two pieces of possible Roman tile (Redknap 1987). Other small excavations have also revealed deposits claimed to be associated with the Roman road, but the evidence is far from conclusive (Brown 2008).

A possible alternative line is suggested by the cartographic evidence, although with no archaeological evidence to support it. If the straight course of the Roman road followed by Ilford High Road is continued west, its line is picked up at Forest Gate (after a short break at Manor Park) by Forest Lane and (west of Maryland Point) by Windmill Lane. This alignment is particularly clear on maps pre-dating the construction of the Eastern Counties Railway (which followed a similar line), such as the 1777 Chapman & Andre map where the road ends at a Hop Ground; the 1800 Thomas Milne map where its ends on the edge of the valley terrace (Fig. 5.3); and the 1801 Mudge map. While there are dangers in relying solely on such cartographic alignments, is it noteworthy that the line of the Roman road excavated at Lefevre Walk, on the west side of the valley, if projected north-east across the valley, is closely aligned on the western end of Windmill Lane.

The Olympic Park trenches

Even with the excavation at Lefevre Walk Estate appearing to fix the position of the Roman road on the west side of the river, its course and orientation over the valley and its position on the east side remained unclear at the start of the Olympic Park investigations. In order to increase the chances of exposing any surviving remains of the road within the Park, evaluation trenches towards both sides of the valley were laid out in dense and overlapping arrangements across the full width of its various projected lines (Fig. 4.3). Despite this, however, no traces of the road, or of any features likely to be associated with it, such as roadside ditches, were identified.

Discussion

While it is possible that the road passed between the trenches (whose extents as shown on Figure 4.3 are the tops of the trenches, not the often much smaller areas exposed at their bases), it is also possible that it was truncated by later activity. The severe flooding to which the valley was often subject, and which led eventually to the construction of a substantial medieval causeway at Stratford, plus the repeated scouring of the river channels, and their widening, straightening, revetting and other modifications, as well as groundworks in advance of modern infrastructure and industrial developments, are all likely to have impacted heavily on any remains of the road and its channel crossings.

The task of identifying the road is also hampered by uncertainty about what form(s) it would have taken as it passed across the valley – ie, over the river channels and the areas of wet floodplain between them. As indicated above, much of the gravel topography of the valley is likely to have been masked by alluvium by the Romano-British period, and the courses of the channels at this time are not clearly understood, although it is possible that some of the higher 'islands' revealed by the deposit model were still visible, and noticeably drier features within the floodplain. Nonetheless, the generally wet, marshy grassland that was the predominant vegetation on the valley floor, as indicated by the environmental and geoarchaeological evidence, would have represented conditions ill-suited to the potentially heavy military traffic such an important road was initially designed to carry.

While the name of *Old Ford* indicates a ford at this point, it is an English name referring therefore to a post-Roman river crossing, although that does not preclude a ford also in the Romano-British period. Some form of causeway, albeit of unknown date, is known to have existed across the Lea at Old Ford, which was still sufficiently substantial in the post-medieval period to cause problems for barges navigating the river (Fairclough 1986). It is possible, therefore, that the valley was crossed via a series of fords between the intervening islands, possibly enhanced by laying gravel on the river bed. Lengths of raised causeway may also have been constructed across the ground between the channels, in addition to the construction of the road's *agger*. Alternatively, it is possible that some channels were bridged, with areas of wetland spanned by raised timber walkways.

Approximately 100 m north of the projected crossing at Old Ford, an arrangement of substantial timbers, suggested to include a possible bridge *c.* 7 m wide, was exposed at Crown Wharf Ironworks, Dace Road, associated with Romano-British pottery and broadly dated by radiocarbon dating to the early-middle Romano-British period (Stephenson 2008). The structure, aligned NNE-SSW, comprised rows of almost 40 timber piles; two very large vertical posts resting on substantial plank base plates appear to be later than the piles, although associated with them in some way. However, unless the London–Colchester road diverted significantly from its line, this structure is too far north to be associated with it, although it could potentially relate to the road between *Londinium* and the Roman small town at Great Dunmow (*ibid.*, 54, Fig. 4.1).

In 1722, the writer Daniel Defoe referred to the discovery some time after 1607 of 'a great stone causeway' in the bottom of Hackney marshes. This crossed the Lea Valley from some point between Old Ford and Hackney Wick, and passed Temple Mills to near Ruckholt Manor (Defoe 1722). If this was the Great Dunmow road, it could have joined the Colchester road just west of the River Lea (*ibid.*, 57). The later trackway across the south end of Hackney Marsh at Temple Mills, shown for example on Rocque's 1746 map (below, Fig. 5.2), may therefore indicate a route of considerable antiquity.

Nonetheless, the presence at Crown Wharf of such a substantial Roman timber structure, whether a road bridge or, alternatively, some form of wharf for the unloading of produce transported by river, indicates the potential for the Colchester road to have been carried across at least some of the river channels on timber bridges.

It is also possible that there was no fixed line for the Colchester road across the valley. While the lengths of road on either side of the valley may have been surveyed in as straight lines, one possibly aligned on the other, the actual course of the road between them may have negotiated an irregular route, 'hopping' between areas of higher, drier ground, perhaps changing over time as ground conditions improved or deteriorated.

Romano-British Land-Use

In the face of the negative evidence for the Roman road, the other evidence for Romano-British activity comprises a number of largely isolated lengths of ditch which hint at the continued marginal agricultural exploitation of the valley floor, and timber structures pointing to the continued economic use of the river channels. However, it is likely that the presence of the road had some influence on the disposition of settlement and agricultural activity in the adjacent landscape and it may be significant, therefore, that that most of the trenches in which Romano-British features were recorded lie within the area through which the Roman road is assumed to pass (ie, Trenches 9, 56, 58, 59) (Fig. 4.2).

Trench 9

The arrangement of the Middle Iron Age enclosure and other ditches in Trench 9 (see Chapter 3), on the eastern side of the valley, was crossed by a single Romano-British ditch (1212), between 2.2 m and 3.3 m wide and up to 0.9 m deep, whose irregular course follows the presumably still visible lines of some of the earlier ditches (Fig. 4.4). From the south-east corner of the site, it ran WSW, lying parallel to and on the north

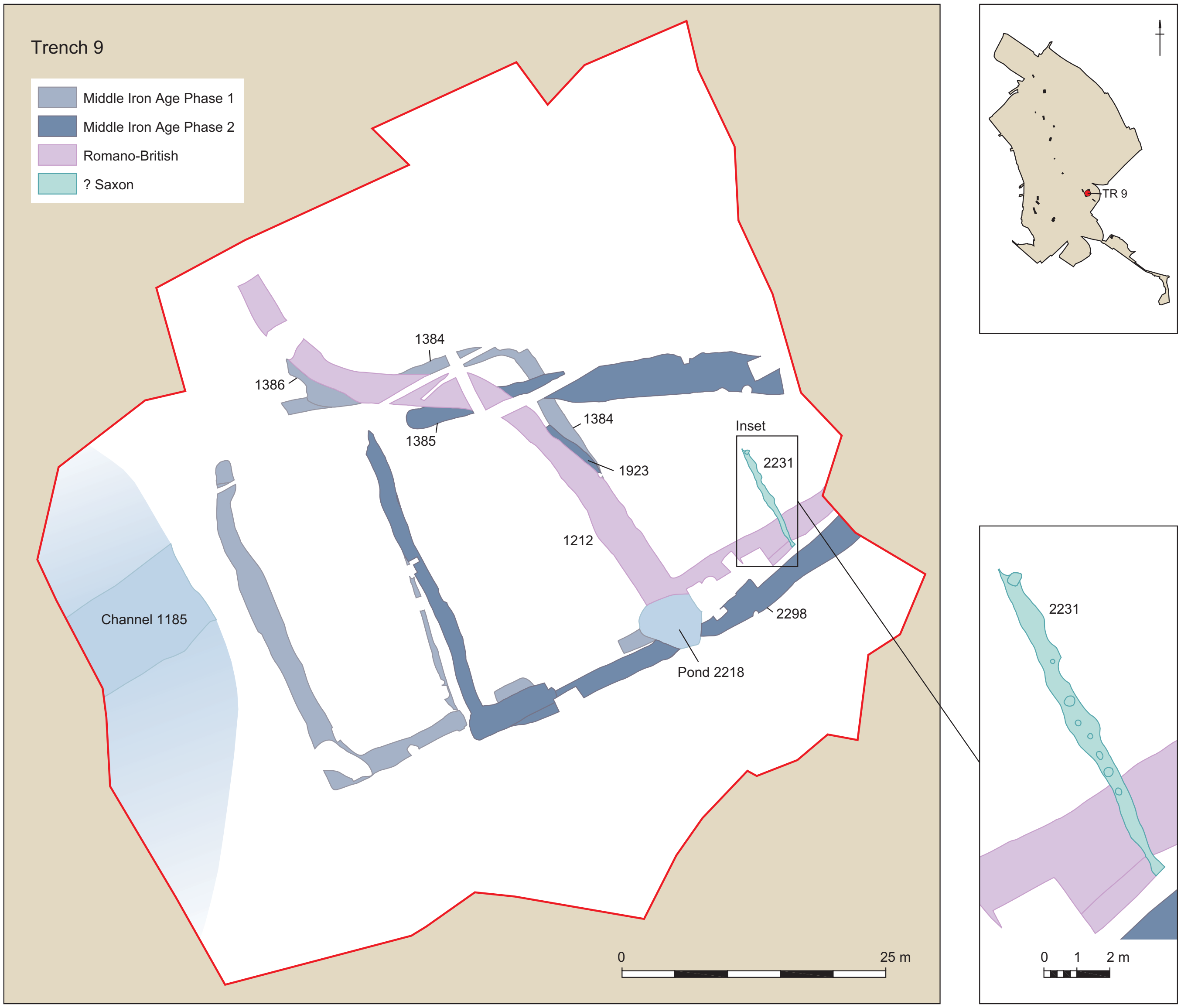


Figure 4.4:
Trench 9: Romano-British phase in relation to the Iron Age enclosures, and possible Saxon ditch

side of Middle Iron Age Phase 2 ditch 2298, and separated from it by a gap of *c.* 1 m. After *c.* 16 m, it turned to the NNW along the line of the Middle Iron Age Phase 1 enclosure's eastern side, truncating both Phase 1 ditch 1384, and Phase 2 ditch 1923; at the turn its fills were partly cut by the undated hollow or pond (2218). It then curved westwards away from the lines of the earlier ditches, cutting across the north-east corner of the Phase 1 enclosure and the end of Phase 2 ditch 1385, before again curving NNW, possibly parallel to a stream channel to the west, and appearing to follow the line of possible Phase 1 ditch 1386.

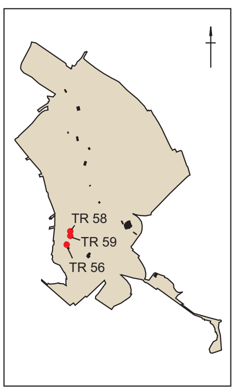
The ditch's fills produced six sherds of Romano-British pottery, one of them from a primary fill. Other finds included residual Late Bronze Age and Middle Iron Age pottery, as well as worked and burnt flint and animal bone, these too probably largely residual. One other Romano-British sherd, no later in date than AD 200, was found on the site, recovered from a layer of silty clay (1164) that extended over the south-western edge of ditch 1212 and sealed its fills over *c.* 50 m of its length. A fragment of shale bracelet of probable Romano-British date came from a secondary ditch fill (Pl. 4.1, Fig. 7.6, below).

Plate 4.1:
Shale bracelet fragment
from Trench 9

Plate 4.2: Romano-British timber structure 42 in Trench 58

Trenches 56, 58 and 59

Evidence for Romano-British activity was also found at three adjacent trenches towards the western side of the valley (Fig. 4.5). These lay within *c.* 200 m of the likely line of the Roman road (Fig. 4.2), on the east side of what would become the main channel of the River Lea. Trenches 58 and 59 lay to the east, and Trench 56 to the west, of what would later be Pudding Mill River close to where it branched off the Lea.



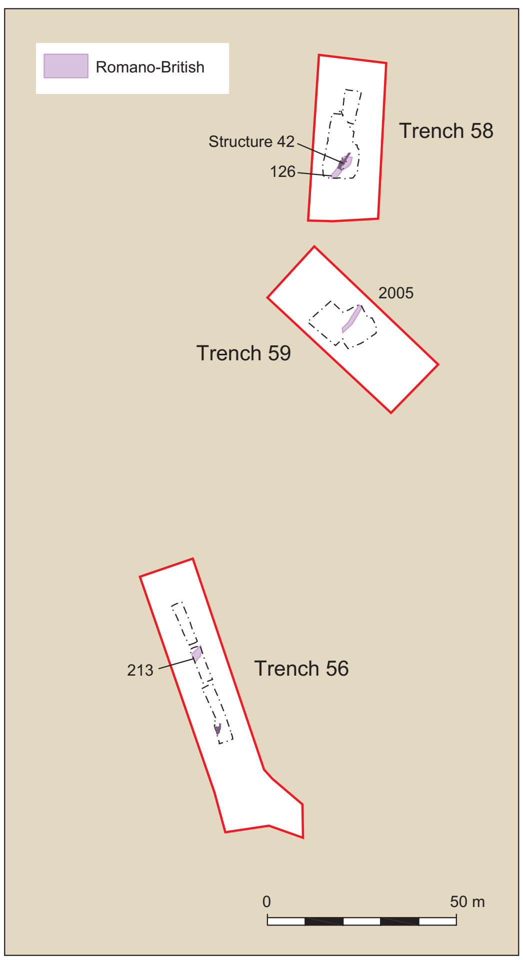
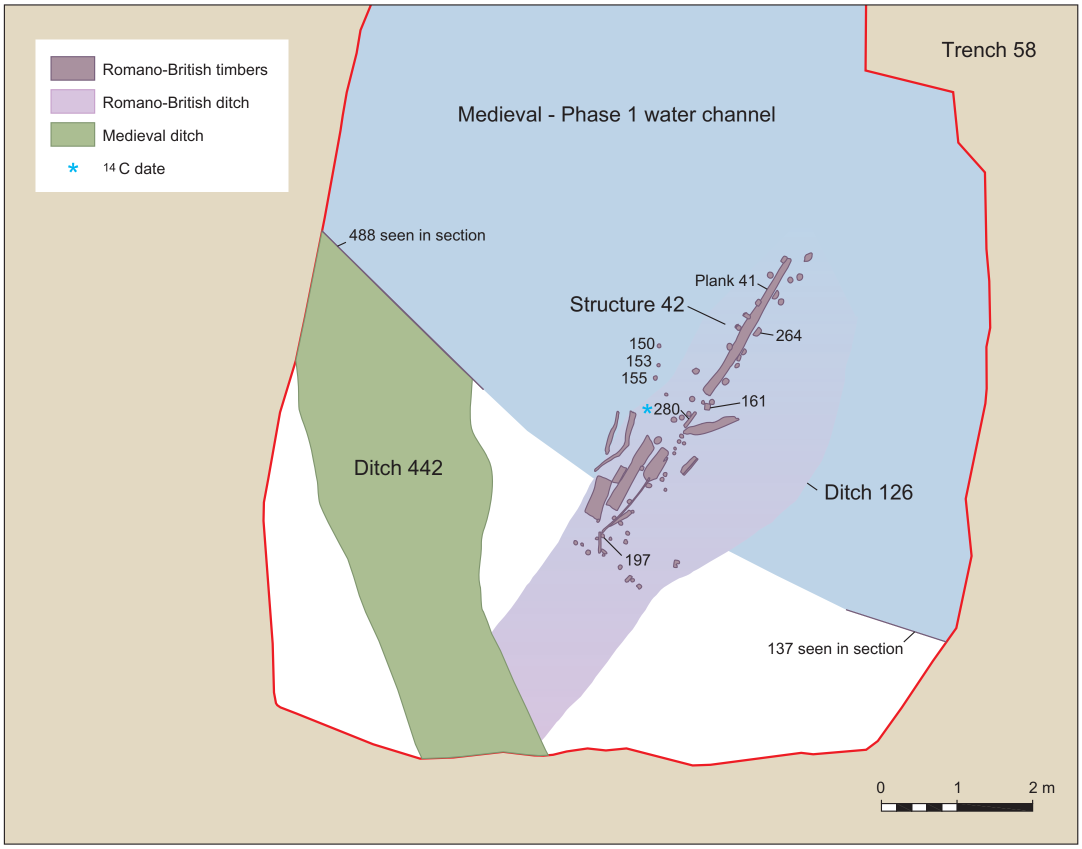


Figure 4.5:
Romano-British features
in Trenches 56, 58 and 59

Trench 58

The evaluation of the most northerly of these trenches (Trench 58) revealed a number of timber structures associated with water channels and interpreted as revetments. What proved to be earliest of them was a short post-and-plank structure (42) (Fig. 4.6, Pl. 4.2), one of the planks from which (280) produced a radiocarbon date in the late Romano-British period of cal AD of 120–340 (SUERC-36581, 1795±35 BP).

It was recorded in a short north-east–south-west aligned ditch (126) in the southern end of the excavation, which cut a layer described as 'natural clay' (at *c.* 1.75–1.80 m OD). This clay is likely to have been one of series of alluvial deposits, together over 0.6 m thick, recorded in the base of the trench. One of these layers (141) contained small fragments of late Romano-British pottery, including *mortarium*, and flecks of daub. Ditch 126 was 1.4–2.3 m wide (although its widest part may have been



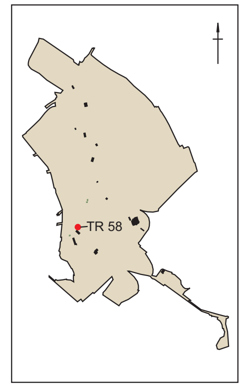


Figure 4.6: Trench 58: Romano-British ditch 126 and timber structure 42, and medieval ditch 442

overcut) and *c.* 0.3 m deep with irregular sides and a concave base. It was filled with a series of layers of natural silting interspersed with dumps of sand and gravel, which together contained nine sherds of predominantly late Romano-British pottery (including amphora sherds), fragments of *opus signinum*, Roman tile and brick (of the London sandy fabric group 2815 which were used between AD 50 and AD 160), and a copper alloy coin of Constantine dated to AD 330–335 (Pl. 4.3, see Cooke, Chapter 7).

Driven through these layers to varying depths and surviving to different heights, and extending 5 m along the ditch, were the 65 timber stakes of structure 42, located to either side of a number of horizontal oak planks set on edge (see Goodburn, Chapter 7). As well as oak posts, there were also examples of Pomoideae and silver/downy birch, and their variability in size and conversion suggest that the structure had been repaired and reinforced over time.

The majority of the timbers lay towards the north-western side of the ditch (Pl. 4.2). This has the appearance of a revetment, although its short length and position within what appears to have been only a small ditch, suggests it may have had some other more specific function. A number of loose timbers to the north-west of the stakes, most of them lying flat, had either become detached from the structure, or were off-cuts from its construction that had been dumped, with soil, behind it. At the south-west, the structure ended at a 1.1 m long line of eight stakes running across the ditch, beyond which no further timbers were recorded. Almost certainly associated with it were a further three stakes (150, 153 and 155) in a short (0.43 m) north-south line, on the western bank of ditch.

At its south-west end, the line of ditch 126 was crossed (at a higher level, *c.* 2.20 m OD) by another ditch (442) of possibly early medieval date, from which came nine redeposited sherds of Romano-British

Plate 4.3: Roman coin from Trench 58

pottery; further redeposited sherds were recovered from other later contexts. Structure 42 was truncated at its north-east end by a medieval/post-medieval channel 137/448 (see Chapter 5, Fig. 5.10), again cut from a higher level (*c.* 2.60 m OD).

Trench 59

A shallow ditch (2005), parallel to ditch 126 in Trench 58, was recorded *c.* 35 m to the south in Trench 59 (Fig. 4.5). It was 1.4 m wide and 0.3 m deep, cutting into a possible prehistoric land surface comprising a thin layer of alluvium (313) overlying soft tufaceous sand (314) (see Chapter 3, Table 3.6, and Fig. 5.15, below). Its silty clay primary fill (395) contained three sherds of Romano-British pottery, including one from a necked jar dated *c.* AD 70–200, along with animal bone, burnt flint and flecks of charcoal. The ditch was sealed by a layer of alluvium (312) which produced a radiocarbon date in the Early Saxon period of cal AD 420–610 (Beta-251401, 1540±40 BP). The recovery of abraded sherds of late prehistoric pottery from layer 312 probably results from the late or post-Romano-British reworking of the prehistoric layers from which pottery was also recovered.

Trench 56

A third Romano-British ditch (213), also aligned north-east–south-west, was recorded at the north end of Trench 56 (Figs 4.5 and 4.12). It was up to 1.7 m wide and 0.5 m deep, and cut a prehistoric land surface (215/217, Table 3.6 above) as well as clay (172) and sand (169) laid down by the subsequent river encroachment. It contained up to six naturally accumulated fills which produced three sherds of Romano-British pottery, two fragments of early Romano-British CBM, and a heavily abraded coin of AD 1st century date, along with horse bones, and a cattle horn core.

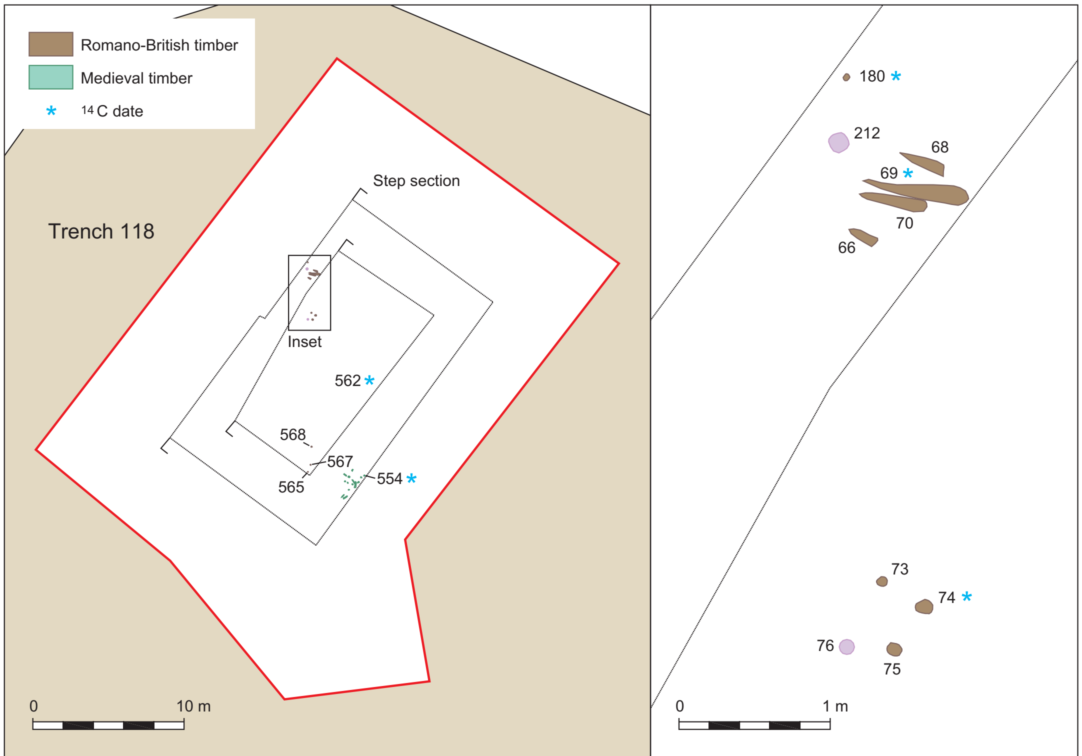
The ditch was sealed by further alluvium which was cut by a later channel (209) (see medieval below). Although a sample of organic sediment from the lowest recorded fill (143) within the channel produced a radiocarbon date in the middle to late Romano-British period of cal AD 120–350 (Beta-250527, 1790±40 BP), this may well derive from material redeposited within a medieval watercourse.

Trench 118

During the evaluation Late Iron Age–early Romano-British channel fills were identified within the south-east facing (Fig. 4.7) and north-east facing sections of the trench. They included active channel deposits (182) consisting of inter-bedded sands and silty clay loams, that truncated Middle–Late Bronze Age channel fill 183. Overlying these, and corresponding to layer 170 in the south-east facing section, were deposits more characteristic of a channel edge (210 and probably 208), which extended across much of the trench, but which were truncated in turn by a medieval/post-medieval channel (179) (Fig. 4.7). Radiocarbon dates upon material from layer 182 provided dates of 40 cal BC–cal AD 130 (SUERC-36577, 1945±35 BP) from just above the channel cut and cal AD 70–240 (SUERC-34944, 1865±35 BP) from an unspecified height within the layer. A date on waterlogged seeds from context 210 provided a similar date of cal AD 20–220 (SUERC-34954, 1900±35 BP).

A horse bone from 'Neolithic' context 55 (see Chapter 2) yielded a radiocarbon date of cal AD 250–420 (SUERC-34933, 1700±35 BP). This context, which extended over the base of the evaluation trench, was sampled in two sieving squares. It is likely, at least within the square in the south-west corner of the trench, that context 55 equates with context 182 and will therefore be of Romano-British date.

The subsequent extension of the trench to the south-west clearly revealed the western side of this channel (600), where it could be seen to cut through the thick Middle–Late Bronze Age silty loams (562). Because the contexts assigned to channel fills in the two



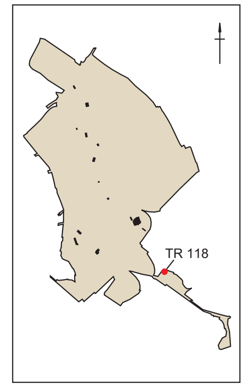
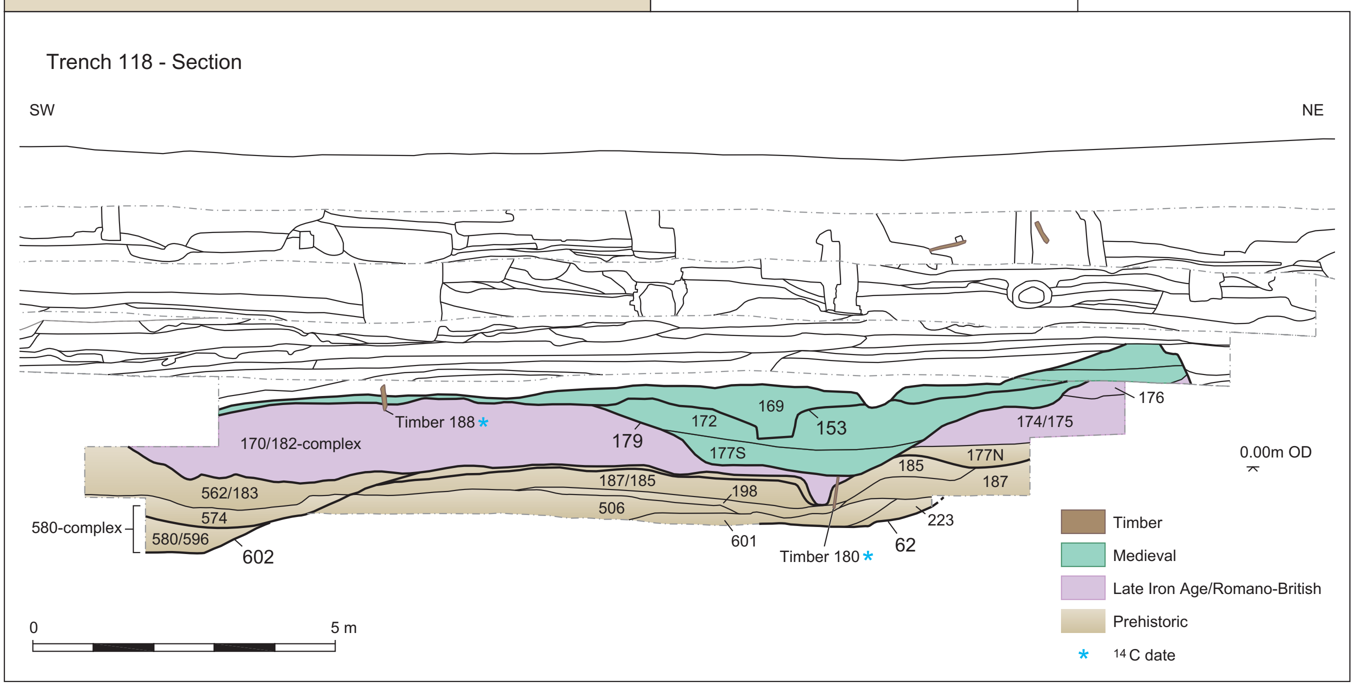


Figure 4.7: Trench 118: trench plan with detail of Romano-British timbers; and south-east facing section through Romano-British and medieval deposits



Context	Material	Lab. code	Determination BP	δ13C‰	Calibrated (95.4%) AD
Stake 180	Worked wood (alder)	SUERC-34960	1820±35	-30.4	80–330
Stake 69	Worked wood (alder)	SUERC-33687	1850±30	-28.4	80–240
Stake 74/504	Worked wood (alder)	SUERC-35345	1855±30	-29.5	80–240
Stake 565	Worked wood (willow/poplar)	SUERC-34959	1835±35	-28.5	80–260
Stake 567	Worked wood (alder)	SUERC-36225	1875±30	-29.8	60–230

Table 4.1: Radiocarbon dates from Romano-British timbers in Trench 118

Table 4.2: Identifications, dimensions and levels of Romano-British timbers in Trench 118

Context	Identification	Length (m)	Diam. (mm)	Top (m OD)	Base (m OD)
Timbers associated with SE-facing section					
Stake 180	Alder	0.62	55	-0.23	-0.85
Stake 66	Alder	0.20	60	-0.72	-0.75
Stake 68	Hazel cleft ½ log	0.47	95	-0.52	-0.64
Stake 69	Alder	0.78	140	-0.51	-0.84
Stake 70	Willow/poplar	0.76	95	-0.60	-0.88
Stake 71	No ident.	–	–	–	–
4-stake structure (76 was a stake-hole)					
Stake 73/503	Alder	0.71	90	-0.41	-1.12
Stake 74/504	Alder	0.56	80	-0.43	-0.99
Stake 75/505	Alder	0.55	70	-0.43	-0.98
Three stakes from SW of trench					
Stake 565	Willow/poplar	0.36	40	0.09	-0.27
Stake 567	Alder	0.50	60	0.06	-0.44
Stake 568	cf. alder	0.32	60	0.01	-0.31

phases of work equate only broadly they have been ascribed to another complex (complex 170/182). The lower fills in cut 600 (contexts 572 and 569) were largely comparable to context 182, and provided two identical radiocarbon dates of 170 cal BC–cal AD 50 (SUERC-36578, 2040±35 BP; SUERC-34939, 2040±35 BP), on alder 'cones' from context 572 and on a cattle bone from context 569, respectively. The uppermost context of the channel fill within the north-west facing section was dated to cal AD 1–220 (SUERC-36576, 1920±35 BP).

The lower fills of this channel (572, 569 and 182) were all also associated with redeposited tufa (570/191), as well as a tree stump and broken tree trunk. They were also much richer in finds than any of the earlier channel fills. Context 572 contained pottery dated broadly to 100 BC–AD 100, while context 564 in the south-east facing section (broadly equated to contexts 572 and 569) contained a sherd of Gaulish samian dated *c.* AD 120–250. Context 572 also produced over 50 animal bones/bone fragments, while context 569 had over 40 animal bones (see Chapter 7); these included cattle, horse, sheep/goat, dog and pig, as well as, of some interest, a single bone of mute swan. There were also charred cereal remains (in context 182) and domestic plum, cherry and potentially fig (in context 564).

Twelve stakes, mostly of alder (see Goodburn, Chapter 7), were recorded in the trench that were either radiocarbon dated to the early Romano-British period or were assigned to it by association (Fig. 4.7). The dates and depths of these stakes are shown in Tables 4.1 and 4.2. Timber 180 was still vertical within the trench's south-east facing section and was clearly truncated by the medieval/post-medieval channel cut 179. Close by a further three stakes (73/503, 74/504 and 75/505) were driven, *c.* 0.5-0.6 m apart, in a square arrangement, with a stake-hole (76) where the fourth had been removed (Pl. 4.4).

Four further timber stakes (66, 68, 69 and 70) were exposed in the basal step of the south-east facing section, less than 1 m from stake 180, and appeared to be have been laid horizontal (or near horizontal) in context 221/222 with their points to the west; another is represented by a stake-hole only (212). The clear use of a metal axe to shape their tips, and the radiocarbon dates from timbers 69, 74/504 and 180 (Table 4.1) indicate that these are all of early Romano-British date. They were probably all driven vertically into Late glacial to Early Holocene channel fills (with the horizontal timbers possibly flattened by the mechanical excavator during the creation of the stepped section).

Almost all of these stakes still had their bark attached and most were worked to rough points made by *c.* 4–6 simple axe cuts. Stake 180 was made from a straight branch or tree-crown from which the side branches had been lopped, but with the stubs left protruding. It was then driven in at least 0.5 m, with the protruding branches pointing down into what must have been very soft ground given the stake's narrow width and general condition.

Despite their having been cut and/or shifted by the machine it is unlikely that any of these stakes or any structure would have survived much above the base of the trench. The medieval/post-medieval channel (179, see Chapter 5) can be seen in section clearly to truncate timber 180, as it would the other posts at a similar level. As such it is unlikely that much more than 0.2 m has been lost of what might have otherwise survived. As such, one can only speculate as to their function, although they are likely to have been close to the channel's original northern edge.

Towards the south-west of the trench were a further three stakes (565, 567 and 568) in a 1.7 m long north–south line, the two dated examples of which gave similar dates, although they were at a significantly higher level (*c.* 0.4–0.5 m). Furthermore, these were driven through Late Iron Age–early Romano-British deposits, only just penetrating into the Middle Bronze Age deposits underneath.

The Romano-British channel appears have been up to *c.* 15 m wide and *c.* 2 m deep. Moreover, given the still relatively steep profile of the subsequent medieval channel (Fig. 4.7), the fact that the stakes appear to be driven up against the sandbar on its north-eastern bank suggests that this may have been the outer bank on a bend in the river, which entered the trench from the north-west and then turned to the south-west. This might indicate that the northern-most stakes formed part of a revetment of the outer bank of this bend. The square arrangement of stakes, however, must have been within the channel, possibly forming a small jetty, or some similar structure. Those within the south-west of the trench, (565, 567 and 568) appear to have been driven only in at a shallow depth, within the middle of the channel, possibly they may have related to tethering posts for fishing traps, or for retting flax etc.

Plate 4.4: Timber in situ *from Romano-British four-stake structure in Trench 118*

Taken together, the animal bones, dated charred cereals, timber stakes and pottery all suggest some form of settlement activity in the vicinity of the trench in the 1st–2nd centuries AD. Evidence for Romano-British activity nearby has been found at Stratford Market Depot to the east (Hiller and Wilkinson 2005), at Stratford Langthorne Abbey (Gilman 1992) to the south-east, and at Warton Road to the north-west (Perry 2009).

Activity on the site in the immediate post-Romano-British period is indicated by a piece of axe-cut roundwood (560, unfortunately unstratified) dated to cal AD 420–580 (SUERC- 36222, 1555±30).

Trenches 72, 78, 94, 95 and 114

A pollen sample from a layer in Trench 72 was dominated by hemp (*Cannabis sativa*) (see Chapter 8). Although this layer was undated, the overlying layers produced four radiocarbon dates in the Romano-British period (Appendix 5), indicating that the pollen cannot be post-Romano-British. Hemp was an important economic plant used for example in textile and rope production. In order to separate the plants' stem fibres, it is necessary to steep them in water (retting) for a number of days, which would cause them to shed large amounts of pollen. Although no features indicative of retting were found in the area, the location of the trench, on the edge of the 'Bowling Alley' section of the River Lea (see Chapter 5), would have been well suited for such activity.

The remains of a partially articulated horse skeleton (911), recovered from the base of a 0.4 m thick layer of sandy clayey silt (905) in Trench 94, produced two radiocarbon dates of cal AD 60–230 (SUERC-36294, 1875±30 BP; SUERC-36295, 1880±30 BP); the trench lies between the River Lea and Waterworks River (Fig. 4.2). The horse was male, aged 9–10 years, with a withers height of *c.* 13 hands, and its remains include the skull, parts of the vertebral column and a number of long bones. Its carcass had been exposed for a while as indicated by gnaw marks on the left ulna. Further disarticulated horse bones (two fragments of horse rib and a complete right metatarsal) recovered from the same and underlying contexts (906 and 907) are probably associated with the skeleton.

No contemporary features or finds were recovered from Trench 94, although a low level of Romano-British activity in the general area is indicated by a number of finds from within 500 m to the south, possibly relating to movement along the river (Fig. 4.2). Seven sherds from a single Much Hadham Oxidised ware vessel, dated AD 200–400, were recovered from a layer of sandy gravel (24) in Trench 78; the Hadham kilns in Hertfordshire, would have been accessible by water via the Rivers Stort and Lea. A single redeposited sherd of a South Gaulish samian dish, dated *c.* AD 50–100, was recovered from Trench 114, slightly further south.

A Roman brick was recovered from a layer of sandy silt (4808) overlying the natural gravel in Trench 95, along with a large mammal long bone. The brick had the imprints of a hob-nailed shoe or sandal and, on the base, a thick layer of coarse *opus signinum* mortar. A copper object recovered from modern made ground which covered the trench, was suggested in the evaluation report to be a badly worn Roman coin, but despite being X-rayed, could not be conclusively identified.

Discussion

By the Late Iron Age increasingly wet conditions appears to have led to the abandonment of low-lying locations for habitation, with the result that little direct evidence for Romano-British settlement was found within the Park. Although the valley may have provided rich pasture, the farmsteads from which the farming was organised are likely to have been located on drier land set back from the river. Nonetheless, the organisation of the agricultural valley landscape appears to display some continuity from the Iron Age, as indicated by the line of the Romano-British ditch in Trench 9 which was clearly influenced by the position of the earlier enclosures.

The prosperity of settlements beyond the valley appears to have followed the general socio-economic trends that characterise the Romano-British period; prosperity in the early 2nd century followed by a general decline in the late 2nd to early 3rd century and a brief revival in the 4th century (Merrifield 1983; Perring 1991, 44–8. 3; Bird 2000). Within *Londinium*'s hinterland, small, nucleated settlements and an organised system of larger farming estates, typically located along the major roads, acted both as markets and as producers supplying the city, particularly with agricultural produce. There is little evidence for villa estates in the area, possibly reflecting the extent of any *territorium* to the east of *Londinium*. The nature of a number of high status building, such as that at Wanstead Park (Shepherd and Potter 2007), and those, including a bath house, over 1 km east of *Londinium* at Shadwell (Douglas *et al.* 2011), remain unclear but may be unrelated to agricultural estates.

The importance of the River Lea as a communication route would have been enhanced during the Romano-British period by its proximity to *Londinium*. Excavations close to Old Ford (Sheldon and Schaaf 1978; Brown *et al.* forthcoming) have established that there was a Roman settlement along the road. The large quantity of cattle bone recovered with evidence of butchery, together with numerous coins, suggest that this may have been a market settlement playing a role in provisioning *Londinium*. A possible tile kiln was also recorded. The settlement could have functioned in part as an interchange point between road and river traffic. Fragments of a herringbone patterned pavement (*opus spicatum*) recovered from dredging close to Iceland Wharf (Smith 1910) probably represent the floor of a significant building, perhaps a *mansio* providing roadside accommodation for official travellers.

The pattern of occupation at Old Ford suggests a fairly substantial ribbon development dating from the 1st century AD, with timber buildings, represented by post-holes and beam slots, fronting onto the road, with one very large building possibly being an open-ended barn. A series of ditches to the north of the road suggest a network of adjacent yards and fields, with rectangular fields/paddocks in the later Romano-British period to the south. The presence of a Romano-British cemetery at the Ranwell East Estate, Old Ford (Pitt 1991) suggests occupation here over a considerable period.

A scatter of other burials has been found in the past at Old Ford, including two stone sarcophagi, one of which contained two inhumations (Smith 1910).

A burial vault containing several urns was also found during the removal of old foundations at Temple Mills, although there is uncertainty as to its precise location. Also east of the river, Romano-British settlement was identified at Stratford Market Depot (Hiller and Wilkinson 2005). Here, despite relatively limited excavations, evidence for possible enclosures, post-hole structures and burials (two adult inhumations, as well as two near-complete horse burials, and a dog burial) imply a fairly substantial settlement. Radiocarbon dating placed the inhumation burials in the late 2nd or early 3rd century AD, and the animal burials perhaps as late as the early 4th century (Hiller and Wilkinson 2005, 17, 48). Although there was evidence for flooding in the late Romano-British period occupation seems to have continued (*ibid.*, 49).

Saxon

Occupation within the walls of *Londinium* would have declined when the Roman administration of Britain was withdrawn in AD 410, but the Early Saxon settlement of *Lundenwic*, west of the River Fleet in the Strand/Covent Garden area of London, was not established until the late 6th/early 7th century (Cowie 2000; Fig. 4.1). Although there must have been a hiatus, therefore, in the influence of 'London' on the lower Lea Valley, the area would still have been affected by the major social, political and economic changes that occurred during the Saxon period. Religious developments also started to play a role, such as with the foundation of Barking Abbey in AD 666 by Saint Erkenwald, Bishop of London, for his sister Saint Ethelburga.

Local occupation and use of the river, which at this time was tidal as far as Hackney Wick, is suggested by settlement evidence at Old Ford, and the finding of

Saxon pottery at Stratford Market Depot (Hiller and Wilkinson 2005). A timber riverside revetment was recorded at Gibbins Yard (Lawrence 1995), and a stone and timber bridge abutment or jetty, built from timber piles enclosed by a masonry superstructure, was recorded in the western part of the Stratford Box (Valler and Crockett 2012). A number of log boats have been recovered from former silted channels of the River Lea, such as from Lockwood Reservoir in 1900 (McGrail 1978, 280). One found on the west bank at Springfield Park, was tree-ring dated to AD 950–1000 (Marsden 1989, 89).

It is also possible that some of the 'crannogs' found during the construction of reservoirs in the lower Lea Valley in the 19th and 20th centuries, and originally interpreted as of late prehistoric date (see Chapter 3), belong to this period. A substantial log platform with covering brushwood layer, and stakes along the edge, was found within the organic deposits in a palaeochannel at the Ikea site, Glover Drive, Edmonton (Humphrey and Melikian 2008), and radiocarbon dated to cal AD 345–540 (SUERC 5677, 1495±40 BP).

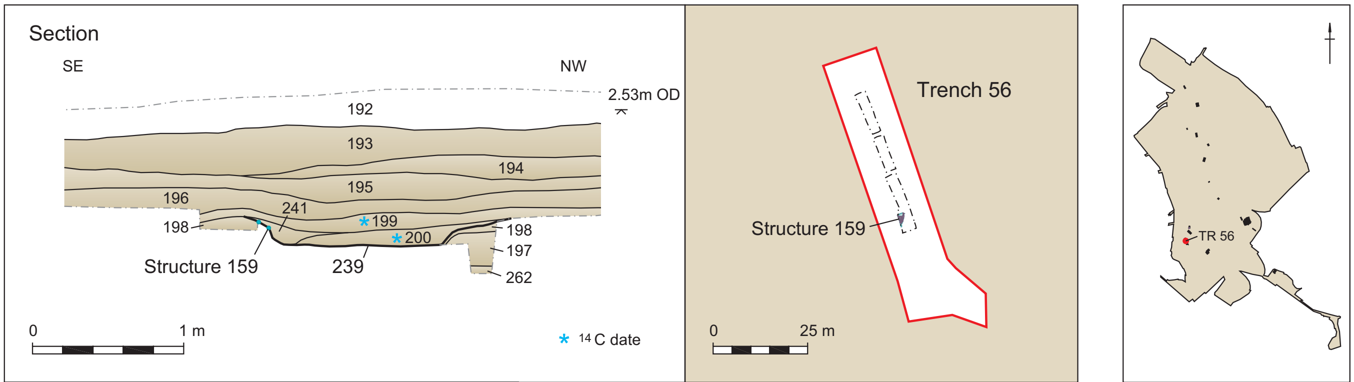
While direct archaeological evidence for Saxon activity in the area is limited, it is supplemented by documentary and place-name evidence. Stratford, for example, means 'fording place on the old street' (probably referring to the Roman road), while Leyton means 'settlement on the Lea', Clapton means the 'farm on the hill', and 'Hackney' refers to the well-watered meadows by the river marshes (*VCH* 1995). Much of the valley floor was probably marshland at this time, used for rough grazing, with the higher ground on the valley sides being the first choice for settlement, providing dry and fertile land.

The general dearth of archaeological evidence for activity in the post-Romano-British period within the wider landscape may indicate a significant decline in population, due either to the abandonment by the native populace of areas considered militarily exposed to foreign incursion, or to economic decline. The loss of the urban and military market would have dealt a blow to the organised agricultural economy, and any continuation of settlement in and around the valley is likely to have reverted to subsistence farming (Cowie and Blackmore 2008). Nonetheless, it has been suggested that the continued use of a possibly Celtic name for the River Lea (from *lug* meaning bright) may indicate the persistence of a significant British influence in the area during the early migration period (Cowie 2008, 51).

The Roman road across the valley, although no longer maintained, appears to have remained in use, but it was probably the river, rather than the road, which became, once again, the principal communication route through the landscape. It also became an important boundary, the marshes and channels representing a defensive barrier to movement. The river became the border between the East Saxons (Essex) and their 7th century offshoots the Middle Saxons (Middlesex). It also became formally established in the treaty, *c.* AD 880, between Alfred and Guthrum, as the boundary between Saxon Wessex and Danelaw (and therefore also between Christendom and the pagan world).

The suggested downstream migration of the tidal head in the Romano-British period may have reversed in the Saxon period. Certainly by the end of the Saxon period, as indicated by the presence of numerous tidal mills along the channels of the River Lea at Stratford and Bow, recorded in *Domesday Book* of 1086, the tidal influence would have been a factor in the valley's economy. This period may also have seen the first concerted efforts at drainage and reclamation.

Radiocarbon dates from geoarchaeological and environmental sequences show a



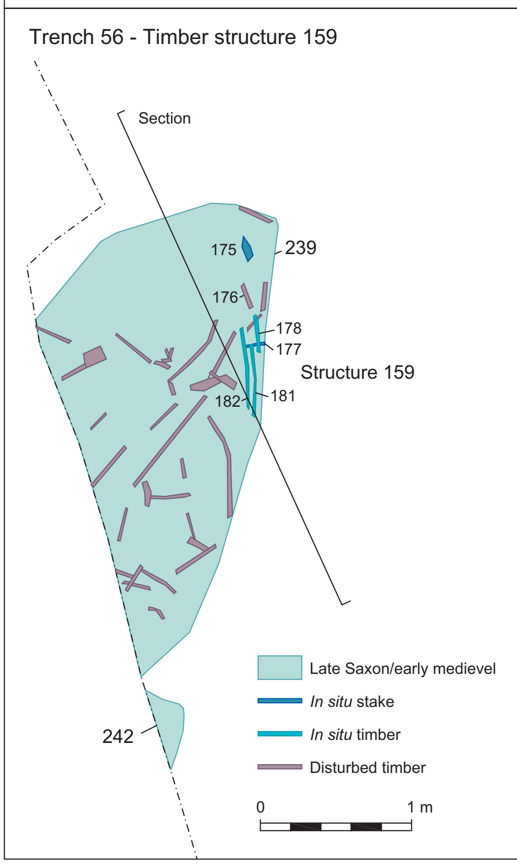


Figure 4.8: Trench 56: wattle structure 159 in feature 239, and section

continuation of the open, wet grassland landscape used for grazing seen within the Romano-British period, but with a greater emphasis on marsh environments, accompanied by more frequent flooding and a general increase in alluviation, which continued through the historic period.

There is no clear evidence, however, for cultivation on the valley floor, although other activities may be suggested by the waterlogged remains of flax (*Linum usitatissimum*). Flax seeds from Trench 27 (Fig. 4.2) were radiocarbon dated to cal AD 640–770 (SUERC-31390, 1335±30 BP), while in Trench 7 other plant remains (waterlogged seeds of water-dropwort *Oenanthe* sp.) associated with flax seeds (which failed to produce a date) yielded a comparable, if slightly earlier date of cal AD 580–670 (SUERC-31558, 1415±30 BP). Flax, grown for its seed oil (linseed oil) and/or fibre (linen) would not have grown well on wet soils of the floodplain. However, like hemp, flax stems need to be retted to separate the plants' fibres for the production of linen, and this could well have been undertaken in ditches and pits on the floodplain.

Trench 56

At the southern end of the trench, there were the remains of a possible wattle structure (159) set within a shallow cut (239) (Fig. 4.8). The cut, which was of uncertain form, and possibly natural in origin, was at least 3.1 m long (north–south) and 1.6 m wide, although its western part lay outside the trench and its north-western edge was not clearly defined. It was 0.2 m deep with shallow sloping sides and an uneven base. The corner of a probably related cut (242) lay to the immediate south.

The wattle structure within it had been badly disturbed, possibly as a result of scouring during periods when the River Lea was in flood, but part of it appeared to be *in situ*. This included two stakes near the north-east corner of the cut, one (175) driven vertically into the underlying surface, the other (177) lying at an angle of *c.* 45° against the eastern edge; a third, disturbed, stake (176) lay horizontally on the base of the cut. There were also over 30 other horizontal roundwood fragments on the base, three of which (178, 181 and 182) were wedged behind one of the stakes possibly forming the base from a piece of *in situ* wattling.

Charred plant material from a layer of decayed unidentified organic matter (200) overlying the timbers produced a radiocarbon date broadly in the early medieval period of cal AD 1030–1210 (SUERC-35335, 905±30 BP). A layer of clay (241) also containing plant material, overlay layer 200 against the feature's south-east edge. These fills were sealed by a layer of dark clay-silt (199), up to *c.* 0.1 m thick, containing the charred remains of probable emmer wheat and rye, the wheat grains producing a potentially contemporary date of cal AD 980–1160 (SUERC-34943, 985±35 BP). Earlier dates obtained from a number of overlying sediments (193 and 196) are clearly wrong (Appendix 5), possibly deriving from redeposited material.

This feature is of uncertain form, and hence could have had a number of functions. It is unlikely that it was sited along a channel edge, in which the smaller material would probably have been washed away. Due to its waterlogged location it was initially tentatively interpreted as a possible retting pit, but environmental samples from it produced no pollen of either flax or hemp.

Trench 43

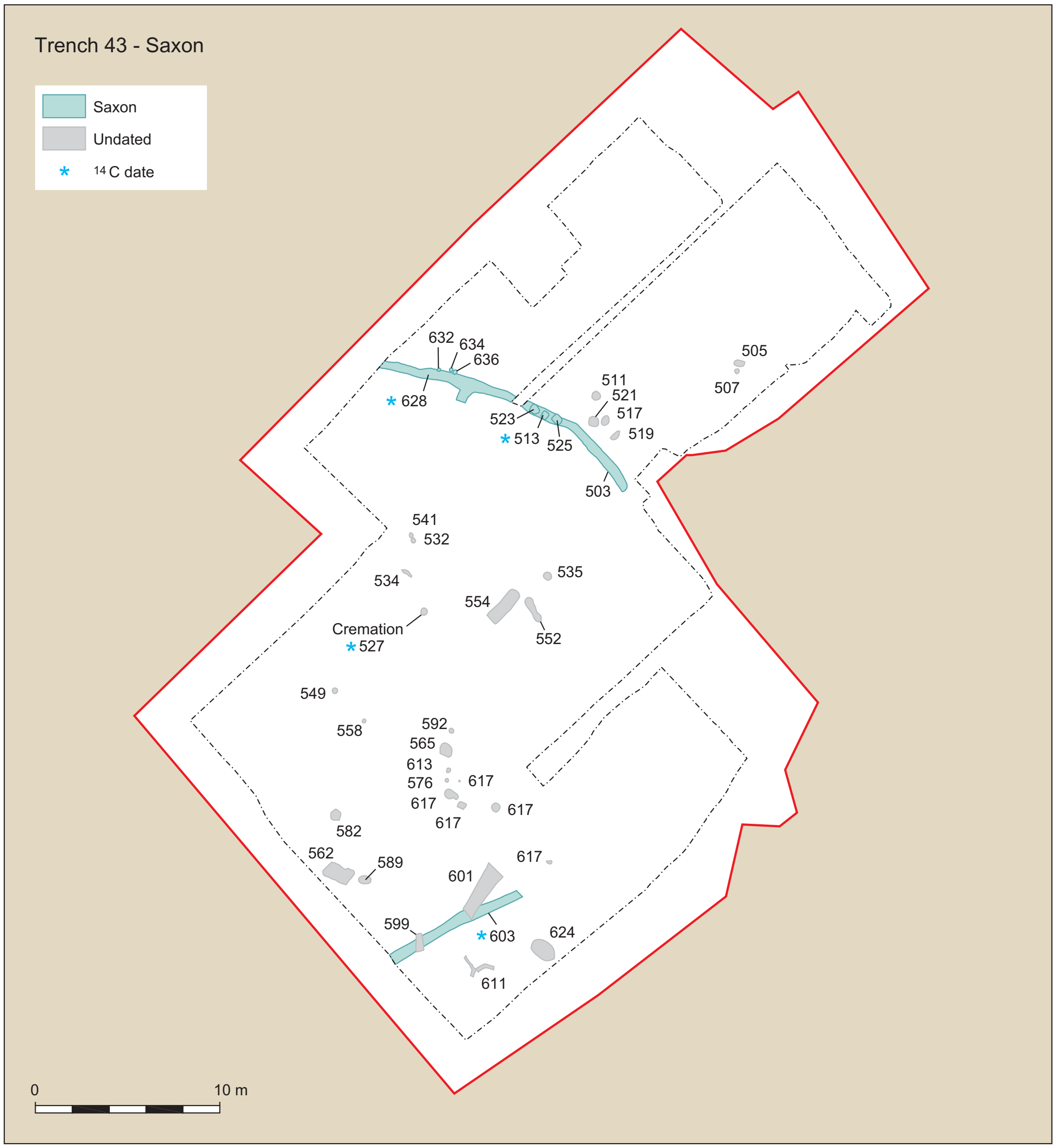
A cluster of ditches, pits and post-holes, and a single cremation grave, in Trench 43 were initially interpreted, on the basis of a number of radiocarbon dates and a small quantity of pottery and other finds, as a small sub-circular settlement enclosure of Late Bronze Age date (see Chapter 3). However, further radiocarbon dating indicated that the ditches forming the apparent enclosure were in fact of Saxon date (Fig. 4.9). No diagnostic Saxon finds, however, were recovered from the site.

Feature	Fill	Width (m)	Depth (m)	Finds
Cutting the ditch fill				
513	512	0.38	0.12	Burnt flint
523	522	0.45 x 0.55	0.12	–
525	524	0.42 x 0.50	0.09	–
On the outer edge				
632	633	0.15	0.20	Late prehistoric pottery (2/4)
634	635	0.20	0.20	Late prehistoric pottery (3/18), burnt flint (31 g), charcoal
637	636	0.25	0.23	Burnt flint (152 g)

Table 4.3: Post-holes associated with enclosure ditch 503/628, Trench 43

The two lengths of ditch, both continuing to the west of the site, appear to be related, partly enclosing an area *c.* 40 m wide, north to south. The northern ditch (503/628), which averaged *c.* 0.6 m wide and 0.3 m deep with steep sides and a flat base, was traced for *c.* 25 m, curving from the north-north-west towards the south-east At its most south-easterly extent, however, it was only 0.1 m deep and it is unclear whether it had been completely truncated by later activity beyond this point, or whether this was a deliberate terminal.

There was a cluster of post-holes and stake-holes apparently closely related spatially to the northern ditch, three of which (post-holes 523, 513 and 525) cut its fill in a *c.* 2 m long line west to east; another three (stake-holes 632, 634 and 636) lay on its outer edge (two of them cutting it) (Table 4.3). These features match the line of the ditch and appear to have had some functional relationship with it. It is possible that these lines extended further along the ditch circuit, perhaps forming a palisade or fence, but were either truncated by later activity or were not visible in the wet ground conditions during the excavation. Of the other nearby post-holes, three (509, 515 and 631; see Fig. 3.12) contained small quantities of late prehistoric pottery but four (511, 517 519 and 521) contained no finds (see Chapter 3, Fig. 3.12).



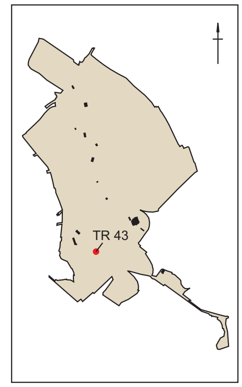


Figure 4.9: Trench 43: Saxon and undated features

Waterlogged seeds from post-hole 513 produced a radiocarbon date in the Early–Middle Saxon period of cal AD 640–770 (SUERC-34958, 1145±35 BP), while similar material from the single fill (629) of ditch 628 produced a Middle–Late Saxon date of cal AD 770–980 (SUERC-34958, 1145±35 BP); the 18 sherds of late prehistoric pottery recovered from along ditch 628 must therefore be residual, probably deriving from the late prehistoric land surface to the immediate south (see Chapter 3).

The southern length of ditch (603), which averaged 0.5 m wide and 0.2 m deep with a similar profile, was traced for *c.* 7 m aligned ENE before it was truncated. Waterlogged seeds from its single fill produced an Early–Middle Saxon date of cal AD 610–770 (SUERC-34958, 1145±35 BP). There were no comparable post-holes associated with ditch 603.

Ditch 603 was cut, however, by a subrectangular pit (599), 0.9 m long (north–south) by 0.5 m wide and 0.3 m deep with vertical sides curving to a flat base. It contained a black 'ashy' silt and gravel fill (598) leading to its interpretation as a possible hearth or fire pit, although it was noted that the fill's dark colour may have been due to contamination from above. There is no record of charcoal, or any finds, within this feature. The ditch was also cut by a barely perceptible feature (601), possibly another ditch, 0.6 m wide and 0.2 m deep, that was traced for 3 m running NNE from it. It was not observed to the south of ditch 603, or further to the NNE due to waterlogging and contamination. It produced a single piece of burnt flint.

In the absence of any finds of Saxon date from this trench, and the fact that the three radiocarbon dates were all obtained from waterlogged seeds, there must remain some question as the nature and date of these features. However, the relative consistency of the dating, even if the date from ditch 628 does not overlap with the other two, adds weight to a Saxon date. The close association of timber posts and stakes with the ditch, possibly representing some form of palisade, also lends the possible enclosure a potentially distinctive character. The only comparable features recorded in the Olympic Park were found in Trench 9.

Trench 9

A ditch containing a series of evenly spaced post-holes was recorded for *c.* 10 m on the eastern side of the trench (Fig. 4.4, above). The unexcavated ditch (2231) was of irregular width (0.2–0.8 m). Eight post-holes were cut into its fill, the six towards the south-east spaced at regular 0.6 m intervals, the wider gaps possibly due to similar post-holes not being visible in the ditch fill. The post-holes were of variable size – between *c.* 0.15 m and 0.35 m in diameter.

As neither the ditch nor the post-holes were excavated, no dating evidence was obtained from them. However, the ditch cut a layer of alluvium (2163) up to *c.* 0.4 m deep that sealed Iron Age ditch 2120 (see Chapter 3) and Romano-British ditch 1212 (above), and it was cut in turn by a number of modern features. Its stratigraphic position, therefore, is at least consistent with a Saxon date, and its form has parallels with the post settings in Saxon ditch 503/628 in Trench 43 (above). Plant remains recovered from alluvium in Trench 7, to the immediate north-west of Trench 9, and dated to cal AD 580–670 (SUERC-31558, 1415±30 BP), were associated with flax seeds, possibly indicating flax retting (and therefore perhaps other activities) in the area during this period.

Trench 22

A small ditch (30), *c.* 1.2 m wide and 0.3 m deep aligned north-east–south-west, was recorded cutting a buried soil horizon overlying the basal gravels (Fig. 4.2). Waterlogged plant remains from its single fill (29) produced a radiocarbon date in the Saxon period of cal AD 710–940 (SUERC-35333, 1200±30 BP).

Summary

The generally low level of direct archaeological evidence for Saxon activity in the wider area seemed to be reflected by its apparent absence during the Olympic Park investigations. Additional, radiocarbon dating, however, has shown that there may have been a significant degree of valley-floor activity of varying forms, including the construction of small enclosures (or at least boundaries of some form), which in the absence of diagnostic finds would not otherwise be recognised as belonging to this period. That lack of finds, however, may indicate that this activity was primarily agricultural, with settlement continuing to be located on the valley sides from which different ecological zones were accessible (Cowie and Blackmore 2008, 131). Nonetheless, the underlying gravel topography in Trench 43 probably ensured that this location would have been relatively dry compared to most of the valley floor.

Medieval

In the medieval period, the nearest settlements to the Olympic Park were at Stratford and West Ham on the east side of the river, and Bow and Old Ford on the west side; Late Saxon/early medieval buildings were exposed fronting Old Ford Road at the Lefevre Walk excavations (Leary 2002). Beyond these settlements, the valley landscape was predominantly agricultural in character, although much of the land was owned by religious houses that played an important role in the drainage of the marsh and the construction of flood defences, providing improved pasture for livestock and fertile land for crops.

In AD 1135, an abbey of the Savigniac order, St Mary Stratford Langthorne, was built on the edge of the marshland south of Stratford by William de Montfitchet, the most significant manorial lord of 'Hame', in an area of fields cultivated since the Late Saxon period. The abbey was absorbed into the Cistercian order in AD 1147, and by the 15th it century owned all of Newham and had extended its estates into Essex and along the Lea Valley. The abbey owned much of the surrounding land, the rich floodplain meadows supporting large flocks of sheep from whose wool the abbey derived much of its considerable wealth. The Abbey Mills on Channelsea River either turned the wool into cloth (fulling), or made flour from the grain cultivated in its fields, supplying the bakeries of Stratford-at-Bow until the Reformation.

Also in the area was the Priory of St Leonard Stratford-at-Bow, a Benedictine convent first recorded in 1122 (Knowles and Hadcock 1971, 291). While not a large house, it became fashionable in the later 14th century, being mentioned in Chaucer's *Canterbury Tales* (Hawkins and Phillpotts 2005, 39). Although there are records that the priory had gardens, orchards and fishponds (*ibid.*), it was probably not a significant landholder within the valley.

Another religious house that may have had economic interests in the valley was the Benedictine Priory of St Helen in the City of London which owned a fulling mill on the River Lea in Stepney – probably 'the mill of Algot' referred to in *Domesday Book* of 1086, and called 'Algoldesmelle' in 1355 (Burnby and Parker 1978).

The *Domesday Book* listed eight mills in the manor of West Ham. It remains unclear, however, to what extent some of these can be identified with the later mills on the complex of channels referred to as the Back Rivers (see Chapter 5, Fig. 5.4), such as those on Pudding Mill River (originally *Fotes Mill*, but known later as *St Thoma's Mill*, *Harts Mill*, or *Pudding Mills*), on City Mill River (*Spileman's Mill*, or *City Mills*), on Waterworks River (*Saynes Mill*). As well as the Abbey Mills on Channelsea River (also known as *Wiggen Mill*, later *Honeredes Mill*), there were, in Bromley-by-Bow, *The Three Mills* located at the convergence of the Three Mills Back River and Three Mills Wall River, and *The Four Mills* located further south on the main channel of the River Lea.

Millstreams and Water Management

Apart from Temple Mills on the Hackney/Leyton border towards the north of the Park, the operation of these watermills was determined by the tides in the River Thames, and the effect these had on the flow of water within the River Lea and the Back Rivers. The incoming tides pushed the flow of water back up the valley raising its levels in the upper stretches of the Back Rivers. This was penned back by the millers to create a head of water. As the ebbing tide in the Thames allowed the water in the River Lea to flow again, its levels below the mills would fall to a point where there was a sufficient drop from the penned water to turn the undershot mill wheels. Because of this, however, the mills could only operate for limited periods roughly twice a day; many of the mills eventually had windmills associated with them, creating the potential for more continuous milling. Although the watermills are in one sense tidal mills, the tidal influence was indirect and, apart from on occasional tidal surges, it was mainly fresh water, rather than sea water, which powered them (see Chapter 8).

Due to the schematic depiction of the Back Rivers on most 18th century (and earlier) maps, it is hard to determine to what degree their more accurately surveyed 19th century courses had changed since the medieval period (and post-dating the construction of the Stratford causeway, see below). Although some of the 19th century mill streams have significant changes of direction, long sections of them are very straight, facilitating the unimpeded flow of water towards the mills. However, given the naturally meandering character of the river, as for instance at the southern end of Hackney Marsh until the late 19th century (see Fig. 5.2), it is very likely that the 19th century mill streams are the result of repeated and deliberate modification.

Three of the mills, Pudding Mills, City Mills and Saynes Mill are located in a line across the valley (see Chapter 5, Fig. 5.4), on the immediate north-west side of the High Street. This suggests that the mills at their recorded locations post-date the establishment of the High Street. The main route across the lower Lea Valley – the old Roman river crossing at Old Ford – was replaced in the 12th century at the insistence of Maud (or Matilda), the wife of Henry I (1100–1135), due to her hearing how many people had lost their lives trying to cross the ford by ferry when the river was in flood; in some accounts '*she herselfe had beene well washed*' in the water' (Stow 1598). She commissioned a new gravel causeway to be built across the valley *c.* 1 km downstream from Old Ford, and the construction of two stone bridges, one across the River Lea at Bow, reputed to be the first stone arch bridge built in England (and after which Bow is apparently named), and another across the Channelsea River at Stratford.

The complex of waterways parallel to the causeway on its north-west side which linked Waterworks River, City Mill River, Pudding Mill River and the River Lea, is likely, therefore, to post-date the construction of the causeway, which formed a substantial obstruction across the valley, necessitating the construction of further bridges, such as St Michael's (or Harrow) Bridge located between the City Mill and Waterworks Rivers, and St Thomas of Acre's Bridge and Peg's Hole Bridge between the City Mill and Pudding Mill Rivers.

Trench 118

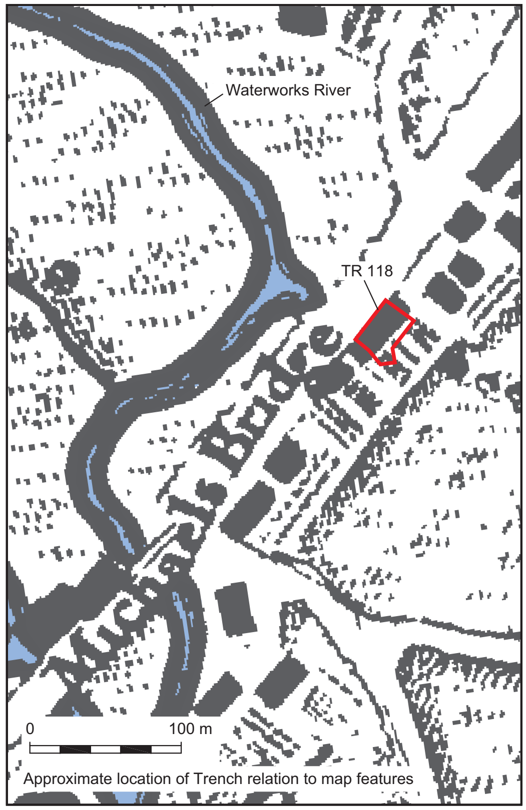
Particularly noticeable in this respect is the course of Waterworks River, which ran perpendicular to the causeway on its approach, before turning sharply to the south-west and parallel to it; it then split into two channels before passing under the bridges to the south. This suggests that the construction of the causeway necessitated the Waterworks River being diverted from an earlier course. This could originally have continued straight over the line of the causeway, and Rocque's 1746 map shows what appears to be a short stub of channel continuing past the turn right up to the causeway (Fig. 4.10). It is also notable that a large water channel (179/563) was recorded immediately south of the causeway in Trench 118 (Fig. 4.7, section), on the same north-west to south-east line.

The dating of this channel has proved problematic, since a radiocarbon date from the several waterlogged seeds from alluvium (177S) within it had produced a Middle Iron Age date of 390–200 cal BC (SUERC-34952, 2235±35 BP). However, the Romano-British date obtained from alder stake 180 (see above), which was truncated by the channel, indicates that the Middle Iron Age date must have been from reworked material.

On the south-west edge of the channel, 21 pieces of worked wood were recovered, most of them, including possible branch loppings and displaced wattle fragments, lying horizontally and not *in situ*. A few, however, were driven in vertically (Fig. 4.7), and some of the stakes were found in possible alignments. It is likely that the stakes once had wattlework, horizontal timbers or poles associated with them which have not survived, and it is possible that they formed part of an east–west revetment, or perhaps a fish trap or hunting blind (Howell and Spurr 2009). Among this group, one vertical piece (554) produced a radiocarbon date in the medieval period of cal AD 1290–1410 (SUERC-36221, 610±30 BP).

An oak stake (188), recorded in the south-east facing section (Fig. 4.1), cut through the fill of the channel close to its south-west side; it produced a late medieval–early post-medieval date of cal AD 1480–1650 (SUERC-36220, 315±30 BP). A horse bone from channel fill 526 produced a comparable date of cal AD 1430–1640 (SUERC-34938, 395±35 BP).

Given the location of this channel in relation to the High Street causeway, it seems likely that it became cut off from the main flow of water in the 12th century, and therefore was no longer an active channel. It is possible, however, that other channels and ditches drained into it in the south side of the causeway, and it is likely that the water levels in it would still have been influenced by the tidal waters.



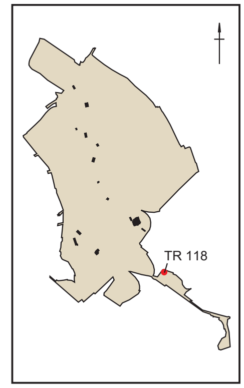


Figure 4.10: Detail of Rocque's map at Stratford causeway in relation to location of Trench 118

Trench 56

Within the predominantly rectilinear pattern of the 19th century ditches which drained the valley floor, there are some which still followed irregular lines, and is it possible that they mark the courses of earlier, natural channels. A possible example is a ditch, east of Old Ford, which is labelled on some 18th century maps as *The Old River*, part of which was revealed in Trench 56 (Figs 4.11–4.12).

As described above, the northern edge of a Romano-British ditch (213) was cut by the southern side of a wide channel (209) (Fig. 4.12). The channel, excavated only to *c.* 0.6 m depth, was at least 10 m wide, and possibly significantly more, its fills being cut by a modern feature at the northern end of the trench. The channel had moderately shallow irregular sides, and contained a complex sequence of fills as would be expected in an active channel, the lowest recorded of which produced a radiocarbon date in the middle–late Romano-British period, probably from redeposited material. The upper fills indicate low energy alluvial deposition, which appears to have continued once the channel (at least as exposed in the trench) had become largely infilled. The absence of dating from the upper fills and the immediately overlying sediment makes it hard to ascertain for how long the channel remained active. However, its south-eastern edge lies approximately parallel to, and 5–6 m from, the *The Old River*. (There is some confusion about this name, as the term '*the old river*' can also applied to that part of the River Lea bypassed by 'the new river', ie, the Hackney Cut navigation between Lea Bridge and Old Ford, see Chapter 5.)

The Old River, as shown on Gascoigne's 1703 map of Stepney (Fig. 4.11), branched off the present line of the River Lea just down-stream from the head of Pudding Mill River, then took a slightly meandering course at

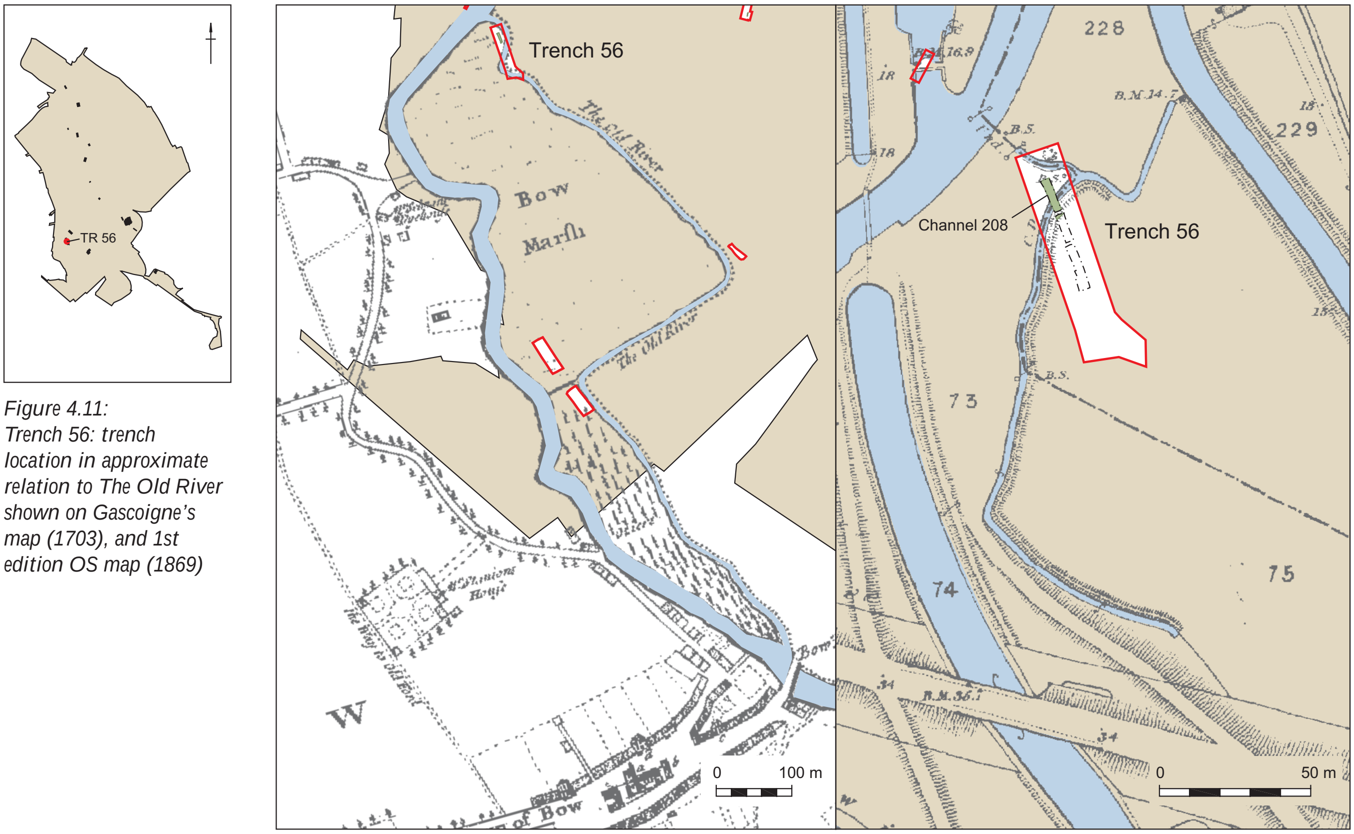
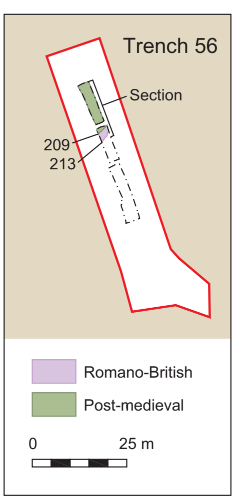


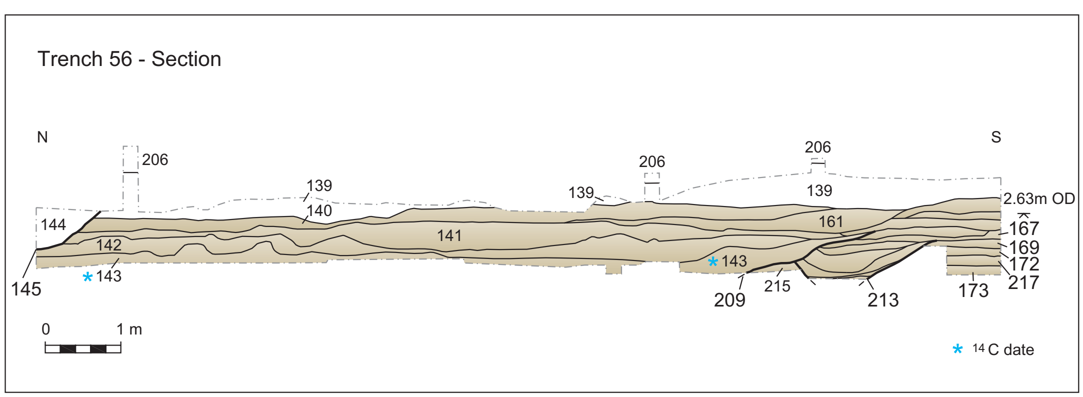
Figure 4.11: Trench 56: trench location in approximate relation to The Old River shown on Gascoigne's map (1703), and 1st edition OS map (1869)

the north before a series of straight sections broken by two sharp bends, rejoining the River Lea at Bow. By the time it is shown on later 18th century maps, such as on Cardwell's map of 1767 where it is also named, (and on 19th century maps) it appears no different from the many other ditches draining the Bow Marsh.

However, the excavation of channel 209 suggests it had originally been a much more substantial channel, giving added significance to its name. Why *The Old River* was so named is unclear. It might simply indicate that in the 18th century it was known that the existing channel had once been a much more substantial and important watercourse. However, it might also suggest that another river was considered to have been 'newer', and while it seems unlikely that this could refer to the channel of the River Lea to the west, it was *The Old River*, and not the River Lea, that marked the eastern limit of the parish of St Mary Stratford, Bow, as well as the border between Middlesex and Essex (and continued do so until 1961).

Figure 4.12: Trench 56: section of Romano-British ditch 213 and post-medieval ditch 209





It seems likely, therefore, that from the Romano-British period until well into the historic period there continued to be a substantial channel on the approximate line of channel 209, at least at the northern end of *The Old River*. It has been suggested that the channel may have had some connection with a 14th century tidal mill, known as *Landmylnes*, in the manor of Stepney which had probably fallen out of use by the early 16th century (Fairclough 1986), but this cannot be confirmed. In the post-medieval period, the channel's significance was retained in its name and use as a boundary, but in functional terms it became just another drainage ditch, recut and maintained on a much smaller scale.

Trench 58

Evidence for a possible medieval mill stream was also revealed during the excavation of a substantial channel (Phase 1, below) in Trench 58; the channel subsequently went through various phases of re-cutting during the post-medieval period and 19th century, its character changing markedly during that extended period (see Chapter 5). Trench 58 was located to the east of the head of one of the 18th century mill streams, Pudding Mill River, which until the mid-20th century, branched south from the main channel of the River Lea immediately west of this trench.

The southern end of the Romano-British ditch (126) in Trench 58 (see above) was recorded in the field as being cut by a north–south ditch (442) (Fig. 4.6). Ditch 442, which was cut from *c.* 2.20 m OD (*c.* 0.4 m higher than ditch 126), was 1.6–2.5 m wide (its eastern side was not clearly defined) and up to 0.37 m deep. It contained redeposited Romano-British pottery, most of it from its lowest fill (424/431), while its main (and uppermost) fill (392) contained sherds of earlier medieval pottery, dated to 1080–1350. The ditch also contained a small amount of animal bone, some of it food waste, but with a relatively wide range of species (cattle, horse, sheep/goat and pig and dog) (Fairman and Spurr 2009, table 9).

At its north end (as visible in section, see Fig. 5.11, below) the infilled ditch 442 was overlain by layers of clayey silt (450) and clayey sand (304), both described in the field as possibly dumped. The latter was cut by the south-western side of a substantial water channel (137/448), running approximately north-west–south-east across the excavation. This represented the first phase of a long sequence of maintenance of this channel that continued through and beyond the post-medieval period (see Chapter 5).

Phase 1 channel

The upper edge of channel 137/448 was recorded only in section (Fig. 5.11), in both sides of the trench, with the result that its line across the trench is not precisely known; the possible line of its south-western side has been projected (Fig. 4.6), based on the slightly curving lines of subsequent recuts. The width of the channel – at least 6 m on the eastern side – is also not known because its fills were cut, to below the limit of excavation, by later recuts of the channel lying slightly to its north-east. However, its north-eastern side may have lain within the line of, and been truncated by, the first of these recuts (300/413, below) since the upper part of that recut on its north-east side was recorded as being cut through a possible dry-land surface (30), rather than a channel fill; it is noted, however, that layer 30 was recorded as overlying a possible earlier channel fill (26). At the east channel 137/448 was at least 1 m deep, but continued below the limit of excavation. It contained a series of sandy fills from which a quantity of animal bone, including horse, was recovered.

The only direct dating evidence for the channel was a single post-medieval sherd from fill 366 (Fig. 5.11, below). It is likely, however, that this is intrusive since, when the channel was almost fully silted, it was recut and a wattle revetment, radiocarbon dated broadly to the early post-medieval period inserted along its sides (Phase 2, see

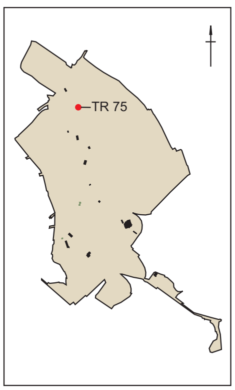
Chapter 5). This suggests that channel 137/448 is likely to be of at least late medieval date, if not (given that its base was not reached) earlier.

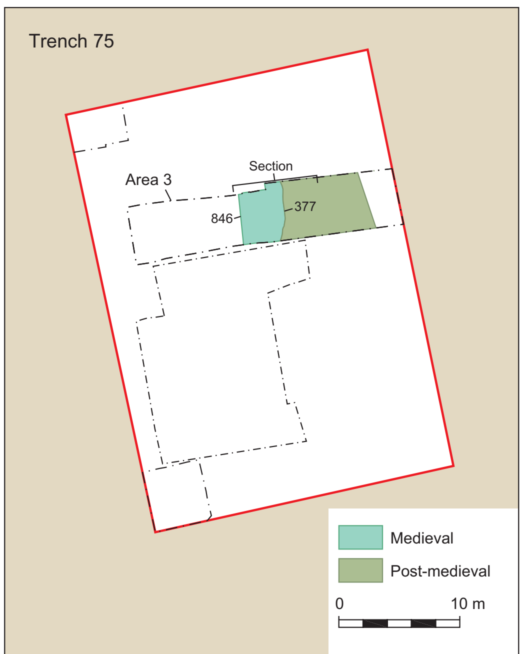
Subsequent cuts along the line of the channel were made during the post-medieval period and the 19th century, representing the changing character and use of this watercourse (see Chapter 5), and on 19th century maps its line is followed by a drainage ditch which ran approximately parallel to, and to the immediate east of, Pudding Mill River, approximately all the way down to the Pudding Mills. Whether this Phase 1 channel also ran down to the mills has not been established, but it is at least possible given that some early 19th century maps (eg, an 1828 map, Fig. 5.21, below) show the water penned above the mills lying in two parallel channels – Pudding Mills River and another channel to its east (see Trench 41, below).

Mills at the southern end of Pudding Mill River are first recorded, as *Fotes Mill*, in the 12th century, later called *St Thomas's Mill* after the Hospital of St Thomas of Acre, which held two mills at Stratford. There are 17th century references to St Thomas's Mills being 'two mills under one roof'. In the absence of clear evidence for the date at which Pudding Mill River was created (see Chapter 5), there is at least a case to argue that the Phase 1 channel (137/448) could have been an early course (at least at this location) of the mill stream for Fotes Mill, superseded in the post-medieval period by a new cut to the west. The river, at the point immediately adjacent to Trench 58, is shown on the 19th century maps as only *c.* 9 m wide – not substantially wider than the Phase 1 channel.

Trench 75

The Temple Mills were the most northerly watermills within the Olympic Park, and a sequence of watercourses which bypassed them on their eastern side, investigated in





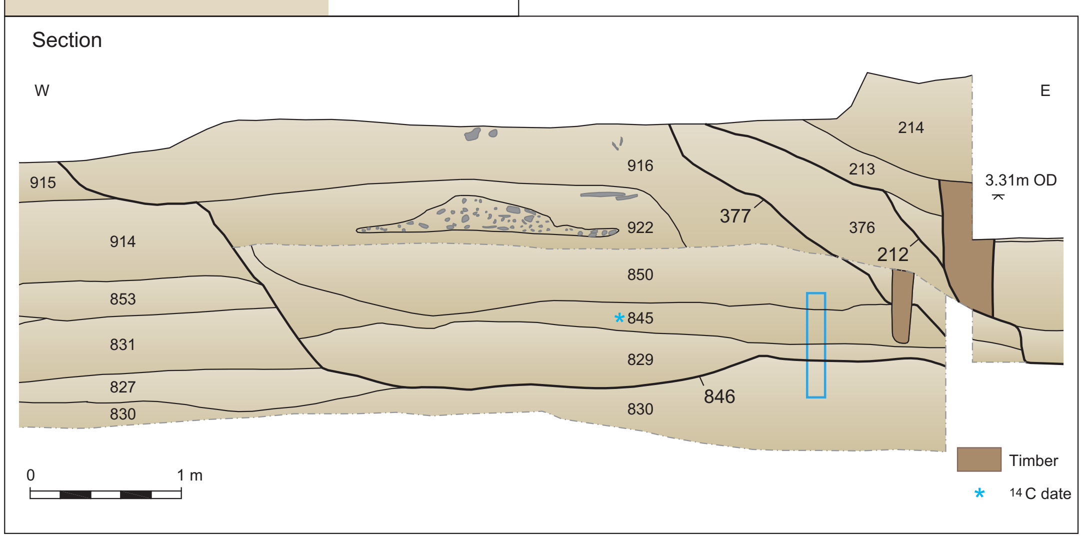


Figure 4.13: Trench 75: plan and section of medieval channel 846, cut by Tumbling Bay stream (377)

Trench 75, was probably directly associated with them. The mills differed in one important respect from these further down the valley, in that they were located above the river's normal tidal reach, and so derived all their power from the flow of river water passing down the mill stream, which was diverted from the River Lea over 800 m to the north-west.

By the post-medieval period, there was a 'tumbling bay' (a weir) just upstream from the mills, which acted as an overflow, diverting water around the eastern side of the mills through a channel called Tumbling Bay Stream. However, the western edge of the Tumbling Bay Stream (377), as recorded in Trench 75, cut through the fills of the earlier channel (846), an apparent medieval precursor lying to its immediate west (Fig. 4.13). This earlier channel was exposed in the two opposing sections in Area 3 of the trench (it should be noted that its lowest fill in the northern section (829) includes part of a layer (827) originally recorded as cut by the channel). Because its eastern bank was truncated by the western side of Tumbling Bay Stream, its width was not established, although it was at least *c.* 6 m wide and 1.5 m deep. Waterlogged plant remains from two fills low within its fill sequence – 845 in the south-facing section (Fig. 4.13), and 833 in the north-facing section – produced radiocarbon dates, of cal AD 1420–1620 (SUERC-36284, 420±30 BP; and SUERC-36285, 425±30 BP respectively). It is unclear whether this channel had some function relating directly to the operation of Temple Mills, or had a similar function as the later Tumbling Bay Stream in diverting water around their eastern side.

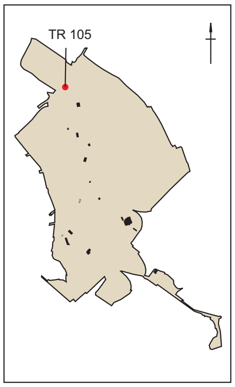
The name of the Temple Mills has its origin in the late 12th century when William of Hastings, steward to Henry II, granted a tract of meadow and marsh beside the River Lea in Hackney and Leyton to the Knights Templar, a military religious order recognised by the Church. The site developed from 1185 and the Templars owned a watermill there by 1278; they also built a nearby bridge over the River Lea. By 1308 there were two watermills under one roof, one on the east side of the river in Leyton, the other to the west in Hackney. After the suppression of the Templars in 1312, the mills were granted to the Hospital of St John of Jerusalem, Clerkenwell, then, following the Dissolution, passed through various ownerships, including the Crown.

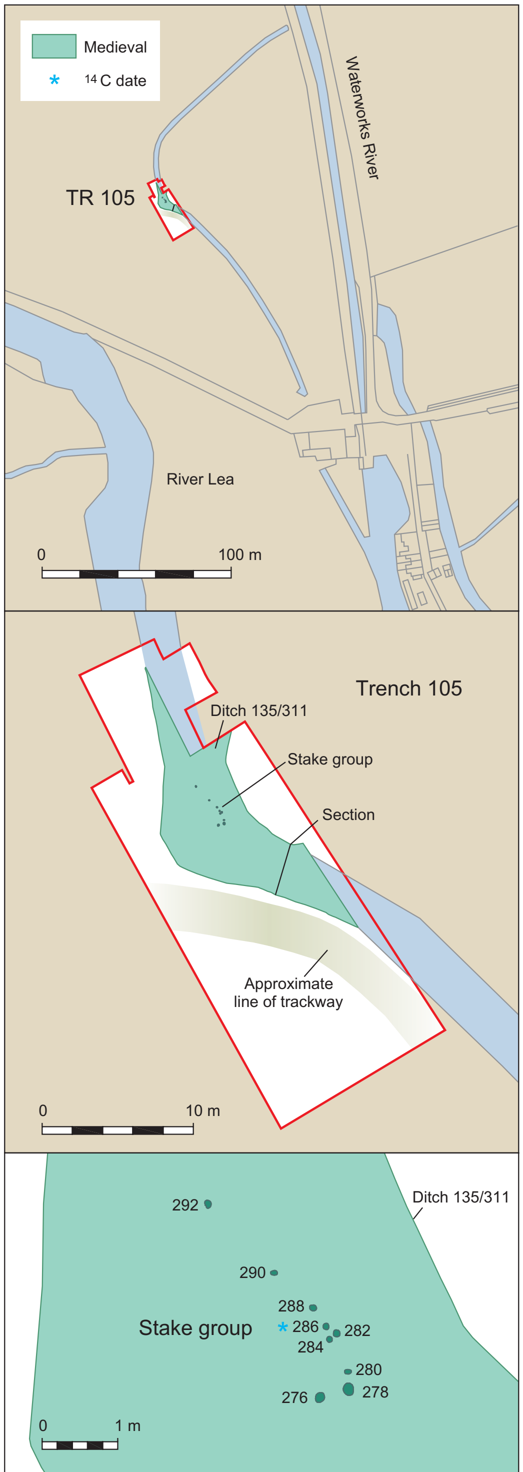
Trench 105

A channel (135/311) excavated in Trench 105, towards the north end of the Olympic Park, was known from map evidence to be of at least post-medieval date, but radiocarbon dating of a timber structure in its base showed it to be of earlier medieval date. This illustrates the difficulties of dating such features which may have been maintained over long periods. The only other finds, from the fill (134) of a recut which left only remnants of earlier fills (270–272) (Fig. 4.14), comprised 20th century rubbish.

The excavation revealed the bend in a curving channel that ran south-west off Temple Mill Stream above the mills, then turned back towards them; it was flanked on its south-west side by the trackway (see Chapter 5) that ran across the southern end of Hackney Marsh from Temple Mills. The channel (135/311), which was *c.* 3.5–5.8 m wide and at least 1.2 m deep (Fig. 4.14), is first shown on the 1799 OS Surveyor's Drawing (Fig. 5.7, below) (but first accurately depicted on the 1832 *Plan of the Parish of St John in Hackney*). It is possible that it ran under Homerton Road emerging as a short length of channel (shown on some 19th century maps, eg, Fig. 5.6) that flowed back into the mill stream below the mills, in which case it could have had some function in relation to activity at the Temple Mills site (see below).

At the bend in the channel, the bases of nine closely spaced stakes (partly machined away) were recorded in an irregular line *c.* 3.3 m long in the lower channel fills,





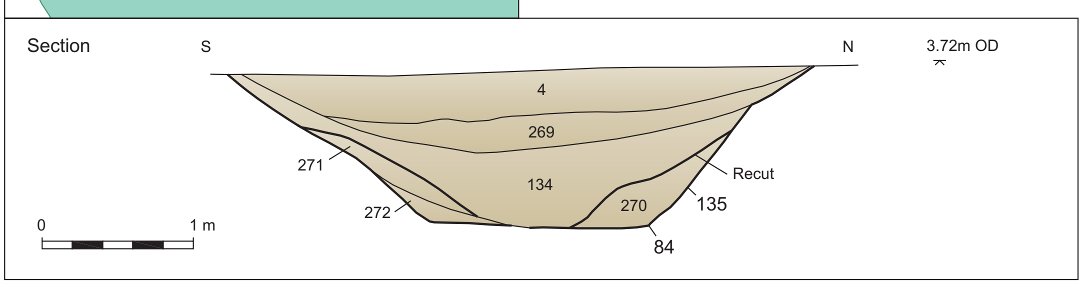


Figure 4.14: Trench 105: location and plan, with detail of stake structure, and west-facing section of ditch 135

driven into the underlying sandy clay. The two at the south (276 and 278), both of which were of oak and lay perpendicular to the others, were the largest (up to 130 mm in diameter); they were also the best preserved and could therefore be of later date. The other softwood stakes were *c.* 20–30 mm in diameter; those at the south were very closely spaced (*c.* 0.2–0.5 m apart), while the two most northerly were 1.2 m apart. Post 286 produced a radiocarbon date of cal AD 1039–1215 (SUERC-36585, 895±35 BP).

The channel's rather irregular line suggests that it may originally have been a natural water channel, possibly bypassed by the construction and/or straightening of Temple Mill Stream. The function of the stakes is not clear although they are likely to represent some structure exploiting the stream channel, such as a fish trap.

Conclusion

The combining within this chapter of the evidence for the Romano-British, Saxon, and medieval periods was in part to avoid a very short chapter on the Romano-British period. Even with the addition of a number of timber structures identified as Romano-British by radiocarbon dating during the analysis stage, the evidence from the Olympic Park remains very limited for this period. This was probably not what was anticipated at the start of the fieldwork, given that the Roman road from *Londinium* to *Camulodunum* has been traced at Old Ford to within *c.* 300 m of the Park, and there must have been a reasonable expectation that the dense array of trenches across its projected line over the valley floor would identify some trace of it.

What was found from the Romano-British period, however, were a small number of relatively light-weight timber structures on two of the valley's now relict river channels, a few ditches probably reflecting the agricultural exploitation of the valley floor, and a small number of finds generally indicative of settlement, but not necessarily reflecting its precise location – and two coins. It is possible that one or more of the inhumation burials at Trench 9 could be of Romano-British date, in which case this low level of activity could be seen as a broad continuation of what was happening in the Late Iron Age, by which time it appears that settlement had moved decisively off the increasingly flood-prone valley floor.

However, it also reflects what was to follow - not just during the medieval period, but, over much of the valley floor, into the 19th century. From the Romano-British period the valley floor landscape appears to become an increasingly clearly defined wetland zone, marginal to and distinct from the surrounding agricultural landscape which was able to support all components of a mixed farming economy. Although the valley floor formed an important agricultural resource, its land had a single primary use as wetland pasture.

The river channels, in contrast, increasingly became the focus for the developing economy, which was not only sustained by its serving the local population, but was also stimulated by the opportunities offered by the valley's proximity to the markets of *Londinium*/*Lundenwic*/London. First they provided a means for transporting goods, and later they powered the mills which processed the produce of agriculture – grain in the corn mills and wool in the fulling mills.

It was the abandonment of the sometimes hazardous river crossing at Old Ford, and the construction of the new causeway and bridges at Bow and Stratford, which determined the future disposition of economic activity. Above and below the causeway, the river channels were shaped, directed and connected to optimize the operation of the watermills, with those on the three central channels – now the Pudding Mill, City Mill and Waterworks Rivers, directly accessible from Stratford High Street. It was the gravitation of industry to this important communication route to London which ultimately determined the trajectory that the valley was to take in the post-medieval and modern periods.

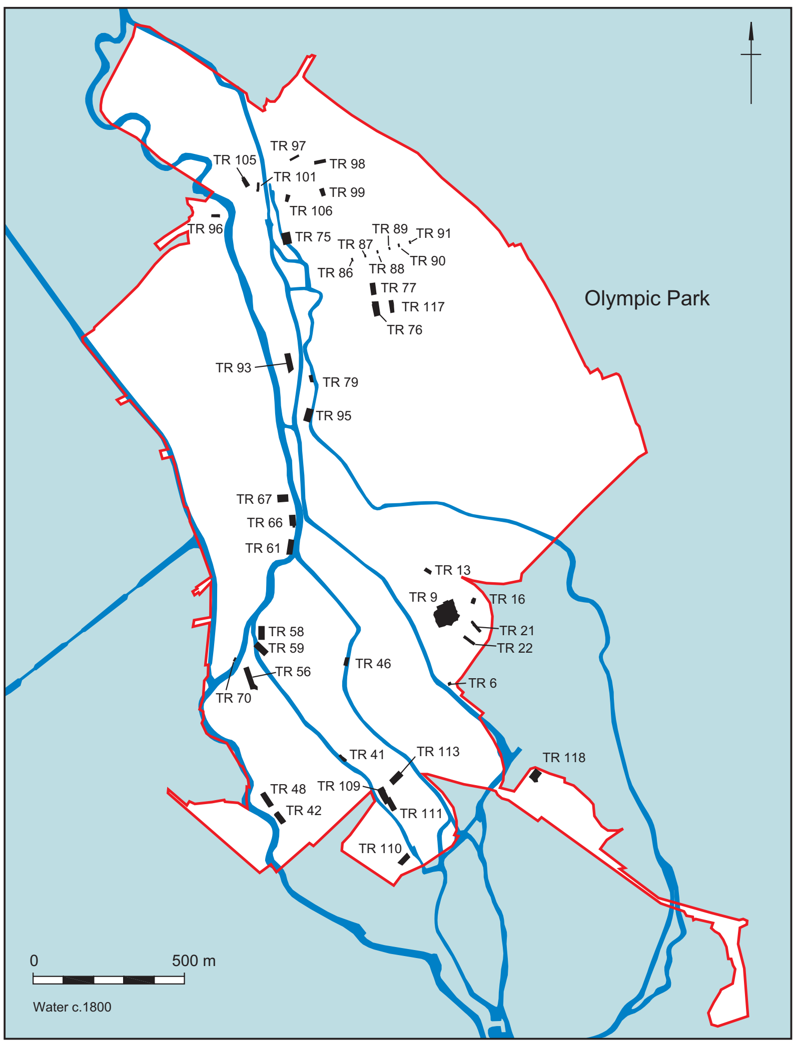
Chapter 5

Agriculture, Industry and Infrastructure in the Post-medieval to Early Victorian Period

The Pre-Industrial Landscape

In contrast to the early historic period (Chapter 4), increasing evidence was recovered during the Olympic Park investigations for activity during the later post-medieval period and the first half of the 19th century (Fig. 5.1). This was a period during which the lower Lea Valley still retained its essentially rural character, with localised pockets of settlement and industry. However, its value as available open space on the capital's doorstep led inevitably to its appropriation for major infrastructure developments at the start of the Victorian era. Rapid industrialisation was to follow, and this is dealt with in Chapter 6.

Figure 5.1: Location of trenches with post-medieval to early Victorian evidence



The Map Evidence

One of the best known, large-scale 18th century maps, which covers the whole of the Olympic Park, is John Rocque's 1746 *Exact Survey of the City of London Westminster and Southwark and the Country 10 Miles Round* (Fig. 5.2). It shows the landscape as it had developed through the medieval and post-medieval periods, about a century before the process of industrialisation and infrastructure development transformed its character. There had been industry in the valley during the medieval period, and to a large extent the post-medieval industry represented the continued development of the valley's medieval mill sites, exploiting the river channels to power an ever widening range of industrial and manufacturing processes. Rocque's map also shows some of the windmills that supplemented the intermittent working of the water mills.

The floor of the valley remained unsuitable for occupation, and settlement was concentrated along the road (a turnpike from 1834) which led the traveller to London across the causeway from Stratford to Bow. The map depicts this main road, and the minor lanes linking other local settlements such as Old Ford, West Ham and Bromley. Even lesser routes are shown, such as a trackway west from Temple Mills that crossed Hackney Marsh just south of Tyler's Ferry across the River Lea. The new patterns of land ownership in the valley, which followed the dissolution of the monasteries and the closure of the other religious houses, is reflected in some of the high status houses and manors shown on the map, such as Ruckholes (Ruckholt) House, Bromley House and Chobham, and the former West Ham Abbey.

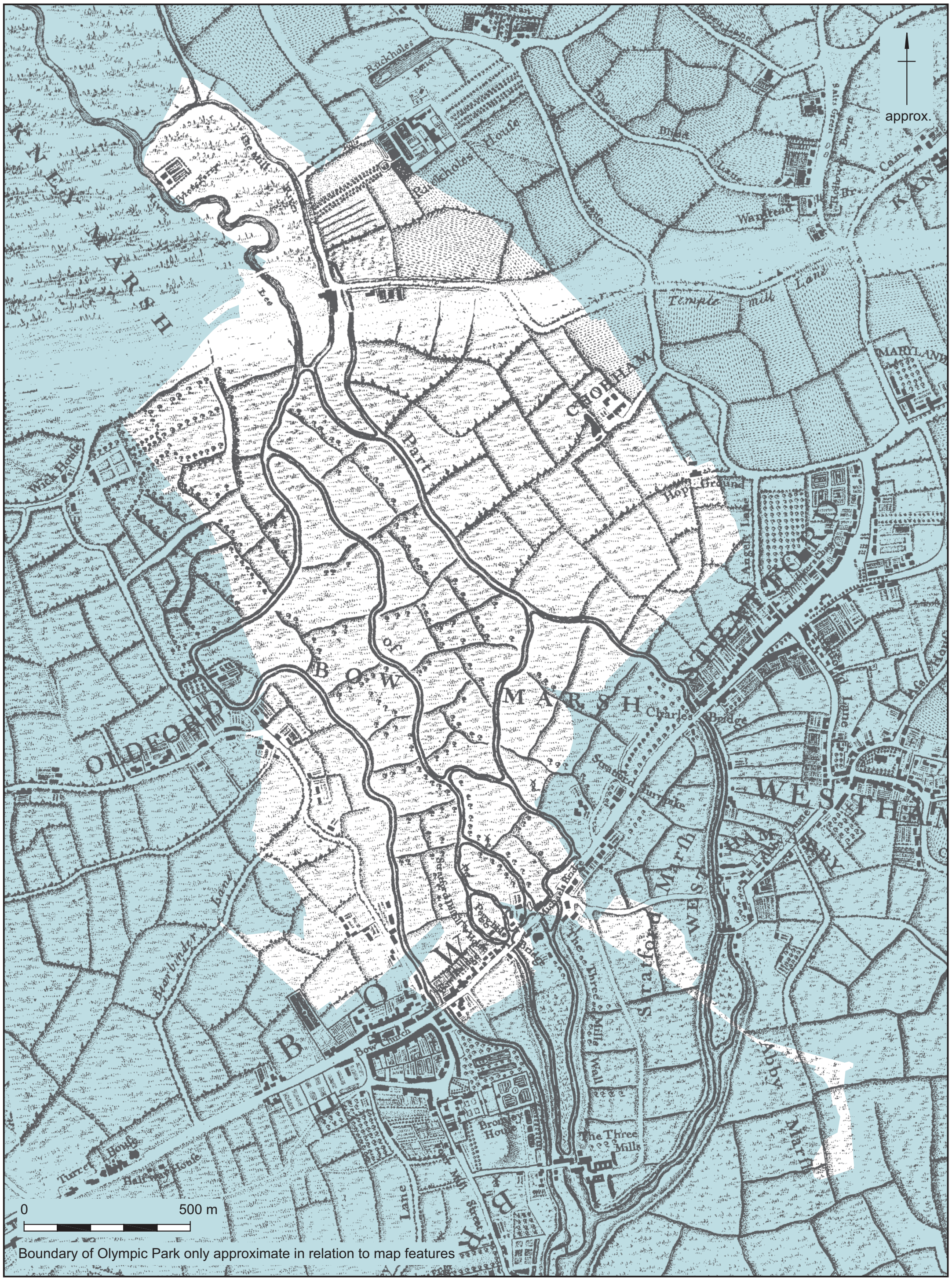
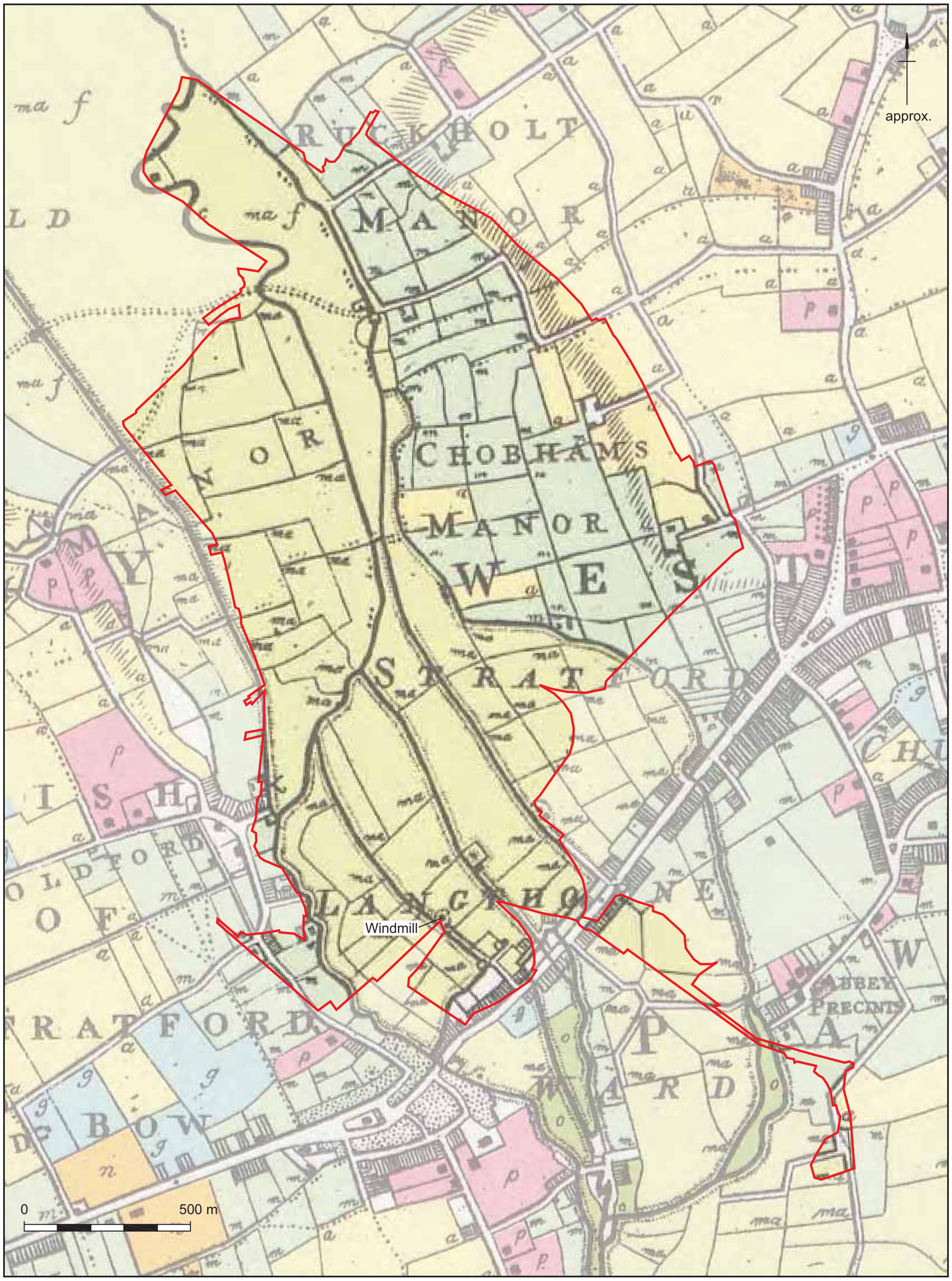


Figure 5.2: Detail of Rocque's 1746 map showing the area around the Olympic Park

Although not as accurate as later maps in its surveying, Rocque's map nonetheless gives a vivid impression of the general pattern of post-medieval land-use. Much of the marshland south of Temple Mills had been drained to create large tracts of grazing land, and the landscape consisted almost entirely of plots of land enclosed by those ditches. Only in Hackney Marsh, at the north-east of the Olympic Park, was the mid-18th century landscape still unenclosed, and doubtless subject to less systematic drainage. While those fields away from the floodplain included some

Figure 5.3: Detail of Milne's 1800 Land Use Map showing the area around the Olympic Park



ploughed land and occasional orchards, those along the river are almost all shown as pasture. The field boundaries are shown as ditches lined by hedges and trees, in places possibly remnants of earlier natural riverside vegetation.

The map also shows the pattern of interconnected river channels and mill streams, and the extensive flood banks along those channels south of Stratford and Bow. The river channels, sometimes referred to as the Stratford (or Bow) Back Rivers, split off from the main channel of the River Lea between the southern end of Hackney Marsh and Old Ford, and only converged again at Bow Creek to the south. Rocque's depiction of the rivers, however, is more schematic than accurate. While it shows Channelsea River at the east and the main course of the River Lea to the west, it depicts the Waterworks, City Mill and Pudding Mill Rivers as a single channel only splitting into the three millstreams just above Bow.

A more accurate depiction of pre-industrialised land-use is provided by Thomas Milne's *Land Use Map* of 1800 (Fig. 5.3). This too shows the Stratford hinterland as still predominantly rural in aspect, its form and use dictated by the natural topography, and the Back Rivers embanked against tidal flooding. In the early 19th century, the large swathe of enclosed marshland that flanked the east bank of the River Lea effectively acted as a buffer between the urban creep of the City of London to the west, and the dispersed rural villages of Essex to the east. Milne also shows the first major infrastructure development in the lower Lea Valley, the new Hackney Cut of the Lea navigation channel, opened in 1768. It ran down the west side of the valley from Lea Bridge to Old Ford, bypassing the long meanders on the River Lea in between, and allowing barges carrying materials and produce to pass more easily down the river to London.

The River Channels

The general pattern of river channels by *c.* 1800 is likely to have been established by the start of the post-medieval period, and is briefly described here (Fig. 5.4). At the north end of the Olympic Park the River Lea followed a very meandering course to a point just west of Temple Mills. This point is shown on the 1896 OS map as *Highest Point to which Ordinary Tides flow*. For over 1 km downstream of this point, however, it followed an almost straight line south to the start of City Mill River; this section, known as *The Bowling Alley*, was historically referred to as 'a new cut' (Fairclough 1986).

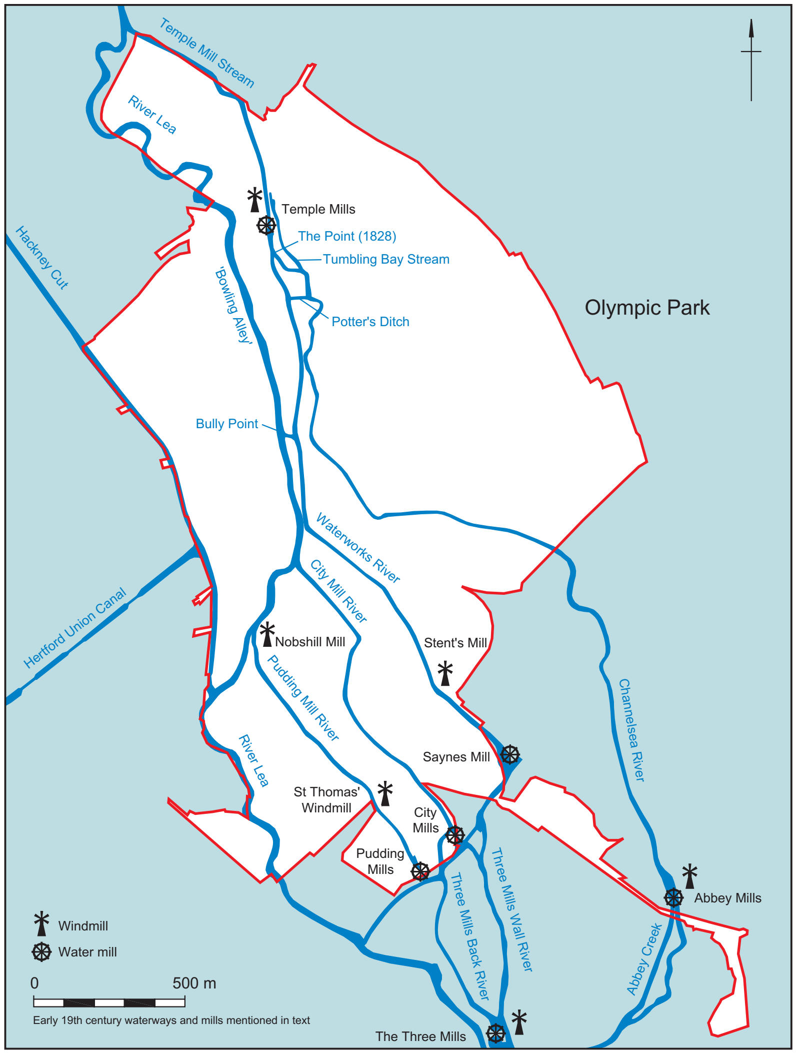


Figure 5.4: Early 19th century waterways and mills mentioned in the text

It is significant that it was the millstream for the Temple Mills, sometimes called *Shire Stream*, not the River Lea, which in this area marked the county boundary (and that between the parishes of Leyton and Hackney).

Temple Mill Stream branched east of the River Lea just above the meanders. In addition to being called *Temple Mill Stream* (as it powered these mills) and *Shire Stream*, by the late 19th century it was also referred to as *Waterworks River* (it supplied the West Ham Waterworks). To avoid confusion, it is referred to here as Temple Mill Stream from where it left the River Lea to just downstream of the mills at Potter's Ditch (see below), beyond which it is referred to as Waterworks River.

A weir (or tumbling bay) just above the Temple Mills diverted some of the water through a channel (*Tumbling Bay Stream*) that bypassed the mills to their east. The mill stream and Tumbling Bay Stream were linked below the mills first by a short channel running off the mill stream (from a point called *The Point* on an 1828 map), then another short channel known as *Potter's Ditch* (or *Pottiphers Ditch* in 1810).

South of Potter's Ditch, the mill stream (now Waterworks River) and Tumbling Bay Stream (from here usually called *Channelsea River*) followed separate but roughly parallel courses, at one point almost converging but kept separate by a narrow strip of land (only *c.* 2.5 m wide on the 1869 OS map). Channelsea River then turned sharply to the east, possibly following a meandering course at the north (as shown on the 1799 Ordnance Surveyor's drawing) although shown as straightened out on Milne's 1800 map. It then ran down the east side of the valley, eventually passing through the Abbey Mills in West Ham, with an additional channel, Abbey Creek, bypassing some of the river bends.

Just south of the near-convergence of Channelsea River and Waterworks River, the latter was connected to the Bowling Alley section of the River Lea by a short linking channel known as *Bully Point* (or *Bully Fence*, *Bullivants*). For a short distance the two channels ran parallel, similarly almost converging (by 1896 they actually did converge). Waterworks River then turned to the south-east, where it had powered Saynes Mill at Stratford (before the waterworks were established *c.* 1745); the main channel of the River Lea turned to the south-west.

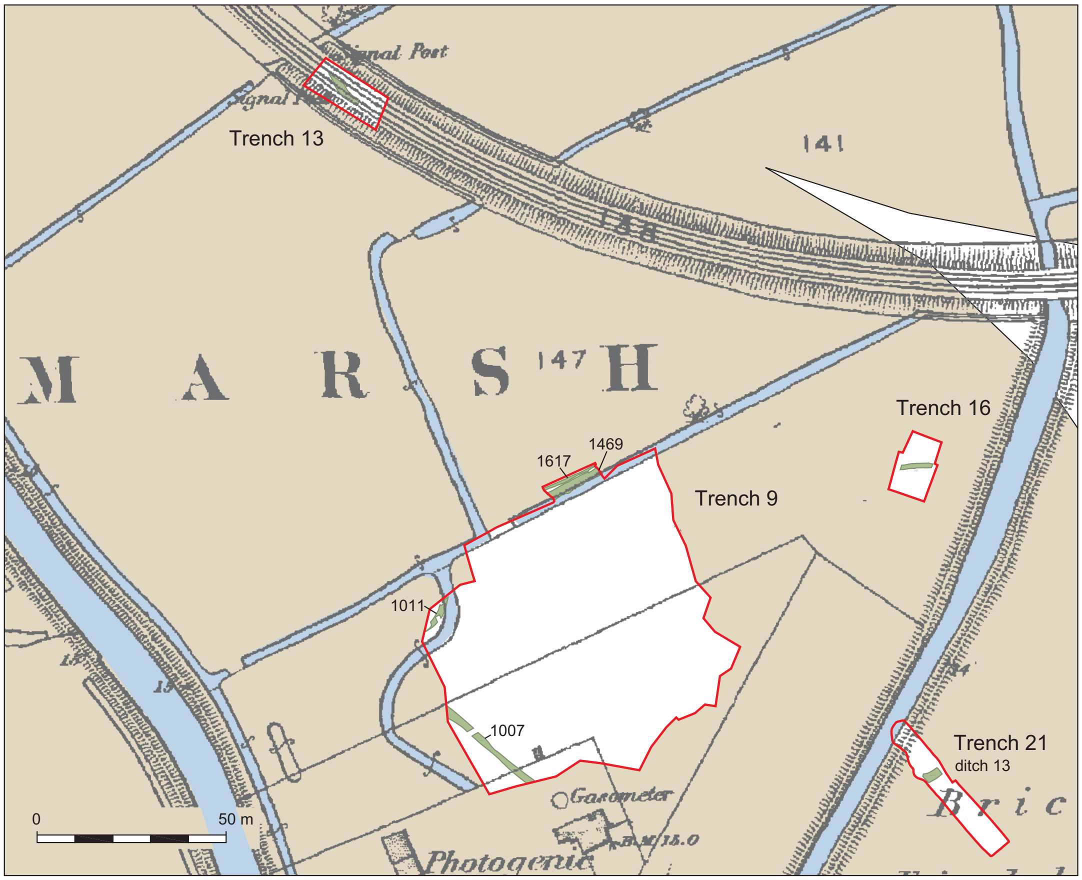
From here the River Lea fed first into City Mill River and then Pudding Mill River (also referred to as *Hart's Mill Stream*); in the mid-20th century the northern end of Pudding Mill River was infilled and recut from *c.* 140 m further down the Lea. The River Lea then flowed down the west side of the valley through Old Ford, eventually becoming the mill stream for the Four Mills in Bromley.

Immediately north of Bow High Street, a complex of channels provided links between the Waterworks, City Mill and Pudding Mill Rivers and the River Lea, while south of the High Street, another two channels, the *Three Mills Back River* and the *Three Mills Wall River*, ran down to The Three Mills at Bromley, before joining Channelsea River below the mills. All the channels converged in Bow Creek, south of the Four Mills.

Although archaeological trenches examined a number of these main channels (Tumbling Bay Stream, Potter's Ditch, Channelsea River, Waterworks River and Pudding Mill River), few of the finds from them were clearly dated to the post-medieval/early Victorian period, probably due to the continued maintenance – scouring, re-cutting, revetting etc – to which they are likely to have been subject later in during the 19th century (see Chapter 6).

Land and Water Management in the Rural Landscape

In the post-medieval period, as earlier, management of water in the Lea Valley was central to the use of the land. This was not just the water flowing down the river channels and sometimes spilling over their banks, but also the water draining off the adjacent valley sides, the waters penned back by the weirs of the mill owners, and the tidal waters at times reaching up as far as Temple Mills. While intermittent and seasonal flooding could enrich the meadows and pastures on the valley floor, prolonged flooding and the incursion of brackish tidal waters would have had a detrimental effect, and the numerous ditches shown on 18th and 19th century maps indicate the efforts taken to ensure that the land was adequately drained.



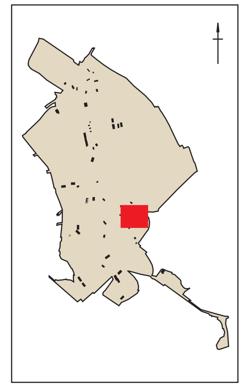


Figure 5.5: Locations of Trenches 9, 13, 16 and 21 in relation to 1869 OS map

Roads

A network of post-medieval roads served the local agricultural community, linking the surrounding villages. Few, however, ran onto the valley floor, let alone across it. The main exception was the High Street crossing of the valley on a causeway at Stratford and Bow. There were lanes running south from it to The Three Mills and Abbey Mills, and, to the north, the beginnings of Marshgate Lane and Wharton Road (later Warton Road) (shown on Milne's map, Fig. 5.3) leading to Pudding Mills and Stent's windmill; at Stent's Mill there was a bridge across Waterworks River.

Rocque's map (Fig. 5.2) also shows a trackway crossing the southern end of Hackney Marsh, part of which was exposed in Trench 105.

Trench 105

The trackway (recorded only in section, ran north-west–south-east across the southern part of the trench, on the south-west side of, and parallel to the medieval water channel 135/311 (see Chapter 4, Fig. 4.14). It is possible, therefore, that it too was of medieval origin (or even earlier). In its early recorded phase it consisted of a compact layer of gravel and sandy clay up to *c.* 0.6 m thick and with a distinct camber. There was a wide shallow depression, 3 m wide and 0.3 m deep, along its south-western side, from which was recovered a piece of post-medieval ceramic building material (CBM). The trackway was overlain by a thick layer of alluvium, but a possible resurfacing of what appears to have been a long-lived feature is represented by a layer of CBM fragments, gravel and clay, up to *c.* 0.2 m thick, deliberately laid above the alluvium.

As shown on Rocque's map (Fig. 5.2), the curving trackway ran from the bridge over Temple Mill Stream to another across the River Lea, and then split into two branches across the Hackney Marsh, one to Homerton, the other to Hackney Wick. (The bridge across the Lea, called *White Bridge* on later maps, was only a footbridge until the 1890s when a new iron bridge was built; until then horses and vehicles had to ford the river just downstream from it.) By 1828, a new straight length of road had been built between Temple Mill Stream and the River Lea – both roads being shown on the 1832 map of the parish of St John at Hackney, and the 1862 Stanford map (Fig. 6.2) (but not on the 1869 OS map).

Marshland Drainage and Division

In addition to the possible medieval channels described in Chapter 4, a number of other historic ditches were exposed within the archaeological trenches. These are summarised in Table 5.1. Their depiction on some of the early maps, such as Rocque's map of 1746, the Ordnance Surveyor's drawing of 1799 and Milne's *Land Use Map* of 1800, was largely

Table 5.1 Summary of other ditches/channels

Trench	Ditch no./ name	Width (m)	Depth (m)	Dating	Description	Map evidence
East of Channelsea River						
86–91	Henniker's Ditch	<4.0	1.0	1800 or later	Early phases truncated by later 19th century recuts	Shown on Rocque's 1746 map; named after John Henniker Esq, an 18th century landowner who lived at Stratford House
East of Waterworks River						
99	224	1.2	0.7	–	Sealed by alluvium	–
	218 (recut as 216)	2.3	0.4	–	Adjacent to 224, also sealed by alluvium; spread of redeposited alluvium to north may be upcast from excavation, capped with gravel to form surface?	–
106	140	2.0	0.6	–	Sealed by alluvium	–
Between Channelsea River and Waterworks River (Fig. 5.5)						
9	1007 1011	1.0 0.8	0.2 0.3	– –	Irregular line could mark an earlier natural channel, possibly of Channelsea River (Bower and Thompson 2008, 45)	Matches boundary shown on 1818 Walker map
	1617 1469	0.7 2.4	0.2 0.2	– 19th–20th	– Possible clay/timber lining	Parallel ditches forming part of field boundary shown on 1818 Walker map
13	184	2.3	>0.7	–	Sealed by made ground – and covered by later railway embankment	Matches boundary shown on 1818 Walker map
16	191	0.9	0.2	–	–	–
21	13	<2.4	0.6	Lower fill produced C14 dates – Late Saxon (humic material) and medieval (plant material), as well as post–medieval pantile	–	Matches boundary shown on 1818 Walker map
Between Waterworks River and the River Lea						
93	812	1.8	0.8	–	Recorded in section, cutting and sealed by alluvium	–
Between Waterworks River and City Mill River						
101	189	2.5	1.0	–	Perpendicular to channel represented by 135/311 in Trench 105 (above)	–
Between City Mill River and Pudding Mill River						
113	92 (Fig. 3.12)	1.1	0.1	Undiagnostic CBM	–	Matches boundary shown on 1821 Clayton map, and probably also on 1800 Milne
Between Pudding Mill River and the River Lea						
110	1	3.0	0.6	Late 18th century glass, 19th century pottery, CBM and clay tobacco pipe	Timber stake (5) driven into the south-eastern edge	Matches boundary shown on 1809 map; by 1868 the ditch was shown as infilled within property fronting onto Marshgate Lane, but still extant to the south-west

schematic, making it hard to correlate them with excavated features. Parish surveys and tithe maps, however, such as Walker's 1818 map and Clayton's 1821 survey of West Ham, where recording the ownership of the numbered land parcels required more precise representation, provide a much more accurate depiction of the boundary ditches, allowing some of the excavated ditches to be identified.

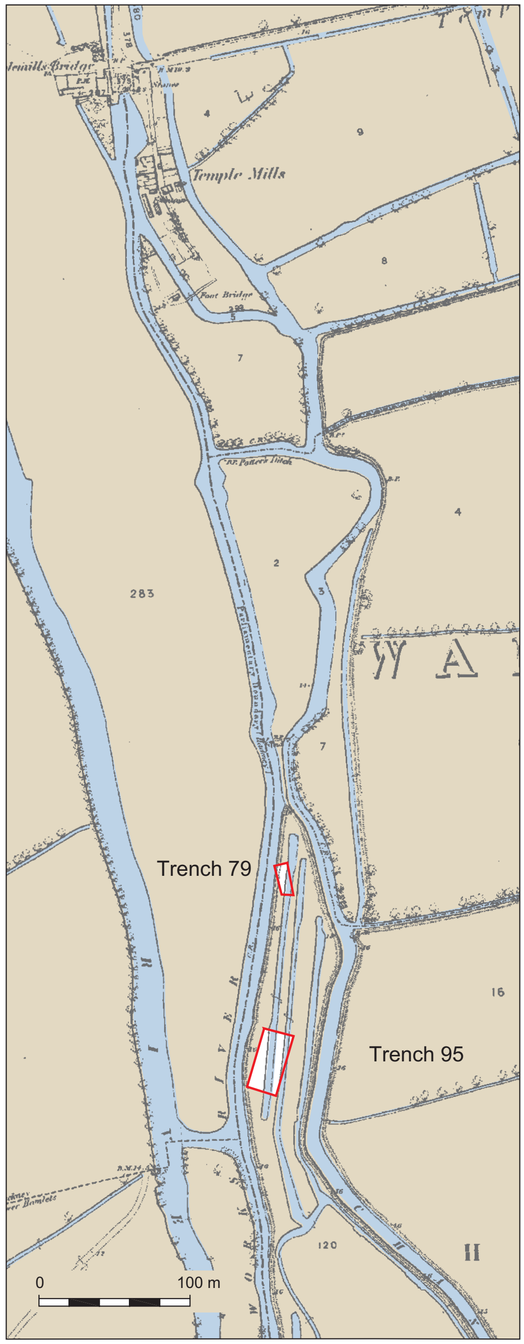
As Walker's map was reduced from maps surveyed in 1735–47, it is likely that these ditches had relatively early origins within the post-medieval period, or even the medieval period. Walker's map also shows a number of watercourses, including *Little Tommy Lee Sewer* and *Great Tommy Lee Sewer*, winding between the fields, the latter discharging into the southern end of Waterworks River. As these two passed through the fields between Channelsea River and Waterworks River, they are likely to have had a primarily surface drainage function, as opposed to the removal of sewage. The course followed by *Great Tommy Lee Sewer* is shown as a river channel on Rocque's map. Another sewer drained into Channelsea River from the north. In the later 19th century these sewers became largely culverted storm drains.

Other Land-Use Features

The long-term maintenance of the ditch system which drained the marshes reflects the importance of the valley floor as an agricultural resource. Seasonal overbank flooding from the river and the laying down of lenses of silt could enhance soil fertility of the meadows and pasture which dominated the valley floor landscape. There were, however, other forms of land-use which perhaps exploited more directly the area's wet conditions, such as osier beds and watercress beds, for which possible evidence was found in Trench 79, just south of Temple Mills.

Trench 79

Trench 79 was one of two trenches excavated within a narrow strip of land between the Waterworks and Channelsea Rivers immediately south of where they almost converged (Fig. 5.6). Alluvial deposits in the trench were cut by a vertical-sided flat-based feature (6), *c.* 0.4 m deep (recorded only in section), filled with layer of soft clay. Only the southern edge of this feature was visible, and its form and extent are therefore not known.



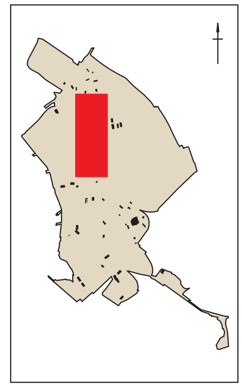


Figure 5.6: Locations of Trenches 79 and 95 in relation to 1869 OS map

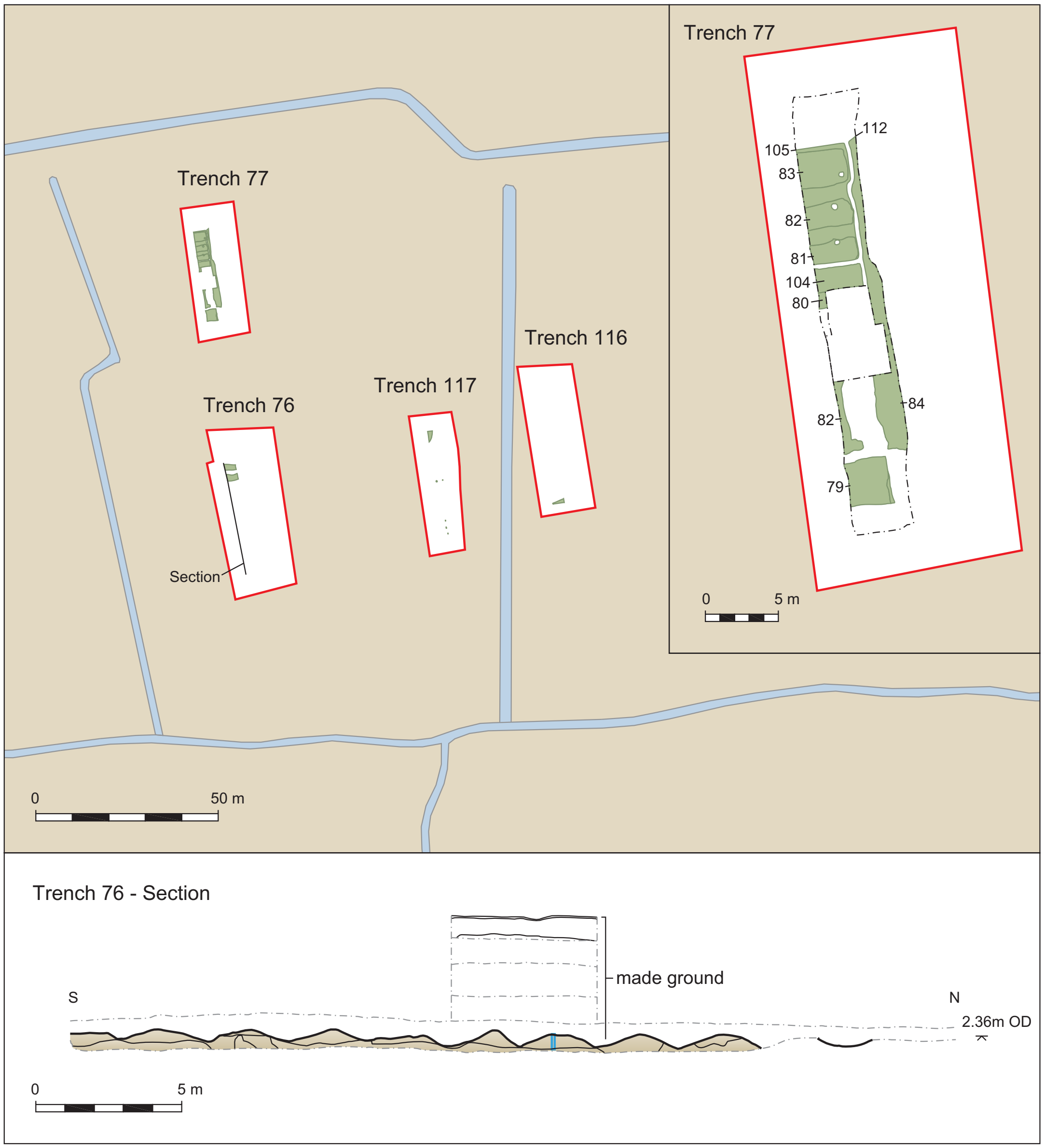
Figure 5.7: Detail of 1799 Ordnance Surveyor's drawing: Temple Mills to Bully Point

A series of maps, from as early as the 1799 OS drawing (Fig. 5.7) and including OS maps up until 1946, show this strip of land largely occupied by three straight, parallel channels. These lay at a very shallow angle to the trench, and it is possible that it was one of these channels, shown on the 1st edition OS map to have been 3–4 m wide, that is recorded in the section. No similar feature, however, was recorded in Trench 95, *c.* 90 m to the south in the same strip of land, and covering the same parallel features.

These channels are of uncertain function. In the apportionment accompanying Clayton's 1821 map this plot (90) is described (like most of the surrounding plots) as *Marsh Pasture*. However, while these channels may have been simply for drainage – they are linked to a number of drainage channels to their south – it is unclear why this narrow strip of land should require such intensive drainage. Moreover, the channels take up much of this narrow area strip of land, and so would have left little ground available for grazing.

One possibility is that the channels relate to osier beds. These are areas of wet land planted with willow rod cuttings; the cuttings root easily and can be cut every 1–2 years to produce withies for use in making baskets and fish-traps etc. The 1799 OS drawing (but not later maps) shows similar parallel features on the small island between the same two river channels *c.* 300 m further north, immediately south of the Temple Mills ground (Fig. 5.7). It is known that a number of osier beds were associated with Temple Mills in the post-medieval period. For example an *osier plott* is referred to in a lease of the mills in 1601, and a 1½ acre osier ground is mentioned in 1769 (Hackney Archives M793). A plan of 1834 shows that there was a parcel of land called *Osier Hope* between Tumbling Bay Stream and Shire Stream (Waterworks River) at the southern end of the Temple Mills (Douglas and Spurr 2009, 19); a 'hope' is a piece of enclosed land in the midst of fens or marshes.

A number of osier beds are shown on early maps in similar riverside locations in the



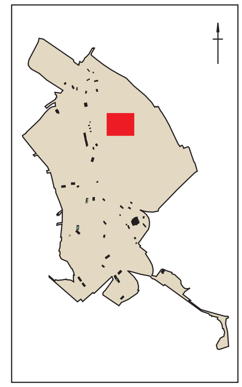


Figure 5.8: Locations of Trenches 76–77, and 116–117 with detail of the features in Trench 77

lower Lea Valley. One is shown on Gascoigne's 1703 map between the River Lea and The Old River (Fig. 4.11, above), north of Bow, while Milne's 1800 *Land Use Map* (Fig. 5.3) shows a number of probable osier beds south of Bow and Stratford. Clayton's map, and the accompanying apportionment, also identify a number of *Osiers*, although it must be noted that neither the Milne nor Clayton maps indicate any osiers at Temple Mills – despite the documentary references. A field with parallel lines, shown on Rocque's map north of Temple Mills (Fig. 5.2), possibly part of the Ruckholt Manor estate, has been suggested as an osier bed (Barrowman and Corcoran 2008, 27), but no comparable features were recorded in the trenches excavated within that field.

Another possibility is that the channels represent watercress beds. Watercress is thought to have been cultivated in the lower Lea Valley from medieval times, and there were mid-18th century watercress beds on Morning Lane and Pond Lane, Hackney, watered by Hackney Brook (Hackney Archives 2011). Although concerted commercial cultivation of watercress was not established in Britain until the 19th century, the possibility that these features are watercress beds of at least late 18th century origin is given some support by the fact that at the end of the 19th century there were watercress beds laid out to the immediate north-east of Trench 79 (on the east of Channelsea River) (see Chapter 6, Fig. 6.33).

Some other form of land-use is suggested by a number of linear features recorded in Trenches 76 and 77, including a pattern of parallel, east-west aligned shallow cuts (Fig. 5.8). These were initially interpreted as ridge and furrow (Barrowman and Yendell 2008, 30), a feature caused by the repeated ploughing of field strips, usually in medieval open-field systems. The trenches lie within the area of a single field, shown on Milne's *Land Use Map* of 1800 as comprising *Common Meadow Field*, part of a strip of land on the east side of the valley between the *Arable Land* on the valley side and the *Marsh Land* west of Channelsea River.

Trenches 76 and 77

The features in Trench 76 cut through a relict topsoil overlying alluvium, and were observable in section across the full length of the trench (Fig. 5.8). They were spaced on average 2.8 m apart, and were between 0.2 m and 0.55 m deep with gently sloping sides. Similar linear features were observable in adjacent Trench 77, where their slightly squared eastern ends were recorded in plan. Despite their interpretation as ridge and furrow, their sometimes quite sharp profiles suggest that they may instead represent drainage furrows, of possible post-medieval date, cut to improve the quality of pasture land subject to flooding. (Two 19th century ceramic field drains, aligned NW-SE, were recorded in Trench 117 to the immediate east of Trench 76.) They were sealed by made ground deposits up to 4 m thick.

Trench 77, however, revealed a more complex sequence of activity than that seen in Trench 76. The three northern parallel cuts (81, 82 and 83) appear to lie within, and largely fill, a larger rectangular feature (105), *c.* 8 m wide north-south, and like the cuts extending west of the trench. A similar large feature (104) lay to the immediate south, and another (112) to the immediate east, each apparently separated from each other by strips of undisturbed alluvium of consistently narrow width (*c.* 0.3 m). There appear to have been similar features (78, 82 and 84) towards the south of the trench.

Although feature 104 was only 0.3 m deep (the others were of probably similar depths), these large features were interpreted as possible gravel extraction pits (*ibid.*, 14), probably because the 1st edition OS map shows a *Brick Field c.* 250 m to the east; by 1896 the adjacent fields had been amalgamated and together were labelled *Brick Field*. However, neither the large features nor the linear 'furrows' contained finds, and so remain undated. The linear features were directly overlain by made ground deposits up to 4 m thick, containing pottery, glass, metal, CBM, bone, clay tobacco pipe, wood and leather dating from the early 19th century onwards.

A public health map of 1905 (Fig. 6.33, below) shows the area labelled as 'house refuse' and a photograph of 1935 (Pl. 6.3, below) shows that the trenches fell within a large enclosed plot containing buildings, long sheds and other features; the nature of these works (also indicated on the 1938 OS map) is uncertain, but by 1951 the site is marked as a *Cooperage*.

Trench 78

Features described as 'furrows', cutting alluvium, were also recorded in Trench 78 (Barrowman and Spurr 2008, 16). One large, irregular feature, visible in section as two almost adjacent 'furrow type' cuts (21 and 22), was recorded cutting a layer of alluvium (19) (not illustrated). It was at least 8.7 m wide up to 0.35 m deep with steep sides and an irregular flat base, and its single fill contained pottery, glass, metal, and CBM dating from the 19th century onwards. It was overlain by modern made ground. The alluvium (19) was overlain by further alluvium (17) which was cut, in the western corner of the trench, by a possible ditch (28), its eastern edge aligned approximately north-north-east–south-south-west. The ditch was over 0.6 m deep with vertical sides and a flat base, and a single clay fill (27). This ditch fill was cut in turn by a feature (29, visible only in section) also described as a 'furrow', as was an adjacent feature (30) which also cut alluvium 17. All these features are of uncertain character and function, and all were sealed by modern made ground. The trench lay within a narrow strip of land immediately east of Channelsea River.

Other possible extraction features

Clay or gravel extraction may be indicated by other features recorded across the Park, such as six large pits – in Trench 21 (pits 19, 54 and 72) and Trench 22 (37, 39 and 63) (Fig. 5.1) – which lie within a plot of ground called *Brick Field* on the 1869 OS map. In both these trenches the pits cut through the alluvium to depths of *c.* 0.9 m, ie, to the top of the natural gravel. They are probably 19th century clay extraction pits, although the quarrying did not seem to be as systematic as the field name suggests and extraction may have been undertaken as and when required. The pits were all sealed by 20th century made ground.

Exploitation of the Waterways

The character of the pre-industrial landscape imposed limits on the nature of farming and settlement in the lower Lea Valley, but its waterways were ripe for exploitation. To the complex network of channels were added tidal locks, weirs (tumbling bays), sluices and floodgates, many of them shown on a *Map of the Lea Navigation* dated *c.* 1825 (Fig. 5.9). These were designed to regulate the flow of river and tidal waters in order to meet the competing interests not only of the mill operators at different locations along the various channels, but also of the landowners, fishery owners, operators of the Ware barges transporting produce down river to London, and the water supply companies extracting water from the river. All these interests competed for this limited resource, resulting in numerous legal disputes, and sometimes violent confrontations (Burnby and Parker 1978).

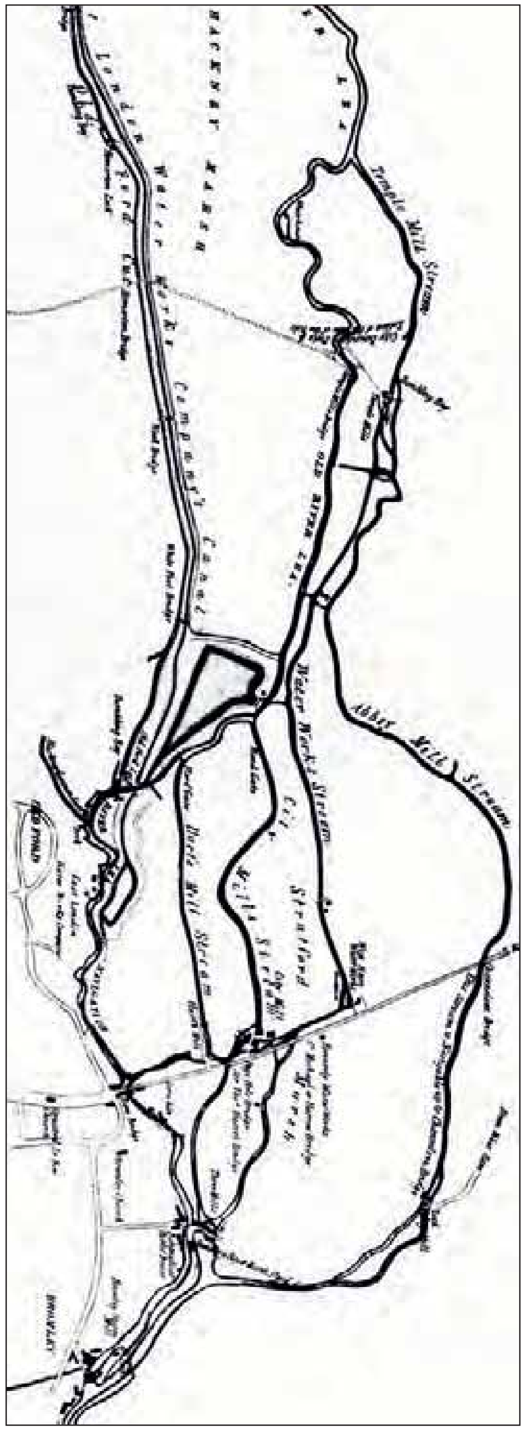


Figure 5.9: 1825 map the Lea Navigation

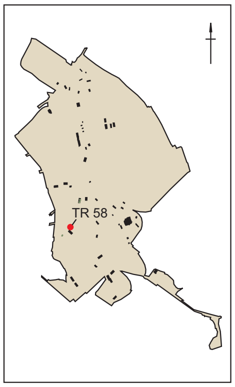
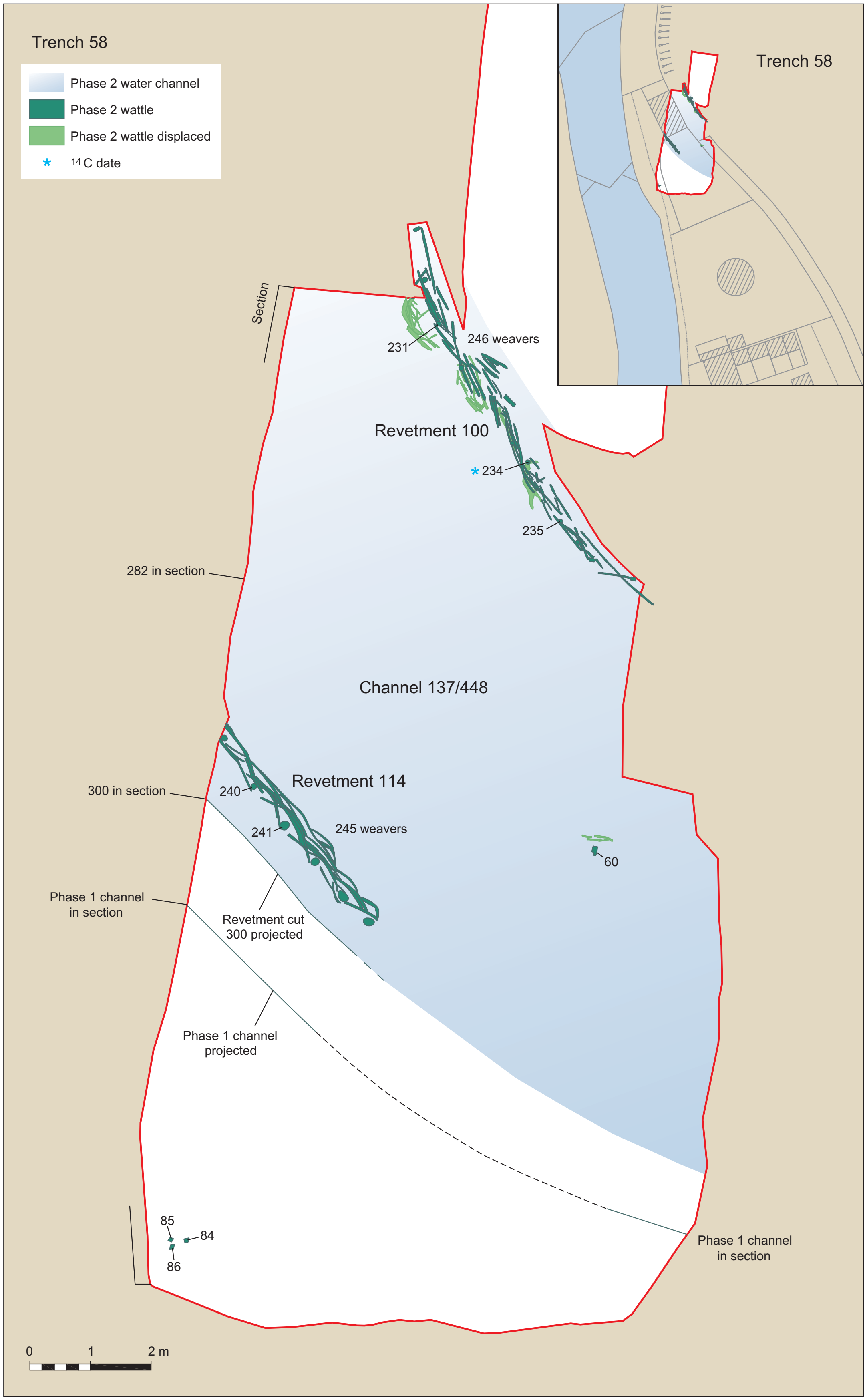


Figure 5.10:
Trench 58: Phase 2 channel and revetment, and location in relation to 1850 OS map



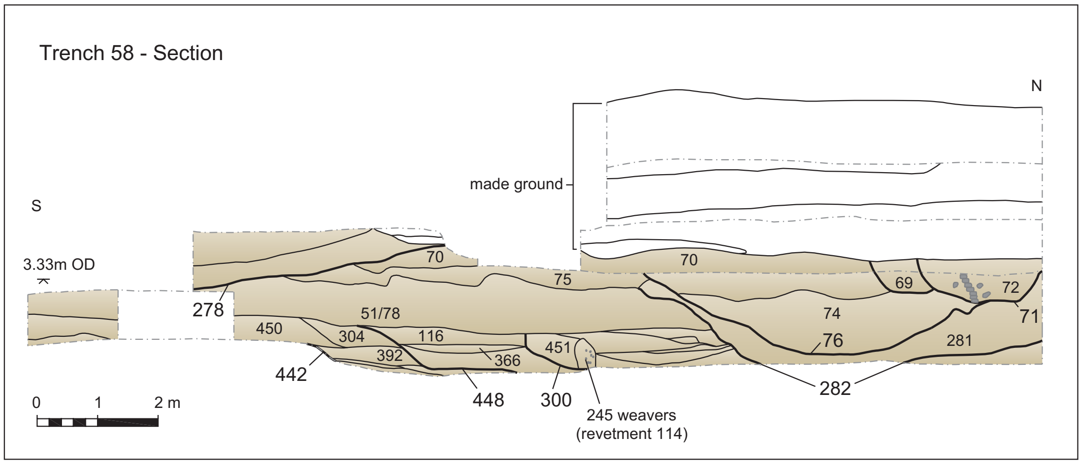


Figure 5.11: Trench 58: east-facing section

The Waterways as a Power Source

For centuries the Back Rivers had been harnessed to provide power for the medieval and post-medieval mills. Because their successful operation was dependent upon a strong and consistent water supply, the channels were frequently redirected, revetted, dredged and scoured. The opening up of the waterways to accommodate regional trade provided further opportunities for the local milling industry to supply the London markets, and it is likely that many of these mills developed their own wharves and acquired landing rights to facilitate movement of their goods.

The abandonment of a millstream?

The substantial Phase 1 water channel of probable medieval date (see Chapter 4), revealed running north-west to south-east in Trench 58, was subsequently recut, and an early post-medieval wattle revetment was inserted along both edges. After a long period of alluvial deposition, a sequence of further but less substantial channel/ditch cuts were made along its line, suggesting a change in its character and likely function (Figs 5.10, 5.11).

Phase 2

When the visible profile of the Phase 1 channel 137/448 (see Chapter 4) was heavily silted, its fills were recut (300) and a wattle revetment (114) constructed *c.* 0.7 m in front of the recut's edge. The revetment, which continued beyond the western edge of the excavation, was *c.* 4 m long, and since the top of the recut was not recorded in plan, the channel's line and extent within the excavation is not precisely known. The recut was excavated to a depth of 0.7 m without its base being reached. The revetment consisted of six roundwood oak stakes, spaced 0.6-0.95 m apart (Fig. 7.13, below; Pl. 5.1) woven with bunches of three or four wattle rods (245) mostly of willow/poplar (see Goodburn, Chapter 7). The space behind the revetment was backfilled with sandy gravel (451) up to *c.* 0.6 m thick.

There was a parallel, although slightly less substantial revetment (100), *c.* 6.5 m to the north-east. The cut (413) against the edge of which it was constructed (as visible in one section) probably marks the opposite side of the recut channel (although this too was not recorded in plan). This revetment, which

Plate 5.1: Revetment 114 in Trench 58, from the north

was exposed for over 7 m, consisted of 11 stakes (oak interspersed with smaller stakes of a softer deciduous wood), which as they survived had uneven spacing (*c.* 0.4–1.4 m). One of the stakes (234) produced a radiocarbon date of cal AD 1470–1650 (SUERC-36580, 315±35 BP), falling broadly within the early post-medieval period. The weaving of the wattle rods (246) was similar to 245, although some had become displaced from the stakes; in places the revetment leant slightly forward into the channel.

A sequence of layers of sand and clay then accumulated within the recut channel indicating variable rates of water flow, eventually submerging both revetments.

Phase 3

The infilled recut 300/413 was sealed by a layer of silt (51/78) which extended over its southern bank, and that of the original channel (448/137), to a depth of up to 0.45 m, indicating a period of significant alluvial deposition resulting from overbank flooding (Fig. 5.11). This was cut by a second channel recut (81/282).

Recut (81/282), at *c.* 3.4 m OD, was only recorded in section, in the western side of the excavation, with only its south-western side fully visible (Fig. 5.11). Because the section cut obliquely across the channel, the base of which was not reached, its width and profile cannot be determined, although it was at least 1.4 m deep. It was filled with a thick layer of alluvium (281), the molluscan evidence (*Viviparus viviparus* and *V. contectus*) appearing to indicate the channel's role in water management (see Chapter 8).

Phase 4

Recut fill 281 was cut, from at least 3.4 m OD (but possibly higher), by a third channel recut (76), also visible in the same section only (Fig. 5.11), although both sides of this cut were visible allowing an estimation of its width at 5 m. It was at least 1 m deep with a concave base and relatively steep sides and it contained two silty clay fills, the lower (74) being organic-rich at the base and containing large fragments of wood.

Further layers of alluvium (75 and 70), in places over 0.4 m thick, overlay these fills but also appeared to extend over the south-western bank of channel 76, possibly indicative of another prolonged period of post-medieval or later flooding.

Phase 5

Layer 70, as recorded in the stepped section along the west side of the excavation, was cut by three features – a broad shallow feature (278) of uncertain nature, *c.* 0.7 m deep, at the south, and a sequence of two small features above the line of the earlier channel cuts (Fig. 5.11).

Because the two small features, both at *c.* 3.48 m OD, spanned two faces of the stepped section, their form and dimensions are hard to determine, However, the earliest of the two (an un-numbered cut) was at least 2.4 m wide and 0.6 m deep with a steep southern side curving to a flat base, and a single fill (69). It was cut on its north side by feature 71, measuring at least 2 m wide and 0.7 m deep, with a similar if slightly less regular profile. It too had a single silty clay fill (72), although within this there was a brick structure (visible on the lower face of the stepped section) comprising a stack of seven single bricks, each slightly offset from the one below so that the structure leaned to the south. Sealing all three features was the earliest of a series of made ground deposits, collectively *c.* 2 m deep.

It is not clear whether the two small features were discrete pits, or ditches extending across the excavation. It is possible, however, that a steep-sided, flat based cut (129), 0.7 m deep and at least 1 m wide and with a single fill, recorded in section in the eastern side of the excavation, below the made ground, is associated with them. Cut 129 is in the right position to be the drainage ditch shown on 19th century maps.

Isolated posts

There were two isolated posts, consisting of reused ship's timbers (see Goodburn, Chapter 7) (Fig. 5.10). One (60), which was located close to the centre of the Phase 2 channel recut (300/413), was *c.* 1 m long and dated originally to the 17th century or later. Its precise stratigraphical position is unclear, however, as is its function, as it was covered by a layer containing modern brick. It may have been driven in from a higher level and therefore be not directly associated with this channel cut.

The other post (86) lay *c.* 9 m to the south-west, outside the edges of any of the ditches and channels, and could date originally anywhere between *c.* 1500 and the mid-19th century. Two smaller pile tips (84 and 85) had been inserted as wedges to support the post; the presence in these of copper alloy nails suggests an 18th–19th century date.

As discussed in Chapter 4, the Phase 1 channel (137/448) recorded in this trench may represent part of the course of the medieval mill stream serving Fotes Mill/ St Thomas's Mill/Pudding Mills, and the Phase 2 wattle-revetted channel appears to be an improvement to it. If so, this would suggest that Pudding Mill River, at least at its northern end, was a later cut. Map evidence indicates that its 19th century course was established by at least 1800; its line as depicted on Milne's map, although slightly schematised, corresponds closely to that on later maps (Fig. 5.3).

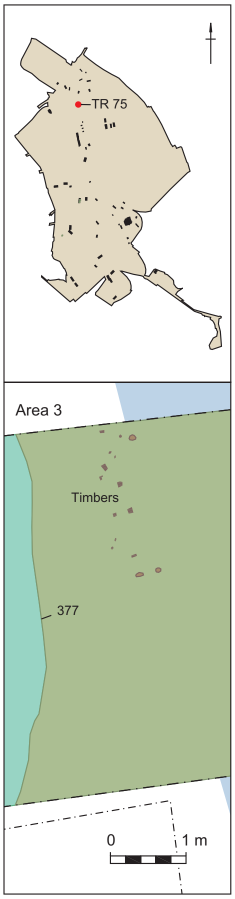
Unfortunately, its depictions on 18th century maps are clearly not accurate, and provide no clues as to whether there had been an earlier cut, and if so when the modern course of the river was established. The partial excavation (in Trench 59, below) of almost the full width of Pudding Mill River at a point just 45 m to the south of Trench 58 did not establish its date of origin, the earliest indication being the timber revetment probably dating from the early 19th century.

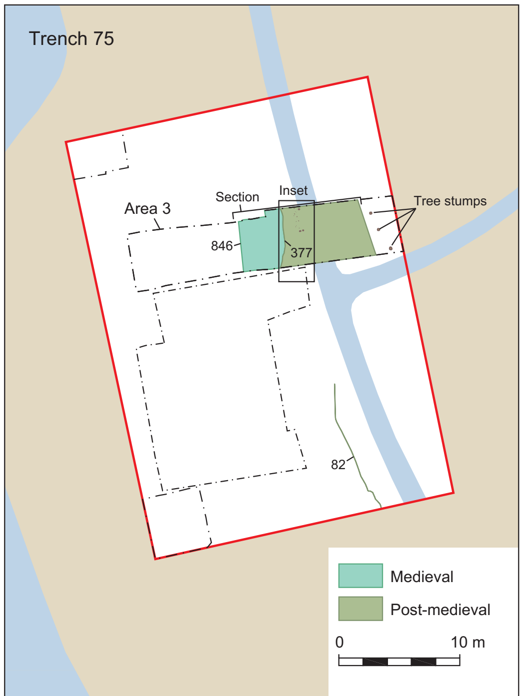
By the early 19th century, the channel in Trench 58 had been largely infilled, and its former line is first shown as a boundary ditch on the 1818 Walker map (probably represented by cut 129 visible in the trench's eastern section). That this ditch had a more complex function than some other field ditches, however, is suggested by the fact that it is shown on the 1850 OS London Town Plan where it appears to run south from a small rectangular building positioned on the east side of Pudding Mill River, adjacent to a bi-directional floodgate (Fig. 5.10 inset). The 1850 map shows only structural features within the landscape, such as major water channels, locks, reservoirs, road and buildings, and omits field boundaries and drains. The floodgate, like another in a similar location on City Mill River, was present by 1825.

The 1850 map indicates that the 19th century drain, while visible in the eastern side of the trench, stopped short of the trench's western side, and it is likely that the brick structure in feature 71 is related to the small building, no other trace of which was recorded. The building, measuring on the map *c.* 7 m by 4 m, appears on maps up to 1882 and probably had some function related both to the drain and the floodgate. The floodgate is likely to have been built to mitigate the effects of changing water levels in the tidal River Lea to the immediate north, retaining water in Pudding Mill River as the tide ebbed. By 1869 the floodgate had been removed and appears to have been replaced by a weir across the top of the river.

A tumbling bay at Temple Mills, Trench 75

During the 16th and 17th centuries complaints were frequently made to the Commissioners of Sewers that the occupants of the Temple Mills were causing flooding of the surrounding marshland by keeping their floodgates closed for extended periods during spring tides in order to ensure the highest possible pen of water to power the mills (*VCH* 1973). Part of the solution to this may have been the





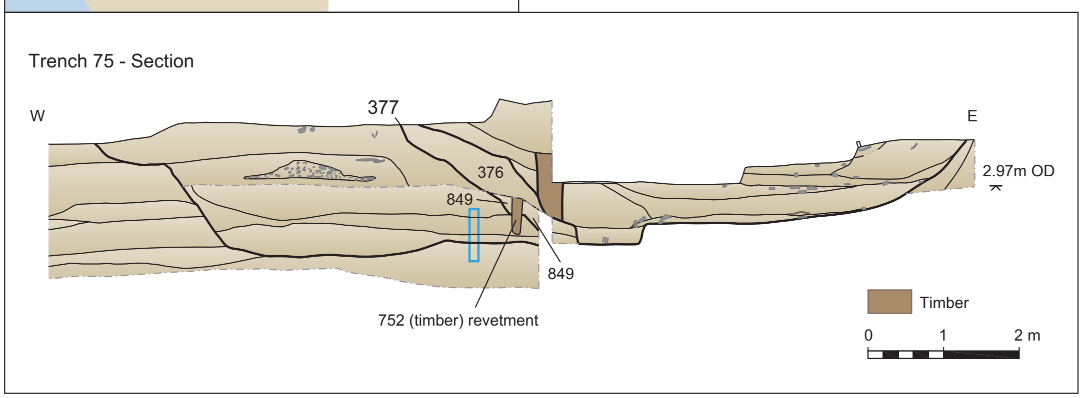


Figure 5.12: Trench 75: south-facing section of Tumbling Bay Stream

construction of a tumbling bay (an overflow weir) just above the mills, which diverted water around their eastern side. This channel, Tumbling Bay Stream, was exposed in Trench 75, and was an important element of the post-medieval and modern mills' infrastructure at the Temple Mills industrial site. Although subsidiary to the main mill stream, it would have acted as a source of power in its own right. It would have been from Tumbling Bay Stream, for instance, that water was diverted through a timber-lined channel to provide power to an industrial building (Building 2, Temple Mills Phase 2, see below).

As with other channels, later modifications to the stream, including recutting and revetting in the second half of the 19th century (Temple Mills Phases 4–5, Chapter 6), have largely truncated its earlier cuts and fills, but some evidence dating to this period was identified, apparently contemporary with the adjacent Phase 2 or Phase 3 industrial and domestic structures on the site (see below).

Part of an early cut (377) of Tumbling Bay Stream survived on the western side of the channel (in Area 3) (Fig. 5.12); its edge may also be represented by cut 82 in the southern part of the site.

In addition, a linear arrangement of 13 irregularly spaced roundwood stake tips (one, 752, visible in section), and a further three stake-holes, arranged possibly in two lines 0.2-0.3 m apart, was recorded over a distance of 2 m (in Area 3) (Fig. 5.12). The stakes (two identified as willow/poplar) were driven into the bank of channel 377, approximately half-way up the western side, and could have supported a fence or light-weight revetment perhaps built to prevent people and livestock falling into the channel. They were all of boxed heart conversion, both square and circular in section and with an average width of *c.* 50 mm. The structure may have been replaced and/or repaired over time, as wattle fences are relatively short-lived (ten years at the most); no horizontal timbers were recorded. The larger stake tips could possibly have supported a heavier structure such as a post-and-rail fence.

No similar structure was recorded on the channel's eastern bank, although the stumps of three willow/poplar trees, evenly spaced 1.5–2 m apart, may indicate deliberate planting to stabilise the river bank. Both archaeological evidence and explicit documentary sources show that such trees were often willows managed by pollarding or coppicing, providing firewood, wattle fencing material and basketry stems.

These features are tentatively associated with Phase 3 industrial and settlement activity on the Temple Mills site (see below), ie, late 18th–mid-19th century, although they could conceivably be earlier. As visible in section (Fig. 5.12), stake 752 was driven into the channel bank through a lower fill of mid-grey sandy silt (849); this was overlain in the upper part of the channel side by a layer of darker gritty silt (376), representing backfill behind the revetment, and containing pottery dated 1830–1850 and clay tobacco pipe dated 1850–1860. The backfill layer lay largely behind the line of the stakes, but had slumped a short way over the base of stake 752, presumably when the revetment had decayed.

The Waterways and Transportation

Unlike the 'two mills under one roof' at Temple Mills, the watermills further down the valley on the Back Rivers were in effect in competition for the scarce river and tidal water needed to power them. The intricate arrangement of channels south of Temple Mills (as described above), with narrow banks keeping converging channels apart, and other short channels, such as Potter's Ditch and Bully Point, linking them, is evidence of the attempts to apportion the limited water resources equitably between the Back River mills. However, the mills were not only in competition with each other, but also, increasingly during the 18th and early 19th century, with the water companies who were drawing off water to supply London and its suburbs.

During the 18th century, rapid technological advancement had resulted in the intensification of agricultural and mining practices enabling the bulk production of manufactured goods, farmed produce and fuel such as coal. This resulted in a need for improved transport links to bring raw and manufactured goods to the affluent London market and southern coastal ports. The complex arrangement of waterways in the lower Lea Valley provided the ideal framework from which to grow this network, but to facilitate the movement of ever larger barges and vessels, they required improvement and management.

During this period, navigation along the River Lea was dictated by the tidal Bow Lock, at the Four Mills in Bromley (replaced by a pound lock in 1855) (Fairclough 1986). The lock allowed barges to navigate the sharp fall in the riverbed, and the remains of a causeway (possibly Roman, see Chapter 4) at Old Ford. Coastal craft were also able to navigate Bow Creek to unload at Stratford to deliver direct to expanding industries and to transfer to smaller River Lea barges. The ways in which these waterways were adapted to accommodate increased demand for both water power and transportation can be traced through their surviving fabric and their associated standing structures, as recorded in both the archaeological and built heritage investigations.

The recorded fabric

The waterways as a whole (Built Heritage Asset (BHA) 25) were subject to a wide-ranging review (Fig. 5.13) (Bower and Thompson 2008), while specific built heritage assets were recorded by photographic survey, including Potter's Ditch (BHA 26), Old Ford Locks (BHA 30), and a stone and brick riverbank wall along the west bank of the River Lea (BHA 32). In addition, a landscape survey of Pudding Mill River (BHA 28) was undertaken. The oldest waterways features recorded date from the 1850s when the natural rivers and medieval millstreams were updated under the auspices of the Lea Conservancy Board.

Structures subject to a higher level of building record largely date from the 20th century, eg, Carpenters Lock (BHA 27), Pudding Mill Lock (BHA 31), Marshgate Lane Lock (BHA 34) and Old Ford Lock house (BHA 33), and these are addressed in Chapter 6.

Features relating to the infrastructure of the waterways were also exposed and recorded during the archaeological investigations. Most of these comprised revetments and/or other riverside timber structures, although the discovery of the well-preserved remains of a small clinker-built boat lying against a revetment on Pudding Mill River highlights the role of these waterways for transport and communications, as well as recreation.

Pudding Mill River

Timber riverside structures were recorded in two trenches along the east side of the river. Although both have been interpreted loosely as 'revetments', significant

Figure 5.13: Location of BHAs mentioned in this chapter

Figure 5.14: Trench 59: location of features in relation to Nobshill Mill and Knobshill Cottages

differences between the structure in Trench 59, located beside an early 19th century mill towards the north end of the river, and those in Trench 41 further to the south, suggest variable and more specific functions.

River channel and revetment

Only the slightly irregular eastern side of the Pudding Mill River channel (319/2008) was exposed within Trench 59 (Figs 5.14, 5.15). At its widest point the trench base extended *c.* 8.7 m west from the channel revetment, and as the river at this point is shown on early edition OS maps as *c.* 11 m wide, its western bank must have lain just beyond the trench base. The channel, which was moderately steep-sided, was excavated to a depth of *c.* 2.6 m without its base being reached (Fig. 5.15).

Its lowest recorded fill (429) was a dark orange-brown silty clay with occasional small rounded pebbles, which extended across the trench and appears to represent a late silting deposit within the river. A boat (below) rested on this layer, and was filled and sealed by further layers of silty clay (428 and 427), the upper of which sealed the top of the revetment; both layers were cut by a large modern feature (394).

Figure 5.15: Trench 59: north-east-facing section

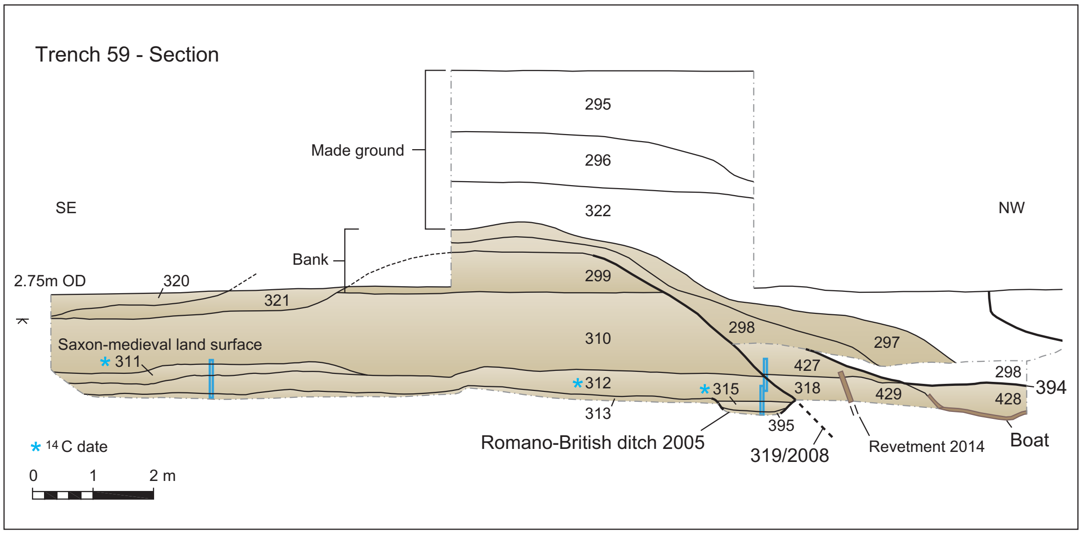
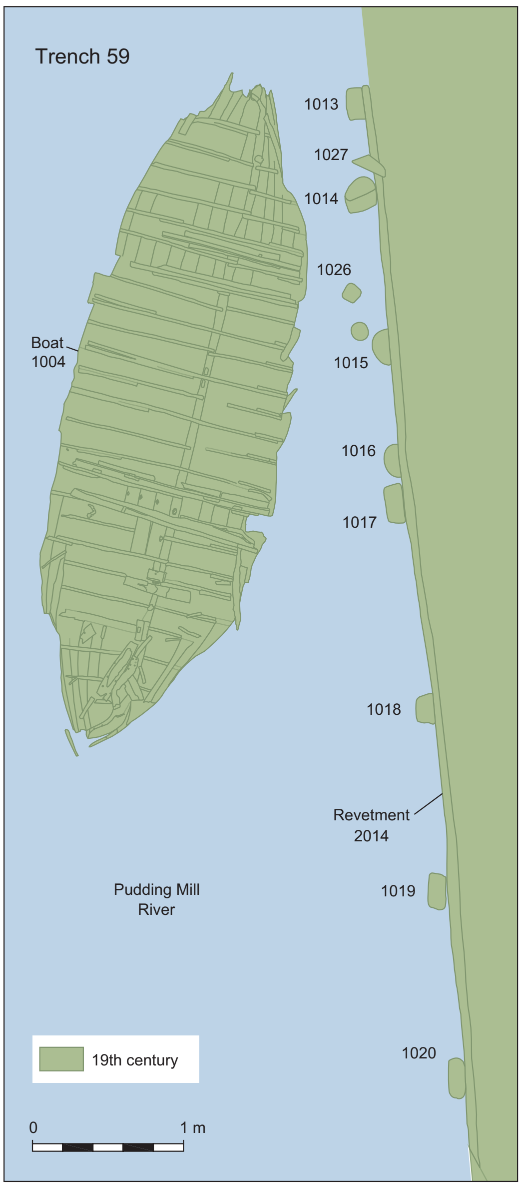


Figure 5.16: Trench 59: plan of 19th century boat and revetment



In contrast to the irregular line of the river edge, the timber revetment (2014), lying 0.9–1.6 m out from it, was straight, aligned approximately north–south, although this differed slightly (by 4°) from the line of the river edge as depicted on the early maps. It was recorded for 7.4 m, extending beyond the trench in both directions (Figs 5.14, 5.16). As it survived, it comprised eight hand-sawn oak posts, to the backs of which were nailed two courses of horizontal oak and softwood planks (see Goodburn, Chapter 7). Seven of the posts were spaced on average *c.* 0.9 m apart, with the eighth inserted where the lengths of planking ended. The whole revetment leaned back at an angle of *c.* 20° toward the bank (Fig. 5.15). Although the excavation did not expose the bases of the posts, they are likely to have been driven into the base of the river channel. Two further posts (1026 and 1027), *c.* 0.7 m apart and to the immediate west of revetment (although the top of 1027 had been pushed back against the revetment), may have been rubbing posts to prevent contact between boats and the revetment face.

The general character of the material and workmanship suggest construction some time in the late 17th to early 19th century (see Goodburn, Chapter 7). A date nearer the end of that range seems most likely given the revetment's position in relation to, and

Figure 5.17: Reconstruction of the area of Trench 59 in the mid-19th century, showing the boat, revetment and buildings of Nobshill Mill

hence likely association with, Nobshill Mill, which dates from c. 1807 (Fig. 5.14). As such, and given the presence of the boat, the revetment may have functioned primarily as a wharf (Fig. 5.17). The gap between the revetment and the channel edge was filled with a firm, dark brown, silty clay (318) containing occasional small rounded pebbles deposited as backfill after the revetment's construction. The revetment appeared to have been sawn down in the relatively recent past to c. 2.4 m OD, possibly to facilitate land-filling; this may help account for the absence of any evidence for land-ties to support it.

The boat

The boat, which is fully described and discussed in Chapter 7 (see Goodburn, below), lay on silt layer 429 (Figs 5.15–5.16; Pl. 5.2). It was pointing downstream, angled at 18° to the revetment, with its bow slightly further into the channel than the stern. Its closest point to the revetment was adjacent to the two possible rubbing posts.

As it survived it measured c. 4.5 m long and 1.5 m wide, and was 0.5 m deep. Approximately 70% of its clinker-built hull, including most of the bow and stern, was present, although the upper parts of the hull were missing. The vessel displayed at least four phases of repair, and three main phases of use; these, together with the associated datable finds, suggest that it was built in the first quarter of the 19th century. After this long period of use, modification and repair it appears to have been finally abandoned outside the mill, possibly when the mill itself was abandoned and demolished between 1882 and 1896. The silts filling and overlying the boat contained 19th century pottery, clay tobacco pipe and glass, as well as the remains of rope, leather and further fragments of wood.

Many of the other riverside timber structures exposed in the Park were less substantial features, and may have had functions other than revetting the river bank. This is particularly the case further down Pudding Mill River, in Trench 41, where a series of

Plate 5.2: Excavation of 19th century boat in Trench 59, from the north-east

post-lines, and post-and-plank structures were recorded also lying parallel to the river but less clear in their role (Fig. 5.18).

It was evident from the nature of the timbers in Trench 41 that at least two phases of structure are represented (see Goodburn, Chapter 7).

Trench 41, phase 1 structures

The most easterly structure comprised a 5.1 m long line of 23 roundwood stakes (709), with horizontal planks (710) lying against their south-western sides, although apparently not attached to them. Most of the stakes were spaced *c.* 0.1–0.4 m apart, with shorter intervals probably due to repairs, and larger gaps (up to 0.8 m) due to some being lost. The whole structure was slanted over towards the north-east. This may have been deliberate, to better retain the river bank. However, the layout of the structure, with the stakes (which to be most effective in a revetment would normally be on its outer face) to the north-east, suggests that it might have supported ground to the south-west, in which case it may have been this that caused it to lean to the north-east.

However, a 5.2 m line of seven larger (80–120 mm in diameter) and more widely spaced circular oak posts (711) to the immediate south-west of the planks, may also be associated with the structure, possibly forming its front face (as opposed to stake line 709), although they appear not to have supported the planks or, again, been attached to them in any way.

It is notable that, *c.* 1.4 m to the south-west of structure 709/710, there was another short length (1.4 m) of similar structure, also with its posts (718-9, 721-2) to the north-east, and with planking and horizontal unworked branches lying against their south-west sides (724). A line of three posts (720, 723, 735) lay immediately north-east of this structure, while another line of at least five posts (712–5, 717) averaging *c.* 0.7 m apart, lay *c.* 1.3 m to the south-west, with two possible outliers (716, 730).

Trench 41, phase 2 structure

In contrast, the third and most south-westerly structure had its posts on its south-west side, with the planks behind them to the north-east. This was recorded for over 15 m, continuing beyond the trench in both directions, and comprised 19 square pine posts (707), with variable spacing of between 0.4 and 1.2 m apart, possibly due to some being lost. A continuous line of sawn pine planks

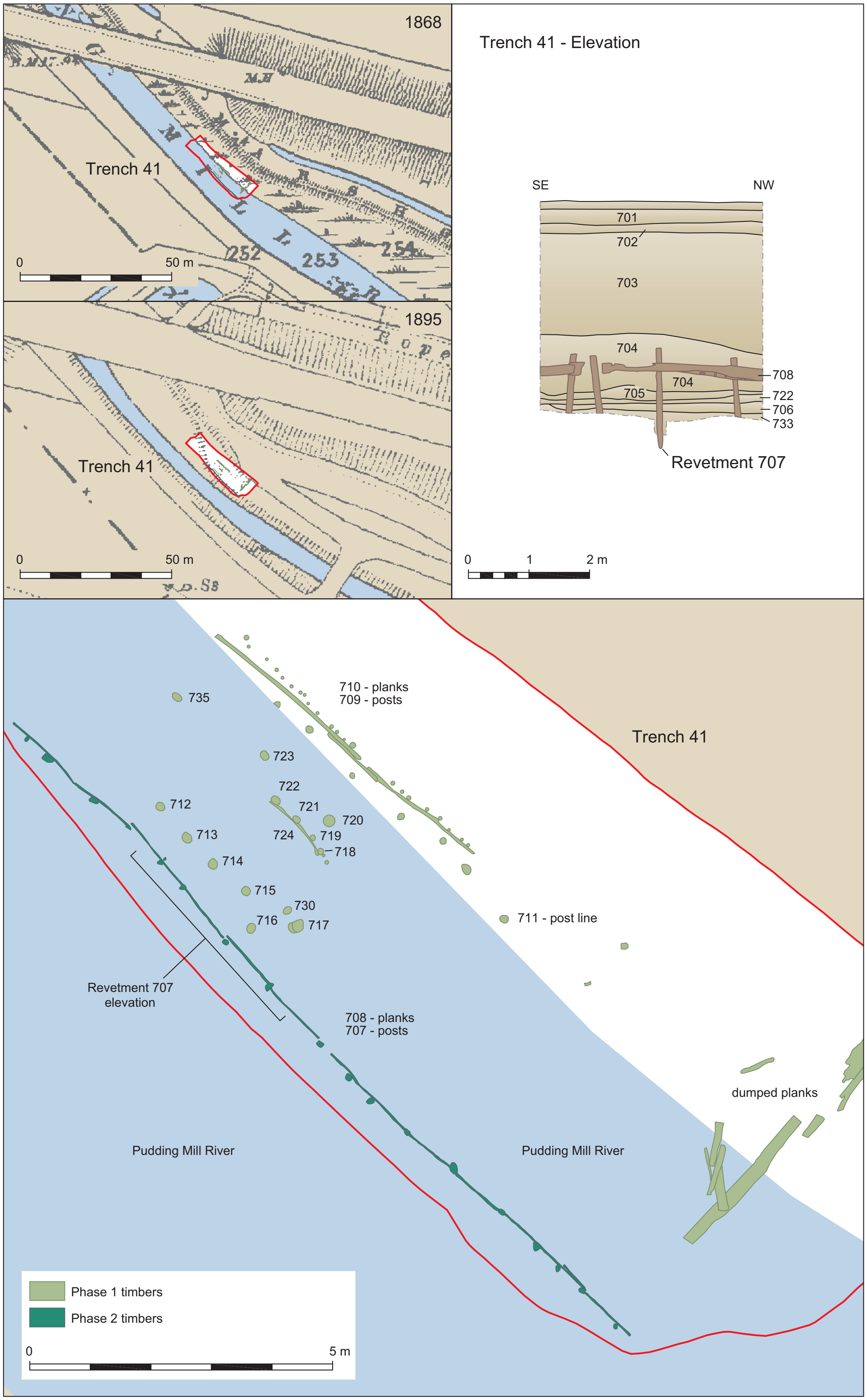


Figure 5.18: Trench 41: revetments and dumped planks, with trench locations in relation to 1869 and 1895 OS maps

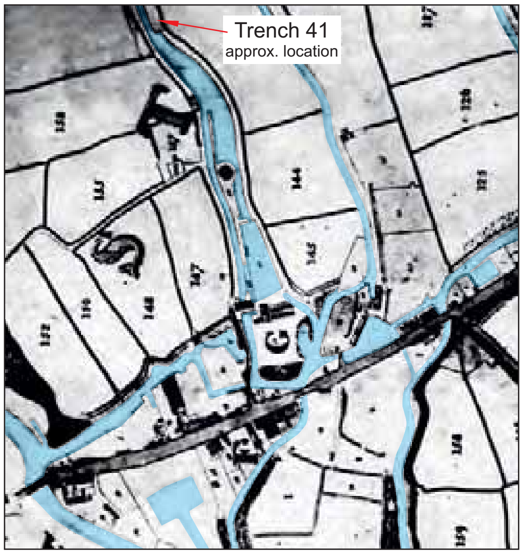


Figure 5.19: Detail of 1821 Clayton map, showing St Thomas windmill and adjacent watercourses

(708), some overlapping, were attached to the posts with square-headed iron nails. The nature of the timbers indicates that this was the most recent of the timber structures (see Goodburn, Chapter 7).

In addition to these features running parallel to the river, there was also a group of largely broken, machine-cut planks lying flat on the ground, most of them perpendicular to the river; they may simply be a dump of left-over material from the construction or repair of structure 707/708.

The interpretation of the structures in Trench 41 is hampered, as elsewhere in the Park, by uncertainty as to their precise location relative to features recorded in early maps, and specifically here in relation to the eastern bank of Pudding Mill River, whose course at this location changed significantly during the 19th century. The low-lying land flanking Marshgate Lane (which ran close to the eastern side of the river) appears to have been regularly flooded early in the 19th century by the penning of water by the operators of Pudding Mills, particularly the strip of land between it and the river (Fig. 5.18).

The character of the Phase 1 timber structures makes them hard to date. Unlike Phase 2 structure (707/708), all of them (including two outlying stakes towards the south-east) were recorded over a distance of just 8.5 m. They could therefore represent a localised feature or structure (possibly repaired over time), facing away from the main river channel, related to a sharp widening of the watercourse at this point shown on the 1821 Clayton map (Fig. 5.19).

In the 1850s/early 1860s, flood prevention banks were built on both sides of the river northwards from the mills, but that on the eastern side ran along the western edge of Marshgate Lane, so leaving the narrow strip of land between the lane and the river unprotected. It is shown as marshy ground on the 1869 OS map, and the actual eastern edge of the river may have been poorly defined. It certainly changed in the second half of the century, the river narrowing from *c.* 10 m wide in 1869 to just *c.* 5 m in 1896 (Fig. 5.18). This may have been due in part to the increasing accumulation of silt in the river (by 1908 it was virtually blocked by silt), but also to the westward shifting, by *c.* 10 m up to the river's edge, of the flood bank formerly along Marshgate Lane.

The westernmost structure (707/708) lies *c.* 3.5 m into the river channel as shown on the 1869 OS map, and *c.* 3 m behind it as shown on the 1896 map. Its posts on its river side and its planks to landward suggest that it could have been a river-edge revetment, even though it appears to have comprised only a single line of horizontal planking; depending on its exact location it may have been more of a simple fence. Its posts were driven through alluvial clays into the underlying gravels, but were covered by made ground, probably representing the pre-1985 embankment, indicating its likely construction before that date.

City Mill River

Determining the function of a timber post-and-plank structure recorded in Trench 46 on the west side of City Mill River has also been hampered by uncertainty as to its precise location in relation to the 18th–19th century river bank.

The structure (506), extending across the 5 m wide trench base and exposed to a height of *c.* 0.3 m, comprised two posts (44 at the north and 42 at the south), spaced 3.3 m apart (Fig. 5.20), with their original sawn-off tops at *c.* 2.9 m OD (see Goodburn, Chapter 7). A single course of two horizontal planks (45 and 46) was nailed to their eastern (ie, river) sides, these meeting end to end at post 42. A third possible post (43), *c.* 0.8 m south of 44, lay at a distinct angle, just out from plank 46 and may have been partially displaced. From the woodworking technology only a broad post-medieval to recent date can be suggested, but a section running east from the structure shows that it was abutted to the east by a layer of clay (505) up to 0.55 m thick, overlying alluvium, and containing a penny of 1862, suggesting an early to mid-19th century date for the structure.

While the highest spring tidal levels in the early to mid-19th century would have reached at least 0.5 m higher than the tops of the posts, a common sight on the Thames and its estuary today is light timber revetting for the lower parts of otherwise earthen banks, designed to prevent erosion where it will regularly occur, rather than to protect against the short-lived and occasional high spring tides (Goodburn 2009a, 21).

However, this structure has more the appearance of a simple fence line than a revetment, and when superimposed on early edition OS maps (1869 and 1896) it appears to have lain up to 5 m west of the river edge, on the west side of the adjacent flood bank. It is possible, therefore that it is associated either with the bank itself, or with the drainage ditch at its base of its western (landward) side, as shown on the 1896 map, although the ditch appears to lie over 3 m to the west of the structure. The clay (505) abutting the east side of the structure, which had an uneven upper surface and was over 0.2 m higher than the tops of posts, was described as a river channel fill (Bull 2009), but could form part of the bank.

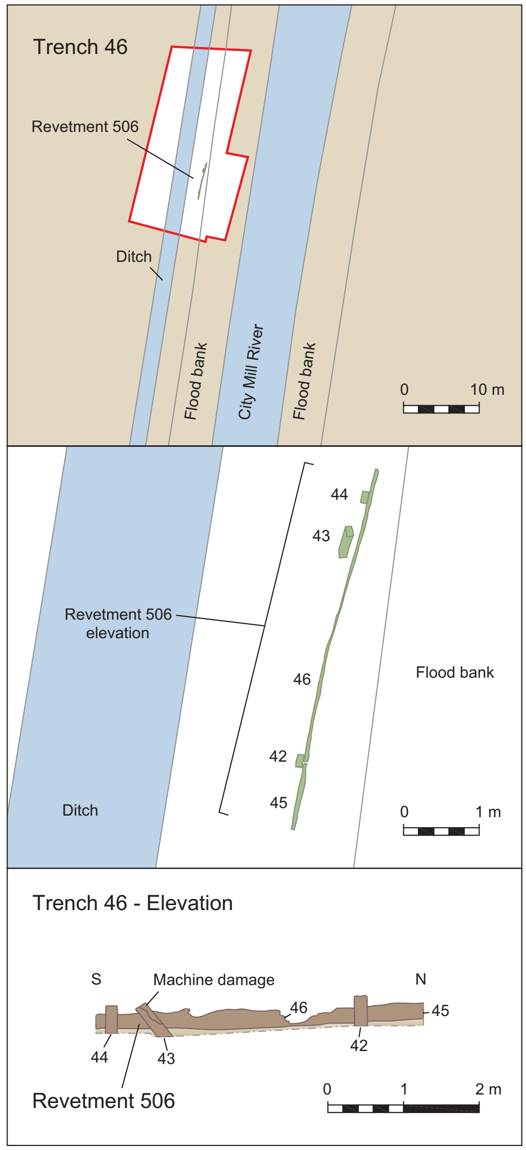


Figure 5.20: Trench 46

The function of some of these timber structures is called into question not only by the uncertainties as to their precise locations relative to the edges of the rivers, but also by the fact that those with planking nailed to the outside of the posts would not have been as effective in retaining the ground behind as having the planking to the landward side, and supported by posts at the front. Goodburn, however, has noted that whilst in medieval and 16th century revetments excavated in the London area the planking is placed on the landward side of the posts, in the 17th century and later it was just as often nailed or tree-nailed to their water-side (Goodburn 2009a, 21).

Summary

During the first half of the 19th century, immediately preceding the start of Stratford's industrial age, the waterways were instrumental in drawing trade to the area. Management of the originally natural (but much modified) waterways was the first step towards taming an essentially wetland environment prone to flooding. The survival of the complex layout of the Lea Valley waterways is significant and regionally rare. In more densely populated areas of the City, many of London's waterways were channelled underground during the process of urbanisation.

By 1860, the waterways had been enhanced and harnessed sufficiently to facilitate the movement of new industry into the area. It is significant that early industrial growth was focused along their banks.

Early Development of Industry

Industry in the lower Lea Valley, prior to the mid-19th century, was closely focused on the sites of medieval industry. As described in Chapter 4, these initially were watermills, whose primary function had been the processing of the products of agriculture – such as the grinding of corn, and by the late 12th century the fulling of cloth. Around the same time windmills were also introduced to Britain, the earliest being recorded in the reign of Richard I (1183–1199). During the 14th century Edward III (1327–1377) encouraged the expansion of other industries on the lower Lea, and those that subsequently developed included soap making, printing, paper making, gun powder manufacture, flour milling, distilling, linen and silk weaving, tanning and potteries.

None of the medieval watermill sites was examined during the Olympic Park investigations, although an area immediately south of the medieval Temple Mills, known to have been also the site of 17th century and later industry (Fairclough 1991) was excavated (Trench 75). However, a number of trenches were excavated on, or immediately adjacent to, the sites of windmills known from late post-medieval maps.

Windmill Sites

A number of post-medieval windmills within the area of the Olympic Park are shown on 18th and 19th century maps. The windmills often belonged to the owners of the watermills which could only operate for limited periods twice every day when the tide was ebbing; the wind, in contrast, (at least when blowing) provided a potentially more continuous source of power. Rocque's 1746 map (Fig. 5.2) shows four windmills on river channels north of Bow and Stratford, and there were also known to be windmills at Temple Mills, Abbey Mills and Three Mills, Bromley.

Archaeological trenches were excavated close to the known locations of three of the windmill sites - two of them on the east side of Pudding Mill River, and the third on the east side of Waterworks River.

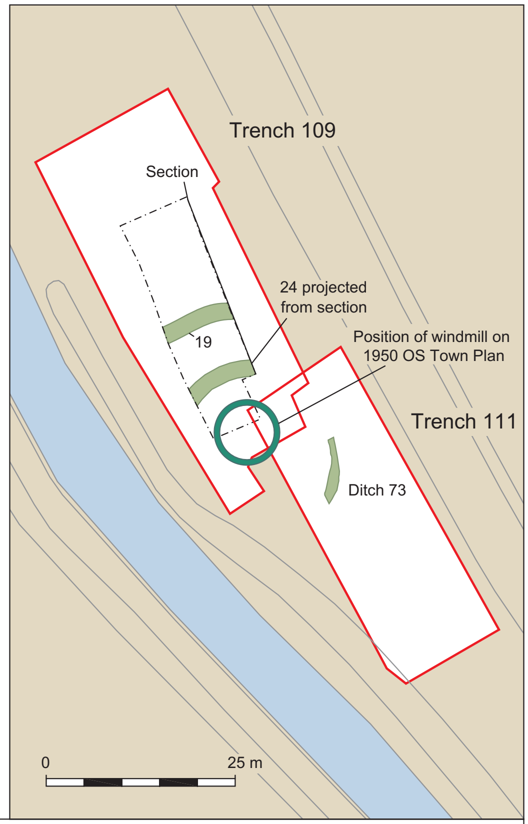
St Thomas's windmill

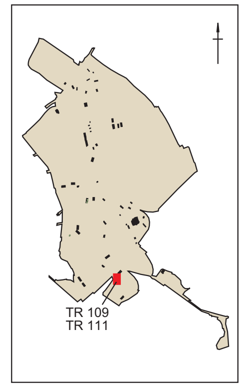
There are known to have been three windmills on Pudding Mill River, which appear to have been associated with the St Thomas's watermills (Pudding Mills) (Farries 1981, 33). Two were positioned on opposite sides on the river towards its southern end, both shown on Rocque's map, while the third, known in 1869 as *Nobshill Mill*, lay at the north end of the river.

The location around the eastern of the two southern windmills was investigated in two adjacent (and just overlapping) trenches (Trenches 109 and 111) (Fig. 5.21). A windmill at this location is referred to in 1702; this had been replaced by another by 1730, and the site remained occupied until the 1840s when the windmill was sold by the Eastern Counties Railway (see below) who by then owned the land.

In the southern trench (Trench 111) a curved ditch (73) with near-vertical sides and a flat base was recorded running approximately north–south for *c.* 9 m, but curving towards the south-west at its southern end. It cut a thick layer (over 1 m) of alluvium, at *c.* 3 m OD, and was between *c.* 0.7 m and 1.4 m wide and 1 m deep. Its single fill of soft dark grey/black silt contained clay tobacco pipe fragments dated 1680-1710, and was sealed by 0.9 m of made ground.

There was a more complex sequence of deposits and features in the northern trench (Trench 109), but while their profiles in section appeared relatively clear (Fig. 5.21), they were not fully recorded in plan. Their extents as shown, therefore, are in part conjectured on the basis of the available evidence. At the southern end of the trench, a sequence of clay layers was cut by two features. The lowest layer (6) consisted of alluvial clay, its upper surface at *c.* 1.8 m OD; this was capped by three further layers (21, 22 and 20), together up to 0.6 m thick.





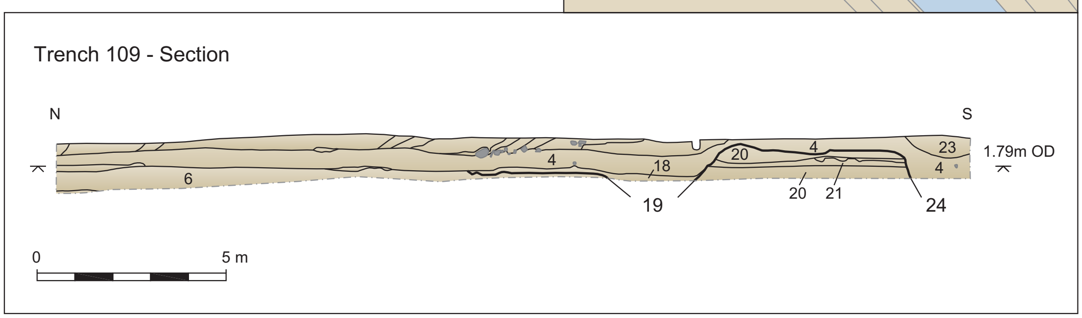


Figure 5.21: Trenches 109 and 111; archaeological features in relation to St Thomas windmill, and west-facing section in Trench 109

Plate 5.3: View of the River Lea Bridge and Stratford Viaduct as now constructing for the Eastern Counties Railway, by George Harley, 1837

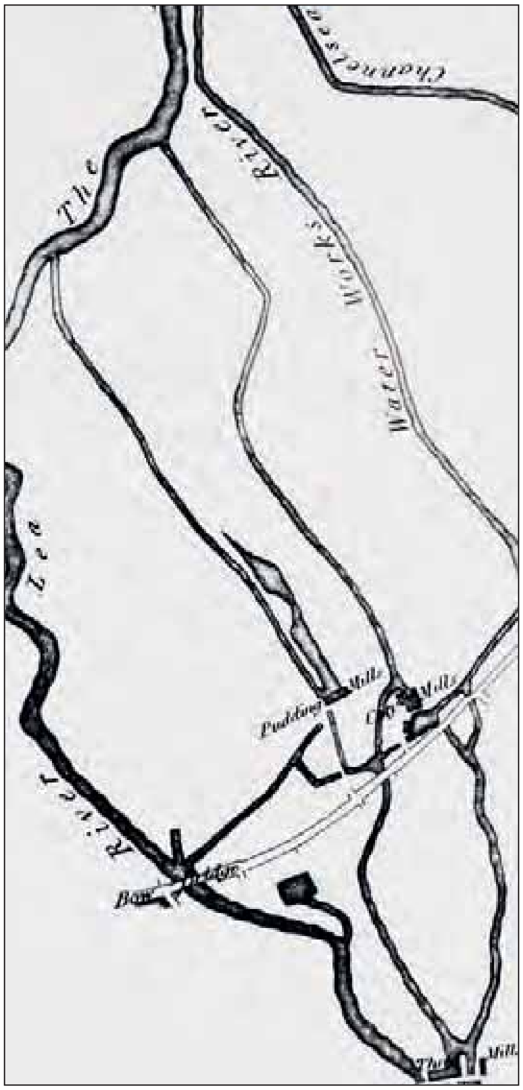


Figure 5.22:
Detail of 1828 map showing Pudding Mill River

These were cut, to the south (but visible only in section), by the near-vertical edge of a feature (24) at least 0.7 m deep and 1.5 m wide, but extending below the base of the trench and beyond its southern end.

Approximately 6 m to the north, the clay layers were cut by the southern edge of another feature (19), here visible in plan running across the trench from the west-south-west then curving towards the east. The southern side of feature 19 was moderately steep and over 1 m deep with a flat base *c.* 2 m wide. On its northern side the base rose to a wide shallow lip, beyond which the clay layers consisted almost entirely of layer 6, rising no higher than *c.* 1.8 m OD, indicating either that any overlying layers had been heavily truncated, or that layers 20–22 were in fact layers of redeposited clay forming a raised bank between features 19 and 24.

The base of cut 19 (and the shallow lip on its northern side) was filled with a firm clay (18). Overlying this, and extending over layer 6 to the north and the possible 'bank' to the south, as well as filling feature 24, was a thick layer of alluvium (4). Its upper surface, across most of the trench at *c.* 2.2 m OD, rose up over the 'bank' (and apparently well above the top of the recorded section at *c.* 2.5 m OD), either because it had been truncated on either side, or because the bank had been maintained and raised. It was sealed by a series of 'ground-raising' layers of redeposited clay some containing CBM, stone and slate fragments, tipping down to the north, and appearing to create a pronounced mound at the windmill location.

These features are of uncertain form and function, and the relationship between those in the two trenches is unclear. However, they are almost certainly related to the mound on the site of the St Thomas windmill. On Milne's 1800 *Land Use Map* (Fig. 5.3) the windmill is shown on what was either a raised platform, or within an area enclosed by a bank (with what appears to be a small structure just south-east of the bank). On the 1821 Clayton map (Fig. 5.19) the mill is indicated by large circular mound set within a rounded area that extends into a wide body of water lying east of Pudding Mill River, above the Pudding Mills; a similar area is show on a map of 1828 (Fig. 5.22).

An 1837 engraving depicting the proposed Eastern Counties Railway viaduct over Pudding Mill River (Pl. 5.3) shows what was probably this same windmill, immediately south of the railway line, sitting on a low mound. The mill is also depicted in a watercolour painting dated 1843, which shows 'a post mill with four common sails, tail-pole winding, and a circular single-floored roundhouse standing on a well defined mound' (Farries 1981, 35, pl. 174b).

Nobshill Mill

The windmill at Nobshill Mill, towards the head of Pudding Mill River to the north, in contrast, did not stand on a mound, probably because its site was not subject to the level of flooding seen further down the river; in fact its location may have been selected in part for that reason. Moreover, it was considerably later than the windmills shown on Rocque's map, having possibly been moved to this location in 1807 from an original position on City Mill River, associated with Spillman's Mill (Spileman's, or City Mill) (Farries 1891, 33), which had two windmills in 1767. Milne (Fig. 5.3) shows one windmill on the east side of City Mill River lying within a small square plot of land surrounded by a bank, with a square building to the south-east, and although its precise original location is unclear it may lie under the embankment of the Eastern Counties Railway.

A mill on the site of Nobshill Mill is first shown on Laurie & Whittle's map of 1819. On the OS map of 1869 (Fig. 5.14) it is seen to comprise the circular structure with a cluster of buildings to its south labelled *Nobshill Mill (Corn)*. A further two buildings are shown at the southern end of the mill property referred to on later maps as *Knobshill Cottage*. The mill lay at the northern end of Marshgate Lane.

Unfortunately, the site of the windmill lay in the *c.* 20 m gap between Trenches 58 and 59, and no traces of it were recorded in either trench. Moreover, no traces of the associated mill buildings were recorded in Trench 59. However, as described above, the substantial timber revetment recorded in Trench 59 (Fig. 5.14) may be directly related to the immediately adjacent mill buildings, probably acting a wharf. The only other feature potentially associated with the mill was a brick-lined well, but its position suggests that it probably postdates the mill's demolition (between 1888 and 1896), and it may have been associated instead with Knobshill Cottage (see Chapter 6).

Stent's Mill windmill - Trench 6

Trench 6 was located within the plot of ground occupied by two buildings immediately south of, and associated with, Stent's/Redcross windmill, which lay immediately east of a bridge across Waterworks River (Fig. 5.4). The trench lay just north of the buildings, and *c.* 10 m east of the windmill location. The only potentially related feature was a single isolated angled timber post (353) driven into alluvium, and sealed by possible post-medieval buried soil or made ground deposit (343).

Plate 5.4: Stent's Mill (blown down Octr 1834) 25 Aug 1835 at Stratford, watercolour by unknown artist

Milne's map (Fig. 5.3) shows what may have been a bank surrounding the mill and the other buildings. The windmill was blown down in October 1834, and the abandoned structure is depicted in an 1835 painting (Pl. 5.4). However, any prospect of resuming milling at this site would have been thwarted by the construction shortly afterwards of the high railway embankment and the bridge over City Mill River, less than 40 m to the south-east, which would have impeded the flow of wind to the mill. However, the windmill's location is still shown on the 1850 OS Town Plan suggesting that its remains may still have stood on the site. The larger of the two adjacent buildings remained until at least 1882, but both were gone by 1896.

Discussion

There is evidence for windmills in Britain from the late 12th century, such early mills probably all being post mills. In a post mill, the body of the mill, containing all the machinery, was mounted on a large vertical post. This enabled it to be rotated to face the wind by pushing a tiller beam extending from the back. The post would normally be supported on two horizontal timber crosstrees, braced by angled quarter bars. These would either be laid directly on, or buried in the ground, or raised on brick piers to prevent rotting as indicated by another image of the abandoned Stent's Mill (Essex Records Office I/Mp 164/1/34). These and other contemporary images of such mills show their bases enclosed in roundhouses, which would have provided added protection from the weather and provided storage space. Contemporary images of the windmill at Abbey Mills, in contrast, indicates that this was a tower mill rising high above the adjacent buildings.

Temple Mills - Trench 75

A rough (and highly inaccurate) sketch of the courses of the various branches of the River Lea between Temple Mills and Abbey Mills, dated 1810 (Essex Records Office D/DU 245/2), has a small elevation of Temple Mills showing its two waterwheels and a windmill positioned apparently above the buildings on the eastern side of the millstream. The site at Temple Mills is significant in the development of the lower Lea Valley because it spans the period between the medieval (see Chapter 4) and post-medieval mill-based industry and the late Victorian industrialisation of the valley landscape (Chapter 6), and appears therefore to represent some degree of industrial continuity over this extended period.

However, the story is not that straightforward. The manufacturing industry which developed at Temple Mills was initially closely focused on the medieval mill site, and even after those mills had been demolished it did not extend outwards into the adjacent landscape. The site's location at the northern end of West Ham, at the boundary with Hackney and Leyton, placed it outside the area of heavy industrial development seen in the late 19th century further down the Lea Valley (see Chapter 6).

There were still two mills under one roof in 1593, referred to as Ruckholt Mill (in Leyton) and Temple Mill (in Hackney), attached to which in 1601 were the adjacent meadows, and a plot of land '*wherein a Little Water Mill sometime stood*' (Hackney Archives M793). In addition to grinding corn, Temple Mills had a long history of milling and manufacturing other products, such as oil and smalt (a deep blue pigment with various uses, including as an ingredient in *powder blue* used to whiten linen). There had been a leather mill, a gunpowder mill (which blew up), a mill boring gun barrels (made of an alloy, *Prince's metal*, invented by Prince Rupert, grandson of James I), a cutter's mill (making pins), a logwood mill (boring logs for water pipes), and manufacturers of sheet lead, brass kettles and tin and latten (brass sheet) plates, as well as calico printers and flock-makers (Fairclough 1991; *VCH* 1973).

Early maps of the site show the layout of river channels, drainage ditches and mill streams which passed through and around the mills. The medieval mills had straddled Temple Mill Stream (also Shire Stream, and later Waterworks River), which branched off the east side of the River Lea upstream of the mills. Bypassing the mills to the east, from an overflow weir just to their north, was Tumbling Bay Stream which flowed under Temple Mills Lane. Henniker's Ditch and a number of other natural streams and man-made ditches drained into this channel, before these together flowed into Channelsea River which followed a course down the east side of the valley.

Archer's 1721 *Mapp of the Mannor of Ruckholt* shows two long buildings, east of the mill stream, running south from *The Road to Cannon-Hall* (later Gunn Lane or Temple Mills Lane), with an enclosed plot of ground to their south and another building on the edge of the mill stream. Rocque's map of 1746 (Fig. 5.2) shows the mills building straddling the mill stream and a long building running south from them down the river's eastern bank. Although the rest of the island between the millstream and Tumbling Bay Stream is shown as unoccupied in 1746, the 1777 Chapman & André map shows additional buildings to the south, arranged around a plot of land at the end of a short lane running south from Temple Mills Lane (this map does not show Tumbling Bay Stream).

Phase 1 (late 16th–mid-17th century)

Apart from Tumbling Bay Stream (Fig. 5.12) and its medieval precursor (Fig. 4.13, above), which ran around the eastern side of the mill site, effectively making it an island, the earliest features recorded on the site include a double line of timber piles running parallel to the stream on its west side, brick building foundations and associated features, and a land-tie extending west of the site (Fig. 5.23).

Early made-ground deposits

The ground level across the site in this period was between *c.* 3.9 m and 4.1 m OD and sequences of silty clay deposits with high levels of inclusions (chalk, pebbles, coal, charcoal, CBM and mortar), recorded in section in all the trench Areas may represent the early deliberate dumping of material over the alluvium in order to raise the ground levels and make a drier and more stable ground surface in what would have been a working and access area in the immediate vicinity of the mills. One of these deposits (625 in Area 4) produced clay tobacco pipe dated 1660–1680, suggesting a late 17th century date (later pottery from this layer may be intrusive).

Part of one of these deposits (568/660) was recorded in plan extending from near the western edge of Tumbling Bay Stream. For the most part it represented level made ground, but on its east side it sloped down towards the channel. There was no evidence for similar ground consolidation on the east side of Tumbling Bay Stream, where the ground was *c.* 0.4 m lower.

Timber pile structure

A linear timber pile structure was recorded extending north–south for *c.* 12 m. At its north end it lay *c.* 2.5 m west of the edge of Tumbling Bay Stream but it diverged slightly from the stream's line to the south. It comprised a rather irregular double row, 0.4–0.6 m wide, of 24 timber piles driven vertically into a layer of peaty alluvium (1007). The structure was most regular at its southern end, where it comprised pairs of posts *c.* 0.3 m apart, with the pairs placed 0.7–0.9 m apart.

The timbers varied in shape, size and apparent origin, with many of the pieces showing signs of reuse. They measured in width between 70 mm by 90 mm and 140 mm by 160 mm, and were between *c.* 0.6 m and 1.8 m long (average *c.* 1.1 m). They are dated on technological and stratigraphic grounds to the late 16th or early 17th century.

There are a number of possible interpretations for this feature (Goodburn 2009b, 96–7). One is that it formed a more substantial revetment or double fence set back from the edge of Tumbling Bay Stream. Alternatively, it may have supported some form of elevated walkway built to aid passage over wet ground. However, given that the ground between Tumbling Bay Stream and Temple Mill Stream was over 0.4 m higher than the ground to the east, it is likely that this parcel of long-developed land was probably reasonably dry for much

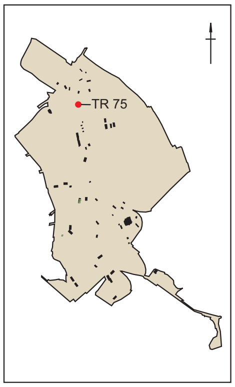
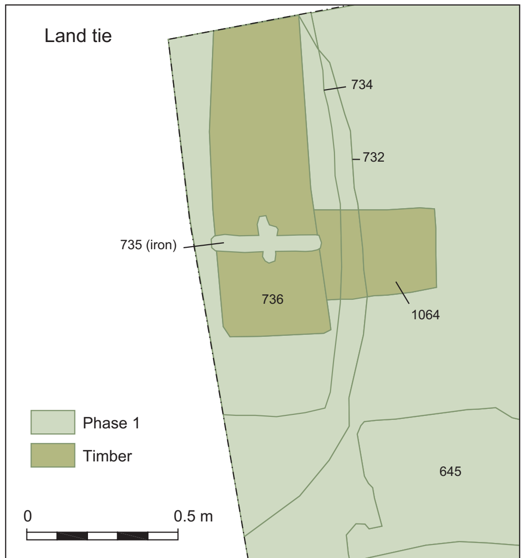


Figure 5.23: Trench 75: Phase 1



of the time. A third possibility is that represents the line of a wall. One method of constructing timber foundations for buildings in the post-medieval period involved driving piles into the ground and capping them with broad, thick planks. Upon these, masonry would be laid for dwarf walls for timber buildings, or heavier masonry or brick walls, as, for example, at Bellamy's Wharf, Rotherhithe during the 18th and 19th centuries (MoL code BEY95). If the piles were associated with a wall foundation, that wall may have had some relation to Building 1 (below) to whose wall foundations (the southern of which was just 3 m to the west) it was perpendicular. A counter-argument to this interpretation might be that the pile line did not have return foundation lines at each end.

Building 1

The earliest building on the site comprised two lengths of brick foundation aligned east–west in Area 4, and possibly also features on their north side. The southern foundation (991) was at least 4 m long aligned east–west (at *c.* 3.6 m OD). A robber trench (997) at its west end appears to extend its length by a further 2.2 m. The foundation's construction trench, and the robber trench, cut early made-ground deposits (above). Another short length of similar foundation (645) lay 3.1 m to the north.

The southern foundation, made of unfrogged orange bricks (230 x 100 x 70 mm) dated to 1664–1725, bonded with off-white chalk/lime mortar, was 0.35 m wide and survived to a maximum height of two courses (0.13 m); the northern foundation survived to three courses.

Also possibly associated with this building was a large sub-rectangular cut (684) to its immediate north, the southern side of which truncated foundation 645. This was at least 6.3 m long east–west, at least 2.7 m wide, and over 0.8 m deep, with near vertical sides and a flat base. In its base were two parallel linear cuts (705 and 707), *c.* 0.8–1 m apart on the same alignment as the building. The full length of the southern one (707) was exposed, measuring *c.* 5.1 m, 0.24 m wide and 0.1 m deep, with near vertical sides and a slightly concave base. The northern cut was similar in form, but its western end lay outside the locally excavated area. These features were filled with rubble (506), possibly deriving from the demolition of *Building 1* some time in the early 18th century. Their precise nature is unclear, although the linear cuts could represent beam slots for a sunken floored structure abutting the north side of the stone founded building.

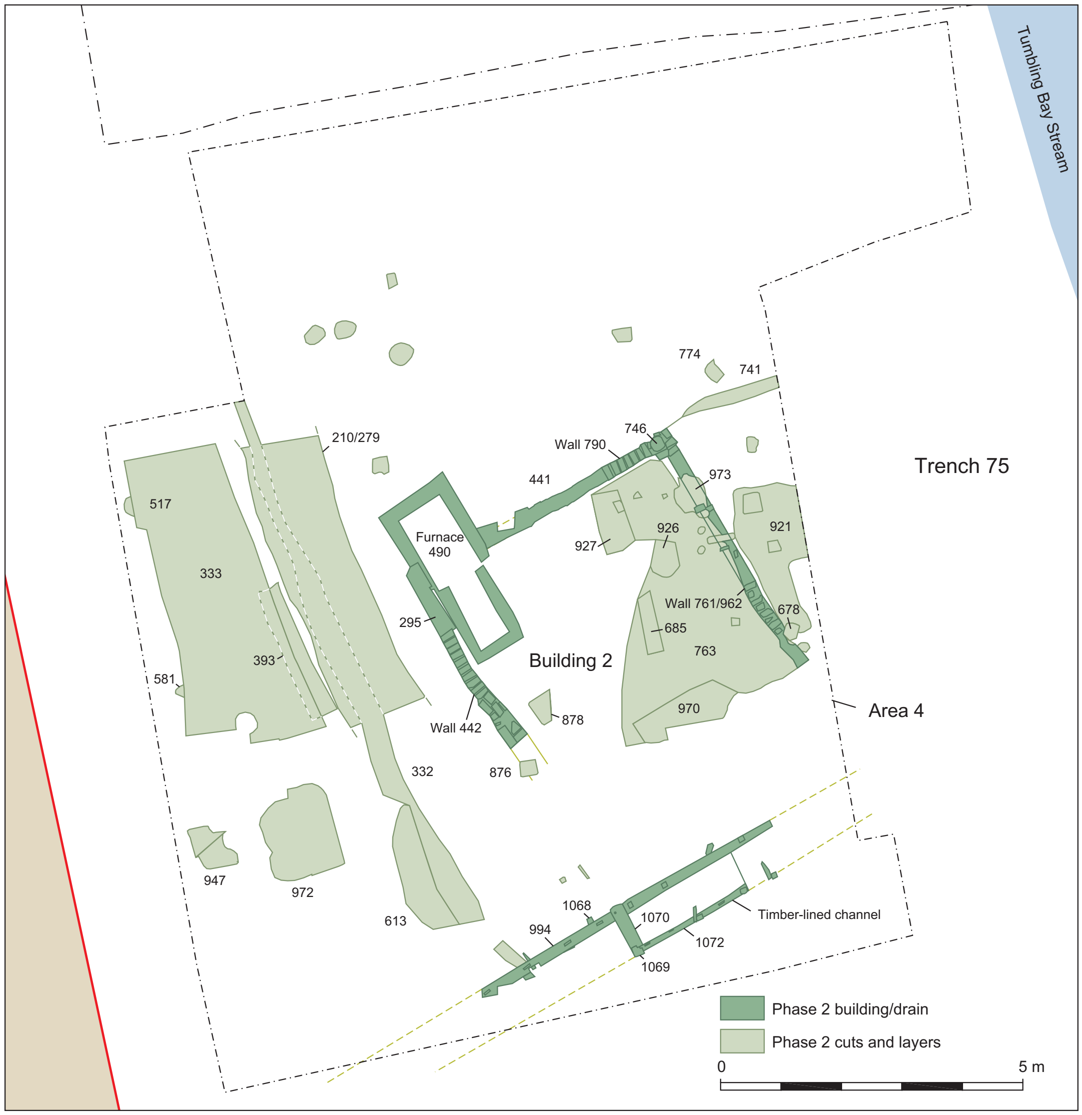
Land-tie

The landward end of a metal and timber land-tie providing support to some feature west of the excavation was exposed in the north-western corner of Area 4. Although it clearly pre-dated the construction of the terrace of cottages in Phase 3 (below), its precise relationship with earlier features is unclear, particularly with large sub-rectangular cut 684, at the western end of which it was recorded. The land-tie appeared to lie within a vertical-sided, flat bottomed construction cut (734), *c.* 0.7 m deep and at least 1.3 m long (north–south) by 0.5 m wide (but extending beyond the northern and western edges of Area 4) (Fig. 5.23, inset). The top of the construction cut was truncated by a later feature (732), but that cut through the rubble fill of 684, obscuring their relationship; the fill of 732 was directly overlain by the bedding for the front wall of the Phase 3 terrace (below).

The land-tie anchor plate comprised a very knotty oak beam (736), measuring at least 2.2 m long, 270 mm wide and 190 mm thick, aligned north–south. A wrought iron tie rod (735), bolted at its east end, passed through a recess cut into the top of the beam, and continued west beyond the excavation. The anchor beam was subsequently shown to rest on a box-halved plank (1064) at least 800 mm long east–west, 300 mm wide and 50 mm thick; this was left *in situ*, and only drawn in a sketch plan, but it is clear from that sketch that it extended over 0.3 m east beyond the recorded edge of cut 732. It is possible that plank 1064 is not related to the anchor beam, but part of an earlier structure, or that the construction cut was larger than that recognised. This feature's relationship with cut 684 was therefore unclear.

It was also not established what the land-tie was connected to at the west. The anchor beam was located near the midpoint between Temple Mill Stream *c.* 13 m to the west and Tumbling Bay Stream *c.* 15 m to the east (at least as they were configured in

Figure 5.24: Trench 75: Phase 2



the mid-19th century), and it is unlikely that a land-tie for a revetment along Temple Mill Stream would have been anchored so far from it. However, on the first detailed maps showing the Temple Mills site (from 1850) the eastern bank of Temple Mill Stream is seen to turn sharply south-west into the channel, at a point just north of the terraced cottages (Fig. 5.31, inset), and it is possible that some of this area (west of Trench 75) was made ground laid down to accommodate the new buildings and their gardens to the rear. If so, the bank of the stream may have originally lain much further to the east, possibly within 5 m of the anchor, in which case it may have supported a revetment of the mill stream, possibly due to the presence on, or close to its edge, of Building 1. The later (Phase 4) land-ties, supporting the Tumbling Bay Stream revetment, had tie rods almost 6 m long (see below).

Other features

To the north of Building 1, an east-west cut (274), *c.* 0.4 m wide and 0.4 m deep with vertical sides and a flat base, was exposed cutting the made ground in a 1 m wide machine slot at the west end of Area 3. It had bricks laid on its base (as recorded in section), perhaps indicating a structure (or possibly a drain) at this location, and its stratigraphic position and orientation suggest it belonged to this phase.

Just south of Building 1 there was an irregular pit (961), *c.* 0.8 m wide and 0.35 m deep, extending west of the excavation. Its sandy silty clay fill contained clay tobacco pipe that could not be closely dated.

Phase 2 (late 17th–mid-18th century)

This phase saw the demolition of Building 1, as represented by the robbing of its foundations and the rubble fill (506) in feature 684, followed by a reorientation of activity on the site, possibly reflecting the changing industrial developments. This involved the construction of a second brick building, possibly a foundry, partly overlying the earlier structure, and a number of associated features, including a narrow, timber-lined water channel (Fig. 5.24).

The site of the demolished Building 1 was overlain by a second phase of ground levelling deposits (eg, 394, 395 and 342, not illustrated) the uppermost of which (342) contained pottery dating to 1630–1680, frequent fragments of charcoal, burnt flint and ceramic building material. These were cut by a series of southward flowing drainage gullies (332, 613, 393) (Fig. 5.24), aligned north-north-west–south-south-east, which contained pottery dated 1630–1846 and clay tobacco pipe dated 1660–1710, as well as brick and mortar. Two small post-holes (517 and 581), *c.* 3 m apart, lay west of the channels on a similar line, the northern one cutting the rubble fill of Phase 1 feature 684, the other cutting the extensive Phase 1 made ground deposit.

These gullies and post-holes were partly sealed at the west by an extensive layer of clay (333) *c.* 0.1 m thick, and at the east by an area of compacted gravel (279 and 210) which appears to have formed part of a metalled surface to the immediate west of Building 2. A thin spread of silty mortar (302, not illustrated) was possibly laid down during the construction of Building 2. These layers produced pottery dating to 1630–1700 and clay tobacco pipe dating to 1680–1710.

Building 2 and furnace

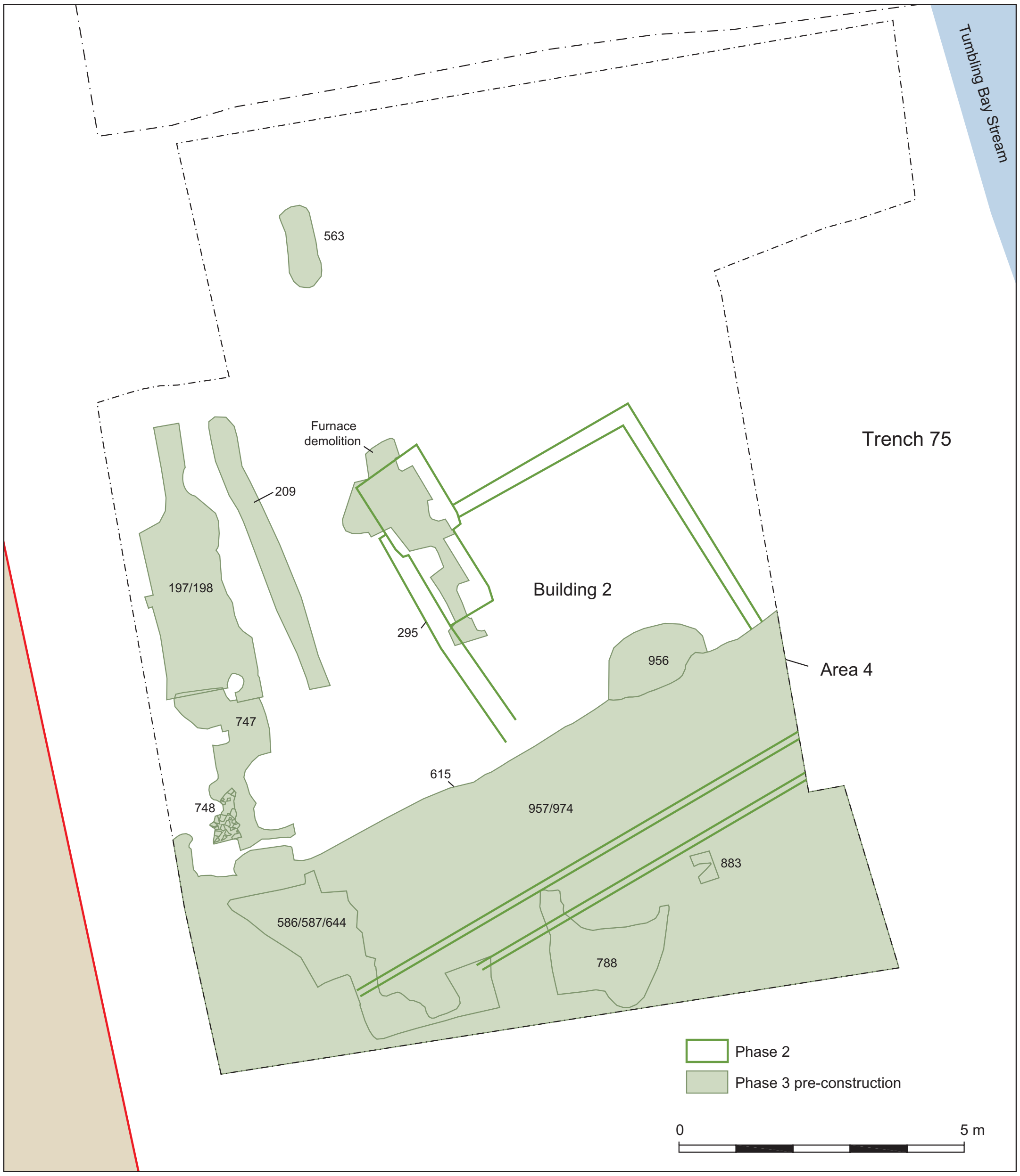
Building 2, orientated north-north-west–south-south-east, was defined by walls on three sides, its southern side having been subsequently removed by a wide, shallow cut (615 below, Fig. 5.25). As it survived it was *c.* 4.3 m wide internally, and at least the same long. There was a rectangular sunken brick structure, possibly a furnace, at the north-west corner, half inside the building but the wide part, possibly the chimney base, extending *c.* 1.2 m outside it.

Plate 5.5: Furnace in Trench 75, from the south

The foundation cuts for the building's walls had been heavily robbed and only sections of *in situ* brickwork survived. The foundations, which were *c.* 0.24 m wide and survived to no more than two courses high (0.12 m), comprised unfrogged stock moulded bricks, laid flat in header fashion and bonded with pale yellow lime mortar. The latest dated brick in the eastern wall had a date range of 1450–1700.

The *in situ* foundation of the building's western wall (442) was 2.2 m long (continued to the north by robber cut 295), and the inner surface at its northern end abutted the western side of the internal part of the furnace. A shallow possible post-hole (876) on the wall line towards its southern end may represent a structural element to the building, perhaps a door post.

Figure 5.25: Trench 75: Phase 3 pre-construction contexts over Phase 2 Building 2 and timber water channel



The northern foundation (790) had been more heavily robbed, with only a 1.3 m length of brickwork surviving at the north-east corner. Its construction cut (441) was T-shaped at its east end where the brickwork made a short return to the south. A square post-hole (746), cutting the foundation at the north-east corner, may represent a timber repair to the building, or part of its original timber framing.

The eastern foundation (791/962) was also badly damaged; at its north end a single brick connected with foundation 790, but to the south of this much of the foundation had been robbed. It is possible that the gap in the brickwork immediately south of the north-east corner was the location for an entrance, *c.* 1.5 m wide. A shallow hollow here (973), filled with compacted clayey silt (760), could represent a repair to the floor surface within the entrance.

The furnace (490) at the building's north-west corner (Pl. 5.5) was built in a *c.* 3.3 m long rectangular construction cut. This cut was 1.4 m wide outside the building but narrowed to 1 m wide inside. It had vertical sides falling 0.46 m to a 0.3 m wide flat ledge, then a further 0.7 m to its flat base. The sides of the cut above the step were lined with six courses of bricks bonded with a grey/pale yellow lime mortar. The furnace measured internally 2.5 m long by 0.8 m wide (outside the building) narrowing to 0.5 m (inside). On its base there were fire rake-out deposits (489 and 515) up to 0.2 m thick, layer 489 containing fragments of copper alloy slag suggesting that the furnace might have been part of a foundry. This may be related to the recorded use of the mill site by a company established in the 1690s to manufacture brass kettles and tin and latten plates, and still active in 1720 (Lysons 1796, 182).

In the eastern part of the building a patch of compacted silty clay (984, not illustrated) containing frequent fragments of CBM, charcoal, copper alloy and mortar may be the remains of a floor surface. This was overlain by a similar but more extensive layer (763) with similar inclusions, again possibly a floor surface. Three shallow depressions (926, 927 and 685) in this layer, filled with sandy silt, may represent repairs to the floor. In addition, the floor was cut by five post-holes forming an irregular and unevenly spaced line close to the eastern wall, with a sixth cutting the fill of depression 927. Another post-hole (878) lay close to the western wall. The highest level of floor surface 763 was *c.* 3.7 m OD.

To the south, the floor was cut by a rectangular timber-lined pit (970) measuring 1.8 m east–west and at least 0.5 m north–south (but truncated to the south by later activity). It was 0.3 m deep with vertical sides and a flat base, and was filled with sandy clay (969) containing lenses of charcoal. Unfortunately the timber lining (980) was too decayed to survive lifting, but the feature clearly had some function related to the use of the building, and may well have been associated with the timber-lined water channel (see below) just 1.8 m south of its southern surviving extent.

A layer of compacted clay (921), abutting the external face of wall 791, contained late 17th century glass and two fragments of copper alloy slag. To its north was another layer (not illustrated), containing frequent fragments of ceramic building material, mortar and chalk. The latter was cut by a shallow gully (741) traced for at least 1.5 m running east from near the building's north-east corner. Its single silty fill contained pottery (dated 1680-1900) and clay tobacco pipe.

Timber water channel/wheel pit

The base of a 5.6 m length of a timber water channel, aligned east-north-east–west-south-west, was recorded less than 2 m south of the surviving extent of Building 2 (Fig. 5.24; Pl. 5.6). The timber-framed structure, comprising oak posts set into two parallel sill beams, was 0.6 m wide internally, and assembled in a wide construction cut (1091), the southern edge of which lay

Plate 5.6: Reused timbers in timber-lined channel in Trench 75, from the north-east

outside the excavation. It was made largely of reused building timbers (see Goodburn, Chapter 7), possibly from the demolished Building 1. The cut was backfilled around the timber structure with soil layers containing pottery dating to 1630–1730, and clay tobacco pipe dating to 1700–1740.

The orientation of the channel suggests that the water in it flowed south-west from Tumbling Bay Stream, probably draining into Temple Mill Stream. Over its 5.6 m length the northern sill beam dropped by 0.06 m from 2.68 OD at the east to 2.62 m at the west. It is possible that the channel formed the pit for a small undershot mill wheel, perhaps providing power for machinery inside Building 2 – possibly a lathe, drop-hammer or fan supplying air to the furnace.

Other features

A number of other features recorded around Building 2 may be contemporary. They include six post-holes in an irregular north–south line, to the east of the building, although they are not obviously directly associated either with the building or with each other. They varied considerably in shape and size, some being sub-square, others sub-circular, and having widths of between *c.* 0.2 m and 0.4 m, and depths of 0.1–0.3 m. Post-hole 678 contained the decayed remains of a post. Further post-holes lay to the north of the building, but again form no obvious structure.

On the west side of the trench there was a sequence of intercutting features, two of them assigned to this phase. The earliest was a large sub-rectangular pit (972), measuring *c.* 1.7 m by 1.5 m, and 0.4 m deep with vertical sides and a flat base. It single fill (971) contained pottery dating to 1740–1780, clay tobacco pipe dated 1700–1770, and a piece of bottle glass (<23>) with a seal dated 1732 (Pl. 7.6, below). A similar but smaller sub-rectangular pit (947), *c.* 0.7 m square and 0.3 m deep, lay to the immediate west.

Demolition

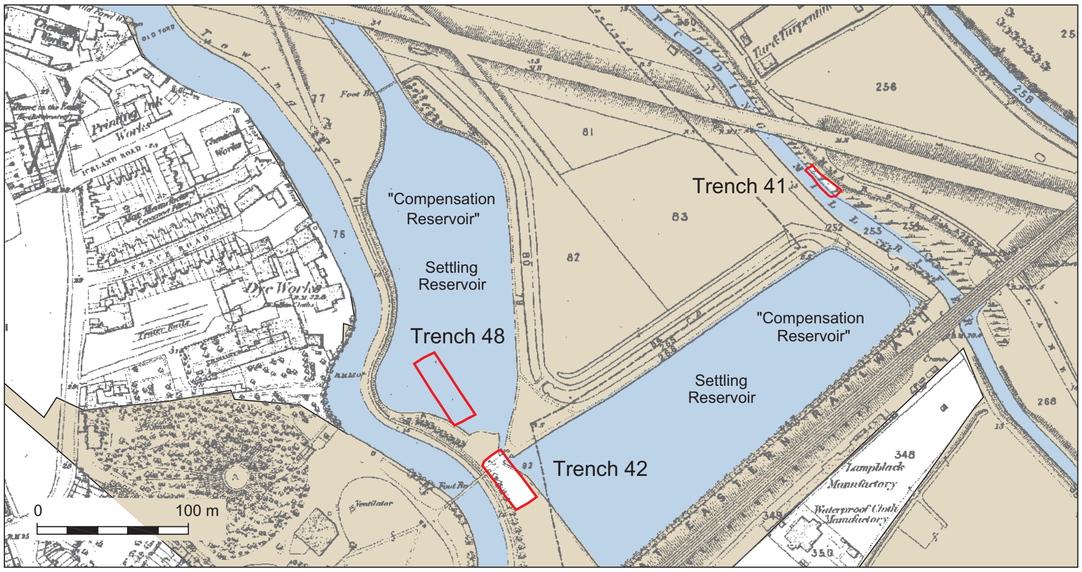
The ceramic dating evidence suggests that Building 2 and its associated features continued in use into the second half of the 18th century, after which it was demolished. This was indicated by the robbing of the building's foundations and the walls of the furnace, the filling in of the furnace with rubble (488), the destruction by a large oval feature (956) of the timber-lined pit in the southern part of the building, and the partial demolition and silting up of the timber-lined water channel/wheel pit (Fig. 5.25).

The channel fill contained pottery dating to 1660–1700 and clay tobacco pipe dating to 1700–1740, while the rubble fill of the robber cut (295) of the building's western wall (442) contained pottery dated 1760–1830.

Infrastructure Developments, Late 18th to Mid-19th Century

While the waterways had long been exploited for their economic resources and power, and to carry trade and people through the area, it was not until the brink of the industrialised era that the area's potential for complex infrastructure developments was realised. In the early 19th century, population and industrial growth remained focused on the metropolis to the west, but the proximity of this expanse of marginal agricultural land saw the lower Lea Valley evolve rapidly from rural backwater to centre of infrastructure and industrial activity.

Prior to the regulation of noxious and dangerous industries by the 1844 Metropolitan Buildings Act, industry and its associated workforce were crammed into the overflowing streets of the City and east London, stretching as far as the River Lea. This density of population and intensity of commercial activity placed huge demands on the City's poorly developed infrastructure, and a series of pressing social and logistical challenges arose.



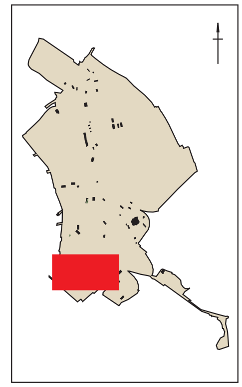


Figure 5.26: Locations of Trenches 41, 42 and 48 in relation to the East London Waterworks Company reservoirs as shown on 1869 OS map

Water Management

Navigation

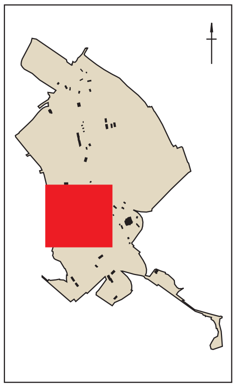
As the demand for waterborne transportation grew in the 18th century, it became increasingly important to improve navigability of the River Lea to allow more direct and unimpeded access between Hertfordshire and the River Thames.

The Trustees of the River Lea Navigation were originally appointed in 1739 to improve navigation along the Back Rivers and the Lea itself. The height of the canal era was marked by the passage of the *River Lea Act* in 1766, which authorised extensive improvement works and the construction of locks and new sections of canal. The most significant of these improvements was the construction of a new 3 km 'cut', named 'The Lea Navigation' or the 'Hackney Cut', which diverted from the River Lea close to Bridge Road in Hackney and rejoined it immediately north of a new lock at Old Ford. In 1766, the trustees instructed the surveyors John Smeaton and Thomas Yeoman to design the canal, and later the same year, Jeremiah Ilsey, a Hackney brickmaker, was commissioned to dig the new cut on condition that he would '*make the banks sound and handsome and finish the work to the approbation of their [the Trustees'] Surveyor for threepence a yard*' (National Archives: RAIL 845/50: 62).

The majority of the banks were constructed of boards and piles with some limited brickwork commissioned for the new lock at Old Ford (National Archive: RAIL 845/50: 100). During the 2008 photographic survey (Bower and Thompson 2008, 92), the eastern bank at Old Ford Locks was noted to retain original ragstone blocks capped by cement blocks and granite coping.

The Hackney Cut was opened in August 1769. Immediate problems were encountered caused by the velocity of the water flow making it difficult for vessels travelling north, but these were solved by widening the cut near the Hackney Waterworks. Following these early adjustments, the canal was subject to limited repair and maintenance to keep it operational. Minutes from regular meetings of the Trustees of the River Lea (1767–72) suggest that early maintenance was largely limited to the periodic dredging of sediment and the annual cleansing of back drains (National Archive: RAIL 845/5).

At the same time, the Limehouse Cut, which was completed in 1770, ran from the River Lea just above The Four Mills, Bromley, to Regent's Canal Dock (now Limehouse Basin), providing a shortcut past the long meanders along the lower reaches of the River Lea and Bow Creek.



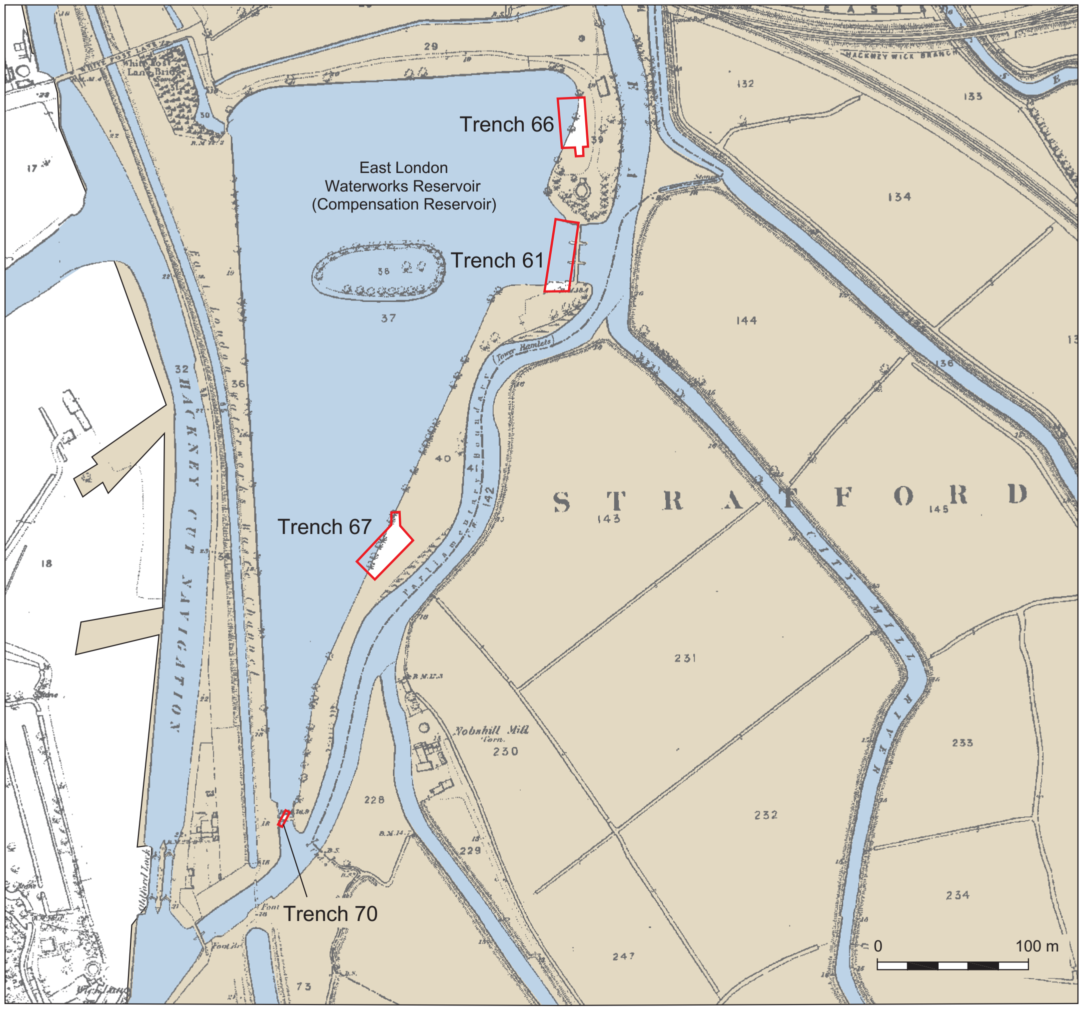


Figure 5.27:
Locations of Trenches 61, 66, 67 and 70 in relation to compensation reservoir as shown on 1869 OS map

The River Improvement Act of 1850 resulted in alterations to the waterways including along the Hackney Cut above Old Ford Lock (BHA 30) (Fig. 5.13), which itself was replaced with a brick-built double lock, as well as widening and dredging works along the River Lea.

Water supply

Also of major concern was the provision of a safe and plentiful supply of drinking water. Land was sought for the establishment of a large waterworks and the area bordering the River Lea was chosen due to its proximity to the city, the large tract of available and cheap land and its proximity to flowing water.

In 1807, the East London Waterworks Company (ELWC) was established, absorbing the West Ham and Shadwell Waterworks Company. By 1809, it had opened its new waterworks at Old Ford, consisting of two brick-lined oval reservoirs on the west side of the River Lea (Fig. 6.1) filled directly from the river. By 1929 the Hackney Waterworks Company was also subsumed into the ELWC. Under its new engineer, Thomas Wicksteed, the company now started drawing water from a new intake further upriver at Lea Bridge, above the influence of the tide. The water passed down a narrow feeder canal running parallel to, and east of, the Hackney Cut, then under the bed of the River Lea through as 3 foot 6 inch (*c.* 1.07 m) cast iron main, to supply two larger settling reservoirs on the river's east side at Old Ford (Fig. 5.26). On the 1869 OS map the supply channel is mislabelled as a

Waste Channel, and the reservoirs are mislabelled as *Compensation Reservoirs*.

A series of cholera epidemics and a burgeoning population led to legislation to further improve supply. As the outbreaks were linked to open stagnant water, the *Metropolis Water Act* of 1852 required that all reservoirs within five miles of St Paul's Cathedral had to be covered, and the two supply reservoirs on the west bank of the Lea were duly covered. The settling reservoirs east of the river, however, which were investigated in Trenches 48 and 42 (Fig. 5.26), were left open, whether by oversight on the part of the East London Waterworks, or in defiance of the law, until the passing of another Act in 1867 after which they were eventually infilled.

Trench 48, at the southern end of the northern reservoir, revealed *c.* 2.2 m of mixed re-deposited alluvial clay, peat and gravely sand, overlying the natural gravel, representing its deliberate infilling. The backfill was overlain by made ground containing demolition rubble and 20th century pottery. Similar deposits were recorded in Trench 42. The southern reservoir originally extended almost up to the eastern bank of the River Lea, as shown for example on Stanford's 1862 map. By 1869, however, the western end had been infilled, squaring off that end, and the trench lay largely within this early infilled area. The infill deposits within it, therefore, may pre-date slightly those recorded in Trench 48.

Compensation reservoir

By 1830, 5,900,000 gallons of water were drawn each day from the River Lea to supply the reservoirs at Old Ford. To counteract the impacts this had on the navigability of the river and the operation of the mills on City Mill and Pudding Mill Rivers, the ELWC built a triangular, 5.6 ha (14 acre) compensation reservoir, with a small island in the middle, in an area of reclaimed marshland on the east side of the river. It was designed to take in water on

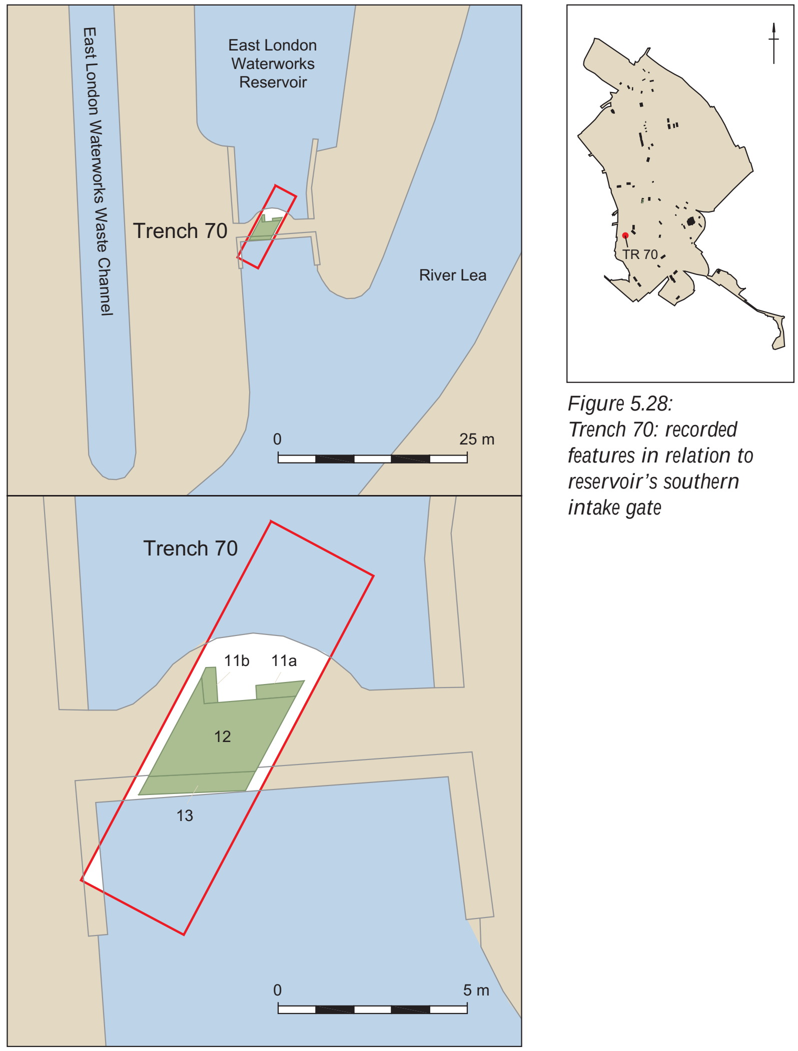
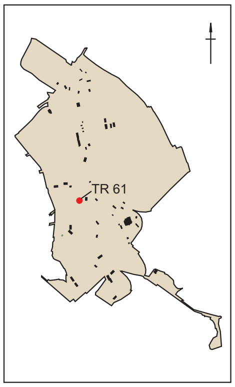


Figure 5.28: Trench 70: recorded features in relation to reservoir's southern intake gate

the rising tide through two gates, store it, and then it release it when the tide had gone out, if required by the millers (Laxton 1840). Because the tidal rise in water level at this point on the river was small and of short duration, the reservoir was designed to receive as much water from the river as possible during the short period of flood, and to discharge it quickly back into the river towards the end of the ebb tide. Four trenches (Trenches 61, 66, 67 and 70) were located within, or on the edge of the footprint of the reservoir (Fig. 5.27).

Part of the reservoir's southern entrance, just upstream from the Old Ford Lock, was revealed in Trench 70 (Fig. 5.28). This had '*a pair of self-acting flood-gates, 30 feet (c. 9.1 m) wide, opening into the reservoir… allowing the*



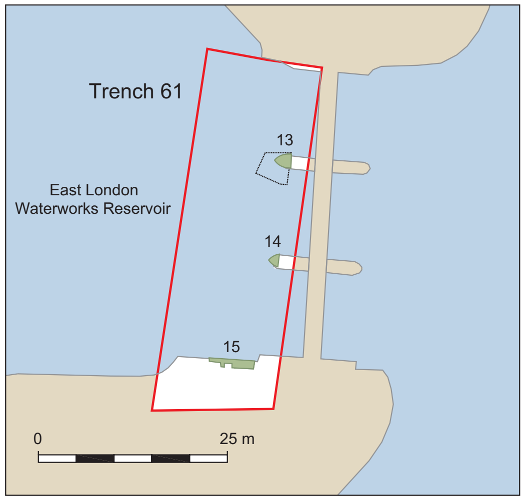


Figure 5.29:
Trench 61: recorded features in relation to compensation reservoir's intake/discharge gate

water to flow in freely, and closing by the first reflux of the stream, so as to impound all that had passed in' (Anon 1872, 243). The gates are shown on early maps spanning a walled inlet from the river, with their northern side having a curved outline, probably reflecting the two gates' northward swings. Within the entrance, a 2.8 m length of the south wall (13), which was *c.* 0.5 m wide, was exposed crossing the trench. The north side of the entrance was represented by a further section of wall (11a), parallel to, and 1.8 m to the north of wall 13, but ending in the middle of the trench; to its west a *c.* 0.9 m long brick pillar/wall (11b) lay at a right angle to it, with the 1 m opening between them being capped by a large iron/steel plate. All the exposed walls survived to heights of *c.* 1.3 m. There was a brick floor between the north and south walls, at 3.2 m OD, forming the base of the inlet channel.

Further upriver, almost opposite the head of City Mill River, there was a much wider entrance (*c.* 40 m wide) which, unlike the southern entrance, was designed for both the intake and discharge of water. Part of this structure was investigated in Trench 61. This revealed the western end of the two prow-shaped brick piers (13 at the north, and 14 at the south), which split the entrance into three channels and which supported the wooden bridge that spanned the entrance (Fig. 5.29). The piers were *c.* 1.8 m wide with vertical faces. A slot was machine excavated against pier 13 to a depth of 6.2 m below the present ground surface, revealing 3.5 m of the pier's height but without its base, or the floor of the reservoir, being reached (Pl. 5.7). Construction drawings of the entrance show that below their vertical faces the piers continued down a further *c.* 1.5 m, gradually stepping out to foundations *c.* 2.5 m wide (*ibid.*, pls 2-3). Also revealed in Trench 61 was a 6 m length of the east–west brick wall (15) lining the southern side of the entrance on its inner (reservoir) side.

The entrance was fitted with 'balance gates' designed by the company's engineer, Thomas Wicksteed, these being the first of their kind used in Britain (Laxton 1840). As described in an 1860 dictionary of engineering terms:

'Balance-gates, in hydraulic engineering, may be described by referring to those made for the Compensation Reservoir of the East London Water-works …They differ in construction from common flood-gates, being made to work upon a vertical shaft or spindle as a centre, and having an equal surface of gate on each side of that centre; so that whatever pressure of water there may be on one side of the gate tending to force it open, there is as great a pressure on the opposite leaf to keep it shut' (Weale 1860, 34-5).

The three channels in the northern entrance were each 38 feet (*c.* 11.6 m) wide, and each was fitted with a pair of balance-gates, with 20 feet (*c.* 6.1 m) wide leafs on either side of the central shaft (Anon 1872). When the gates were closed, by means of a quadrant rack and pinion placed horizontally on the gate's upper framework, each pair pointed inwards to the reservoir. As the gates were evenly balanced on their central axis, they could be easily and quickly opened, even when there was pressure of water on one side, as when the reservoir was full and the river low. This was important, since to have any appreciable effect on the water levels in City Mill and Pudding Mill Rivers a large volume of water had to be discharged back

Plate 5.7: Prow-shaped brick pier base of compensation reservoir intake/discharge gate, Trench 61, from the west

into the River Lea in the shortest possible time. Compared to normal sluice gates, which might take an hour and a half to open, the entire operation of opening all the six gates could be easily performed by one man in just ten minutes (Laxton 1840). Contemporary engineering drawings show the detail of the balance gates, as well as the overall design of the entrance, including the bridge, the piers, the horizontal sills below the gates, and the shallow curve of the concave inverts. These piers and wall were truncated at levels of between *c.* 3.9 m and 5.2 m OD, probably when the reservoir was decommissioned in the 1880s.

Two other trenches – Trench 66 at the north-east corner of the reservoir, and Trench 67 midway between the two intake gates on its eastern side – lie mainly in the narrow strip of land between the reservoir and the river (Fig. 5.27). Trench 66 revealed alluvial deposits surviving to a height of 2.84 m OD, into the upper of which was cut a post-hole containing packing stones and a fallen timber post. The reservoir was also fed (although to a much lesser extent) by a sinuous channel at its north-west corner (see Chapter 6, Trench 64) that drained the fields and marsh to north.

The Railway

The role of the marshland as a site for London's infrastructure was further developed with the construction in 1836–9 of the Eastern Counties Railway (ECR). The ECR line, running between Norwich and the terminus at Shoreditch (later Bishopsgate Station), was one of London's earliest railway lines, providing direct and efficient access from the eastern counties to the city markets. With increased manufacturing and industrial activity, the vision of the railways was to facilitate the movement of raw materials, goods and workers in and out of London and, later in the century, to and from the factories of the lower Lea Valley.

Royal Assent to construct the railway was obtained on 4 July 1836 (Connor 1999, iv). The railway incorporated a viaduct across the more densely populated areas of east London. It then traversed the valley on an earthen embankment, the construction of which required the importation of large volumes of material to elevate the track above the marshes. It also require numerous bridges to be built, as well as significant flood management works.

The Northern and Eastern Railway (NER), with aspirations to connect London with Bishops Stortford and Hertford, was granted approval at a similar time as the ECR and it was planned that the two railway lines should join at Stratford and follow the same line to a shared terminus at Shoreditch. The two lines subsequently became part of the Great Eastern Railway (GER).

An engraving dating to 1837 (Pl. 5.3), imagining (with some artistic licence) the completed ECR railway (then still under construction), shows the proposed bridge over the River Lea, the viaduct over Pudding Mill River, and the large earthen embankment imposed on an otherwise rural idyll. It shows a landscape in transition, with modern industry encroaching on the edges of the marshland – a large smoking chimney on the bank of the River Lea in the distance is juxtaposed against a windmill on the bank of Pudding Mill River (probably that identified in Trenches 109 and 111, above), a remnant of post-medieval industry.

Recorded railway elements

The recorded elements of the railway which date to this period include the railway structures from the River Lea to City Mill River (BHA 36) and the bridges over Wharton Road and Carpenter's Road (BHA 37). After leaving the city, the first engineering challenge for the railway builders was the crossing of the River Lea, just south of the East London Waterworks reservoirs. The core fabric of the bridge (BHA 36) dates from the 1830s. It was constructed in five phases, its original elliptical arch, named the 'Braithwaite Arch' after the project engineer John Braithwaite, surviving within the fabric of the early 21st century structure.

The carrying of the line over Pudding Mill River and Marshgate Lane presented an even greater engineering challenge. The solution was the construction of the Stratford Viaduct (BHA 36) which comprised five arches each 36 feet (*c.* 11 m) in span (Anon 1839). It is a rare example of early railway architecture in Greater London. The original 1830s fabric is well preserved, in spite of several phases of subsequent widening and repair. Traces of the original fabric of the bridges over City Mill River and Wharton Road (BHA 36) are still also evident, amid the late 19th century alterations.

These early elements of railway architecture are reminiscent in form and execution of 18th century canal architecture from which they evolved, and demonstrate the innovation of the early railway architects in adapting to new technology. They have significant group value, reflecting in their fabric changes in engineering techniques and infrastructural design over time, as well as the railway's physical and economic impact on the surrounding landscape.

Construction of the railway embankment, viaduct and bridges was a huge undertaking requiring large-scale consolidation of ground. The preparatory works included the reinforcement and realignment of the banks of the River Lea. Among these works was the construction of a stone and brick riverbank wall (BHA 32) along the river's west bank north of the railway bridge (Figs 5.13 and 6.12, below). This is depicted on the 1869 OS map and originally formed part of the wharf at the Iceland Wharf Ammonia Works. Fragments of the wall that survived later alterations to the riverbank were subject to photographic survey (BHA 32).

The social impact of the railways

The construction of the railway demanded a large and local workforce, and on-site workshops to manufacture, assemble and store railway components. By 1839, the ECR had established a small repair depot, but in 1847 the company's main engineering works were transferred from Romford to Stratford. This was the start of the extensive Stratford Works which covered the eastern edge of the marshes, north-east of the Channelsea River. The scale and productivity of the Stratford Works were unprecedented in the newly industrialised south, employing up to 3000 people in a multitude of construction and maintenance roles (Walford 1878, 571).

The influx of migrant workers, some from the south-east England, but many from the northern counties, and Scotland (Brownlee 2010), demanded accessible local housing, which the Stratford Marshes and their inhospitable environment lacked. Initially residential growth focused on the periphery of the marshes, for example at Bow on the west side of the River Lea, and along Stratford High Street. As demand increased, however, 'Hudson's Town' (later known as Stratford New Town), was founded in the late 1840s by the Chairman of the ECR, George Hudson, to the east of Stratford Works, to meet the housing, educational, recreational and pastoral needs of the incoming workers (Walford 1878, 571).

Discussion

Demand for industrial land close to the River Thames and the London markets grew during the 19th century. The lower Lea Valley, largely unhindered by legal restrictions, and with the ready-made infrastructure of the waterways, and shortly after with the railway, provided an ideal environment for industry to grow. However, both the waterways and the railway dictated the form, and therefore the evolution, of the industrial landscape. They fragmented the valley floor, acting as barriers to development in some areas, and inhibiting their accessibility for industrial use in some cases into the 20th century. Efforts were made, however, to enhance accessibility by improving the navigability of the river, and by creating road access through the railway embankment to the undeveloped land to its north.

By the mid-19th century, the infrastructural focus was beginning to change from primarily servicing London, to also developing the industrial potential of the lower Lea Valley. The railway which initially had carried trade and passengers through the Stratford area, came to be a catalyst for growth within the area itself. Against this backdrop of social and geographical change through the introduction of large scale infrastructure, the Victoria Docks were completed on the north bank of the Thames in 1855. This further opened up the Back Rivers to trade and passage, allowing the approach of larger seafaring vessels from the south.

By 1860, therefore, the lower Lea Valley was a hybrid and fragmented landscape. It was in a state of transition – from an area whose land-use had historically been determined by its expansive pastures and ancient waterways, to the hotbed of industrial activity that is was soon to become.

Industrial Developments, Late 18th Century to 1860

The *Victoria County History* (*VCH* 1973) identifies three main periods into which the modern development of manufacturing industry in West Ham can be divided: 1800–59, 1860–1919 and 1920–69. Much of this development involved the importing of new industries, spreading onto areas of marshland on the valley floor.

This process was very different, however, from the continuing localised industrial development seen in the early 19th century at Temple Mills, which, as described above, had its origin earlier in the post-medieval period, focused on the site of the medieval corn mills.

Temple Mills Trench 75

Chapman & André's map of 1777 had shown a number of buildings to the south of the Temple Mills, arranged around a plot of land at the end of a short lane running

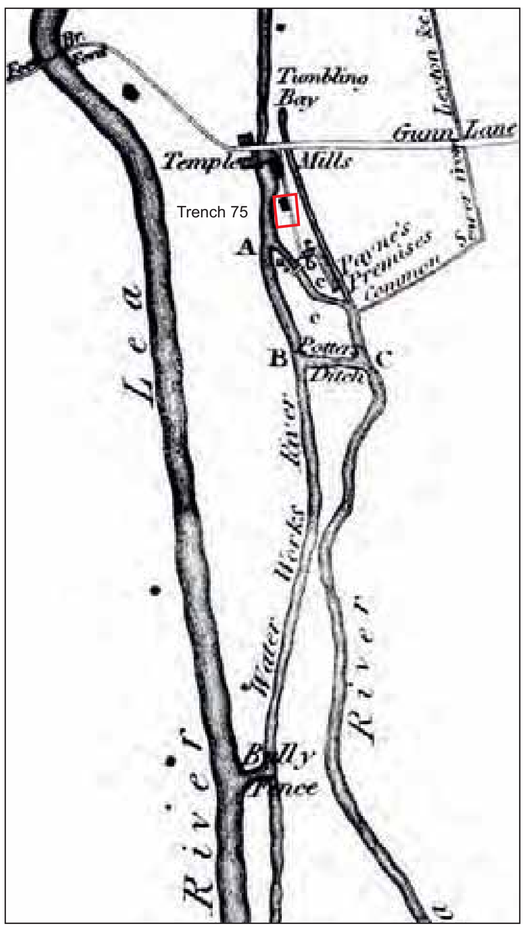
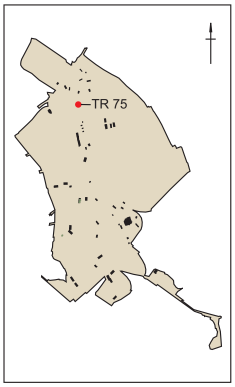


Figure 5.30: Detail of 1828 map showing position of Trench 75 at Temple Mills



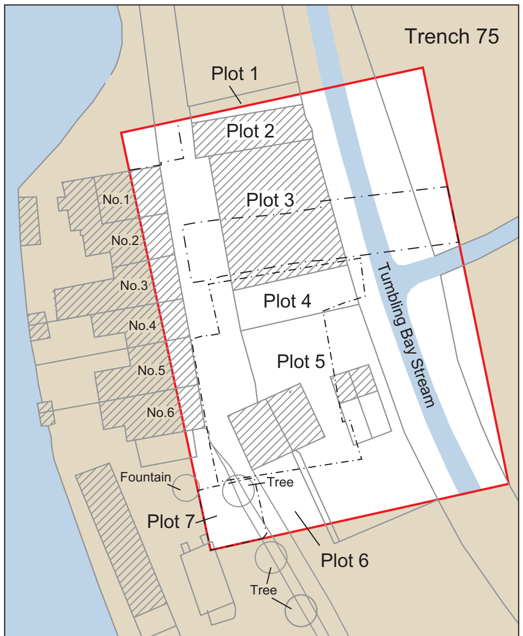


Figure 5.31: Trench 75: Phase 3 (except pre-construction contexts), with inset of plots and buildings shown on 1869 OS map

south from Temple Mills Lane. A similar arrangement is shown on the Ordnance Surveyor's drawing of 1799 (Fig. 5.7), although this map also appears to show what subsequent maps identify as the terrace of six cottages, later known as Temple Mills Cottages, or White Hart Cottages, immediately east of the mill stream. It also shows buildings flanking Tumbling Bay Stream at the south-east end of the island, which on a map of 1828 are identified as *Payne's Premises* (Fig. 5.30).

Phase 3 (late 18th–mid-19th century)

Following the demolition of the Phase 2 furnace building (Building 2) and its associated features (see above), another industrial building (Building 4) was built slightly to the south, although on almost the same alignment. In addition, a terrace of six cottages (Building 3) was built along the west side of the site (Fig. 5.31). Although the presence of some of these buildings is indicated on maps dating from the end of the 18th century, they are not depicted accurately or in detail until the 1st edition OS map of 1869. However, the house numbers for the terraced cottages (Nos 1–6), which are known from documentary records, are referred to here (and shown on Fig. 5.31). The specific nature of the other building and plots of ground depicted on the OS map are not known, but for ease of reference the excavated buildings are referred to as Buildings 1–4, while other plots, including possible buildings not revealed by the excavation, are referred to as Plots 1–7 (Fig. 5.31).

Between and around these buildings there was a complex sequence of variable deposits sealing, and cut by, pits, post-holes and gullies, which appear to predate the Phase 3 buildings' construction. However, as will be discussed below, there remains a question as to exactly when and in what order the buildings were built.

Pre-construction features

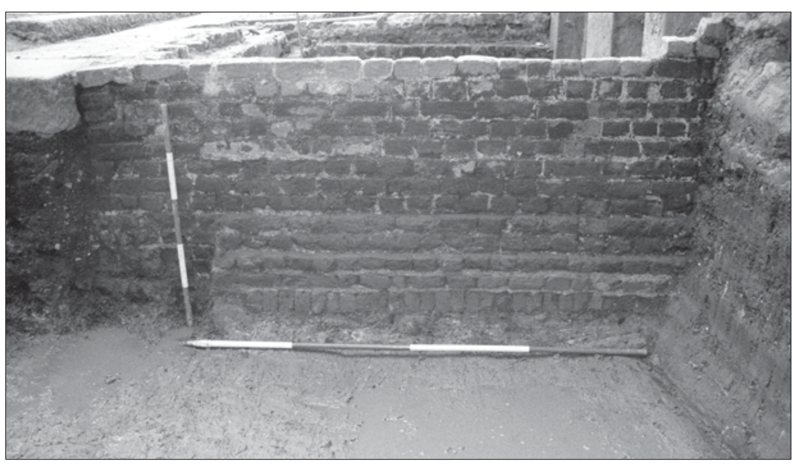
A number of contexts post-date the use of Phase 2 Building 2 (some of them associated with its demolition) and pre-date the construction of the Phase 3 buildings (Fig. 5.25). These include wide shallow cut (615), up to 0.35 m deep but only the north side of which was recorded, which appears to have completely removed the southern side of Building 2, and truncated the top of the water channel's timber lining. The lowest fill (966) within this cut was overlain by layers 957 and 974 which together extended across the southern part of Area 4. Layer 974 was overlain by two irregular dumps of demolition rubble (586/587/644 at the west, and 788 at the east) comprising gravelly sandy silt containing broken brick and tile, and mortar.

Similar deposits extended northwards in the western part of the trench, as represented by layers of sandy gravelly silt – 747 in the south (partly sealing Phase 2 sub-rectangular pits 972 and 947), and 198 in the north – overlain by layers of broken tile (748), and broken brick, tile and mortar (197), respectively. There was a further gully in this area (209), cutting through gravel surface 210, which produced a number of horse bones, including from a large male draught horse probably used to pull carts around the area (Higbee, Chapter 7). An isolated elongated pit (563) of uncertain function measuring *c.* 1.4 m north-south by 0.5 m wide and 0.26 m deep, with steep sides and a flat base, had a single fill (562) containing pottery dated 1770–1830 and clay tobacco pipe dated 1680–1710.

Building 3 – Terraced cottages

The eastern frontage of a terrace, 22 m long, of six small east-facing domestic dwellings was recorded along the western side of the excavation, the fronts of the cottages extending less than 3 m into the site (Fig. 5.31). Historical records indicate that these were numbered No. 1 at the north to No. 6 at the south. Each cottage was *c.* 3.4 m wide internally, comprising a single room at the front, with shared party walls. As described above, map evidence suggests that these may have been built by the end of the 18th century. Although a mixture of brick fabrics and forms were used, such a date would be consistent with the presence of moulded London stock brick (fabric

Plate 5.8: North end wall of terrace of cottages, Building 3 in Trench 75



3035, manufactured after 1780), and the use of 'Roman cement' (patented after 1790) (see Hayward and Leivers, Chapter 7).

The construction cut for the front wall, as excavated inside No. 2, and both inside and outside No. 5, was up to *c.* 1.5 m wide and 0.3 m deep. Inside the buildings it cut alluvium; outside No. 5 it cut pre-construction layer 198 (above). Clay tobacco pipe dated to 1680–1710 was found in the backfill. The front wall (15) was 0.35 m wide and survived to a height of 0.55 m. It was built from regular courses, in English bond, of frogged and unfrogged orange and purple fabric brick, bonded with an off-white lime mortar. Tied into it at either end were the terrace end walls (58 at the north, and 57 at the south) which were of similar construction, and survived to a height of up to 1.6 m (Pl. 5.8).

The party walls, which were also tied into wall 15, consisted of a header course resting on a bed of crushed brick and mortar, overlain by stretcher courses, two bricks wide (*c.* 0.22 m). On most walls the brickwork was exposed, although in places there was surviving mortar render.

Abutting either side, and the insides of the terrace's end walls, but not bonded to them, were roughly built low walls, probably to support the floor joists. These comprised up to three courses of stretchers resting on a mortar bed, capped by a course of headers. The floors were also supported in the centres of the rooms by east–west sleeper walls on rubble foundations, again not keyed into wall 15; No. 4 had two of these internal sleeper walls, more closely spaced. The sleeper walls varied slightly in construction but comprised up to three brick courses – wall 19, for example, having two courses of stretchers with a course of headers on edge between, topped by a course of tiles.

Stubs of masonry which projected at an angle from the north walls of No. 1, No. 3 and No. 5 are of uncertain function, but could represent supports for internal staircases.

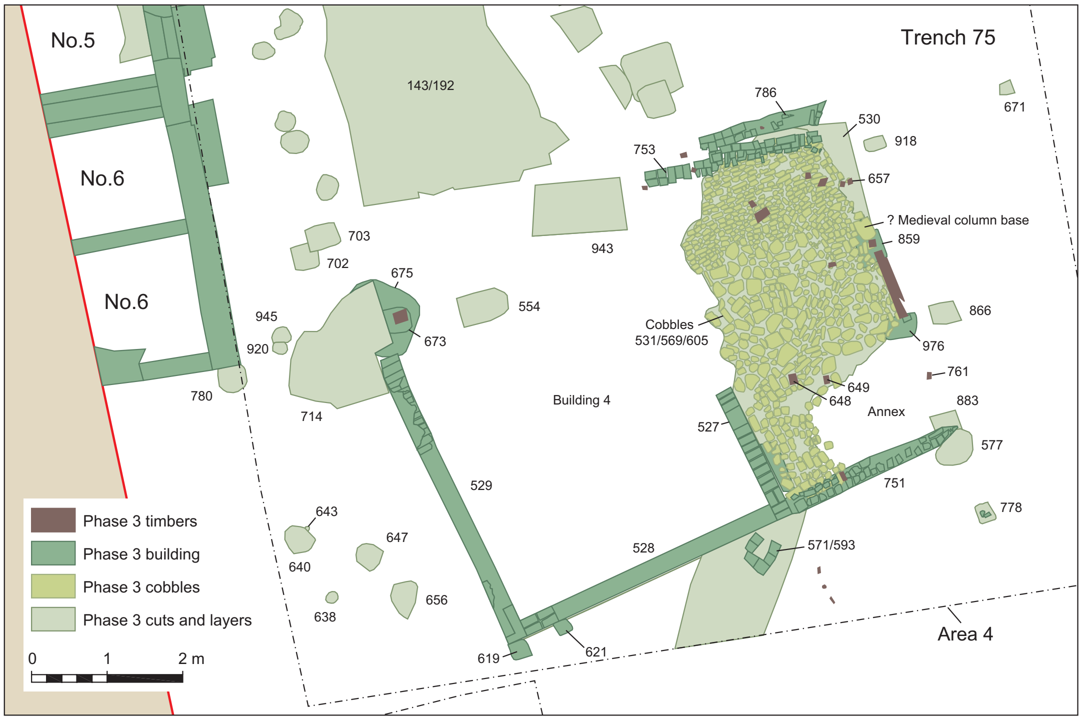
The positions of the front doors of four of the cottages were indicated by external brickwork thresholds, forming the foundations for brick or stone steps, each one of slightly different construction. Nos 3 and 4 and Nos 5 and 6 had adjacent doorways, and it is likely that Nos 1 and 2, where no thresholds survived, did as well. As they survived these threshold features were 0.7–1.1 m long and up to 0.5 m wide. A change in the pattern of the brickwork in wall 15 at the entrance to No. 5 suggests that the doorway was *c.* 0.85–0.9 m wide. Degraded timber (523) overlying wall 15 within No. 4's doorway and extending inside the building was also probably part of the threshold.

On the 1850 OS map a small enclosed yard, *c.* 4.8 m long (east–west) by 2.3 m wide, appears to abut the south end of the terrace. A thin concrete slab, the edge of which corresponds to the eastern end of the yard, may have been its surface.

Building 4 and its annexe

Following the demolition of Building 2, another rectangular structure was built which shared almost the same orientation but lay to its immediate south-south-west (Fig. 5.31). It comprised two parts, distinct in the quality of their construction – Building 4 at the west and a less substantial annexe on its east side (Fig. 5.32).

Building 4 was represented by a 4.1 m long wall along its south side (528), to which were connected a 4.1 m long wall at the west (529), and a 1.9 m long wall at the east (527). No wall was recorded at the north, and while it is possible that this was an open-fronted structure, it may be that the northern end of the building, and the ends of walls 527 and 529, had been destroyed. Whichever the case, it is likely to have measured *c.* 5 m south-south-east–north-north-west – based both on the dimensions of the building's eastern part (below), and on map evidence. No construction cuts were recorded for the walls which were



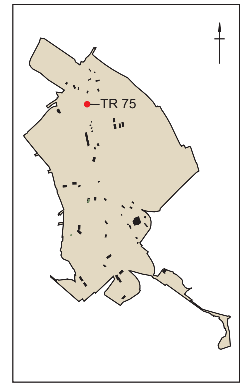


Figure 5.32: Trench 75: detail of Phase 3 Building 4 and annexe

built directly over pre-construction deposits 788 and 586/587/644 (above), and no floor surface was recorded between them.

The walls, of which up to three courses of bricks survived, were built of reused stock bricks in various fabrics, the latest dated to 1666–1850, bonded with either gravel cement (walls 528 and 529) or both gravel cement and Portland cement (wall 527). The coursing varied both between and within walls, generally comprising header courses at the base (mostly on edge but also on bed) and stretcher courses above.

The western wall (529) extended part of the way across the fill of Phase 2 pit 972, but ended at the southern edge of a large sub-square post-hole (675), which cut the earlier pit's fill, and which was positioned at the north-west corner of the building (as shown on early maps). The post-hole, which was *c.* 1 m wide and 1.1 m deep with near vertical sides and a flat base, contained the degraded remains of a wooden post (not illustrated), along with pottery dated to 1810–1830. The fill of 675 was cut in turn by a smaller post-hole (673), *c.* 0.4 m wide and 0.4 m deep, just inside the line of the wall, also containing the remains of a post, as well as pottery of comparable date.

The only internal feature (apart from post-hole 673) was a sub-rectangular cut (554), *c.* 0.7 m ENE–WSW by 0.4 m, and 0.26 m deep, with near-vertical sides and a flat base, and a single gravelly silt fill containing pottery dated 1760–1830. A larger sub-rectangular feature (943), aligned east-west and measuring *c.* 1.3 m by 0.8 m, and 0.6 m deep, lay across the projected line of the missing north wall; it contained 19th century pottery. It is possible that neither feature was associated with the building.

The eastern annexe to Building 4 was of poorer construction, and may have been a later, light-weight addition, or an enclosed yard, extending the building *c.* 2.6 m to the ENE. It was defined by shared wall 527, wall 751 (continuing the line of wall 528), and wall 786. Wall 751 measured 0.25 m wide and up to 0.27 m high, with almost its full length surviving. It was built, apparently unmortared, with header half bricks, using reused stock moulded brick of varying fabrics, the latest dated to 1780–1850, as well as a squared block of chalk at the west

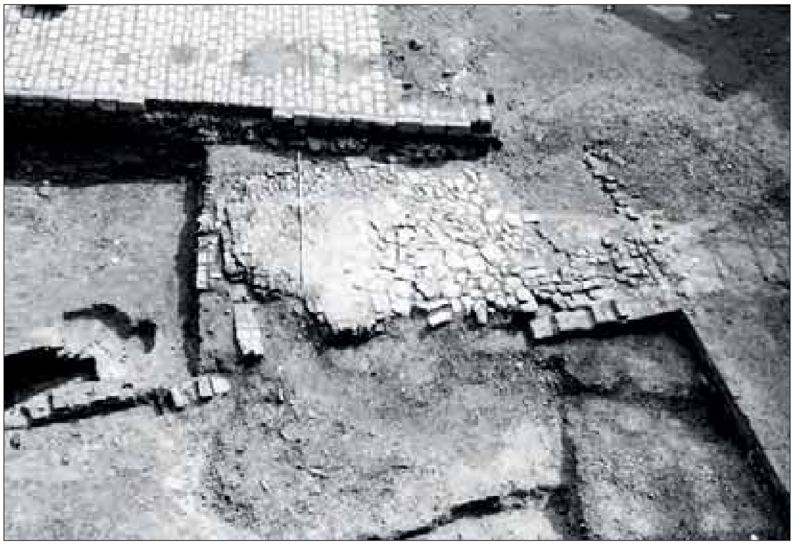


Plate 5.9: Cobbled floor in Building 4 annexe, Trench 75, from the west

end. It had a vertical timber set into its inner face. Its eastern end partly overlay the fill of a rectangular post-hole (883) which was cut, on the immediate south side of the wall, by another, oval post-hole (577), the latter possibly associated with the building.

The north side of the annexe was defined by wall 786 which is slightly misaligned on the main axis of the building (although perpendicular to the terrace of cottages). Although traceable up to the north-east corner, it was heavily damaged, with only a short length (*c.* 0.8 m) surviving apparently intact. It appears to have been similar in construction to wall 751, with reused brick, the latest of which had a date range of 1666–1850. Approximately 0.1 m to the south of wall 786, and parallel to it (and therefore similarly misaligned), were the remains of another, better preserved wall (753), possibly a rebuild, 2.5 m long and 0.3 m wide, extending up to the line of shared wall 527; its latest bricks were dated 1850–1900. Within these northern walls were five timber posts, two in wall 786 and three in wall 753, appearing to form two parallel lines 0.25 m apart, although not aligned precisely either on the walls themselves or on the rest of the building.

There was no wall on the east side of the annexe, its line being marked instead by the eastern edge of the annexe's rough cobbled floor (531/569/605, below), and a line of posts/stakes representing a possible fence or lightly constructed screen with a central doorway. The doorway is represented by two large sub-rectangular post-holes (859 and 976), *c.* 0.8 m apart midway along the east side, both *c.* 0.4 m wide and containing the remains of posts. Between the posts, abutting the edge of the floor, was a horizontal plank, 940 mm long by 130 mm wide and 60 mm thick. The western sides of the post-holes were partly overlain by the cobbled floor. Driven stakes 657 and 761 lay midway between the doorway and the annexe's north-east and south-east corners, respectively, the northern one supported by a stake angled towards it at the west.

The cobbled floor (531/569/605) was bedded on a 0.15 m thick layer of compacted clayey silt (641) which contained pottery dated 1830–1850 and clay tobacco pipe dated 1840–1890. The floor, from which 19th century pottery was recovered, extended over much of the area between the annexe's north and south walls (covering *c.* 7.4 m^2), but missing in the south-east corner (where it overlay the Phase 2 timber-lined water channel) (Pl. 5.9). It was very variable in its make-up, comprising reused brick (the latest dated to 1780–1850) and stone (including granite and sandstone). At the north it consisted largely of whole and half bricks laid on edge, in rows aligned on the annexe as a whole rather than its north walls. At the south-west it comprised mainly half bricks laid on bed, and where the floor survived at the east, this too consisted mainly of brick.

The central part of the floor, however, covering *c.* 2 m by 2 m, consisted mainly of stone cobbles, measuring 90–330 mm wide and 65–180 mm thick, one of which on the eastern edge of the floor was a medieval column base in Taynton stone (Fig. 5.32). A noticeable feature of the stonework was a distinct band, up to 2 m long and 0.4 m wide, of more elongated stones laid with broadly similar NNE–SSW orientations, and having the appearance of a pathway cutting diagonally across the floor from the suggested doorway towards the south-west corner. Possibly associated with its southern end was a pair of timber posts (648 and 649), one on either side. In addition, in the south-west corner there was a layer of mortar (567) overlying the floor, abutting wall 527, the straight eastern edge of which suggests that it may have been a bedding layer for a brick step. If so, this could indicate the position of a doorway into Building 4, although there was no indication of such within the wall itself. An iron chisel (<66>, Pl. 7.11) was found in the mortar layer.

The bases of a number of other posts, all rectangular in cross-section, were recorded within the annexe, some possibly structural, others presumably related to its function. A mortar spread, possibly a repair, overlay part of the floor surface at the north, and there was a trampled layer of crushed brick, mortar, gravel and silt (530) at the north-east corner, containing pottery dated 1800–1830 and clay tobacco pipe dated 1780–1830.

Building 4 and its annexe (with the exception of the annexe's north walls) lay at a marked angle to the terraced cottages (Building 3), with a gap of only *c.* 1.7 m between its north-west corner and the front wall of the terrace. While the position of the cottages (although not the buildings themselves) is indicated on the 1850 OS map, Building 4 is not, although this does not preclude its construction by this date. On the 1869 OS map, the gap between the buildings is seen to provide the point of access to the southern part of the Temple Mills site (Fig. 5.31). On that and later maps both Building 4 and its annexe are shown as shaded, signifying roofed structures. However, while the Building 4 juts out into the roadway between the terrace at the west and the line of buildings and open plots flanking Tumbling Bay Stream at the east (numbered here Plots 1–5), its annexe lies within one of those eastern plots (Plot 5), within which there are also two small attached buildings with what appear to be open yards to their south.

Features external to Building 4

On the south side of the building there was a very truncated brick-lined rainwater gully (571/593) which continued beyond the edge of excavation in Area 4 (Fig. 5.32). Its construction cut was 1.1 m wide and at least 0.16 m deep, its backfill containing pottery dated 1825–1900. At the north-east end a U-shaped arrangement of bricks probably formed the base of the shaft below a down-pipe; a bone handled iron knife <61>, Pl. 7.8) was found in its fill.

There was a line of three wooden stakes driven *c.* 0.2 m apart into pre-construction layer 788, *c.* 0.8 m south of Building 4, on the line of wall 527. Their position corresponds to a possibly ditched boundary, shown on the 1869 map, running south from Building 4, between Plots 5 and 6 (Fig. 5.31).

There were a number of largely rectangular post-holes around the outside of Building 4 and its annexe, the purpose of which is unclear, although some may relate to its construction. Abutting the south wall of Building 4 (528) to the west of the gully were two rectangular post-holes, one (619) at the corner of the building, the other (621) *c.* 0.5 m to the east, both cutting through pre-construction deposit 586/587/644. They were overlain by a small, 0.1 m thick spread of sandy silt (604, not illustrated) containing pottery dated 1825–1900; there was a similar deposit (714) at the building's north-west side containing pottery dated 1775–1830.

There was a close group of three more rounded post-holes (640, 647 and 656), 0.36–0.5 m wide and up to 0.26 m deep, and two stake-holes (638 and 643) west of the building. These correspond closely to the edge of the trackway running south from between Buildings 3 and 4 as shown on the 1869 map (Fig. 5.31 inset).

Road surface and fence line

A metalled road surface lay in front of Building 4 and extended further north than indicated in Fig. 5.31. It was 2.0–2.8 m wide, consisting of compacted layers of silt sand and gravel (143 and 192), overlain by a small area of broken flagstones set in mortar then by more loosely compacted gravely sandy silt (191 and 150, not illustrated). Its eastern edge corresponds closely to the western boundary of Plots 3-5, indicating that the road was on the eastern side of the 4.5–5 m gap between the plots and the cottages. The same surface (250) was also recorded *c.* 5 m to the north (in Area 3), with a shallow gully (246) in its east side. Here it lay closer to the cottages (and may have continued up to them). This would have put it on the line of the narrower (3 m wide) gap continuing to the north, where Plot 2 extended *c.* 1 m further west than Plot 3 (Fig. 5.31).

Just west of road surface 143/192, approximately parallel to and, on average, *c.* 1 m in front of, the cottages there was a rather irregular and unevenly spaced line of nine post-holes (cutting pre-construction layer 197/198). They were of different shapes and sizes, between *c.* 0.2–0.4 m wide and up to 0.3 m deep, but may mark the line of a fence between the trackway and the area immediately in front of the cottages. The positions of post-holes 703 and 702 at the south suggest that the fence curved in towards the southern corner of the terrace to allow access through a narrow (*c.* 0.6 m) gap between the buildings. Three further post-holes, 945, 920 and 780, the latter at the south end of the terrace's front wall (15) may be a continuation of that curving line (Fig. 5.32). However, a fence here would have further restricted the narrow access point between Building 4 and the cottages.

Features external to the Building 4 annexe (Plot 5)

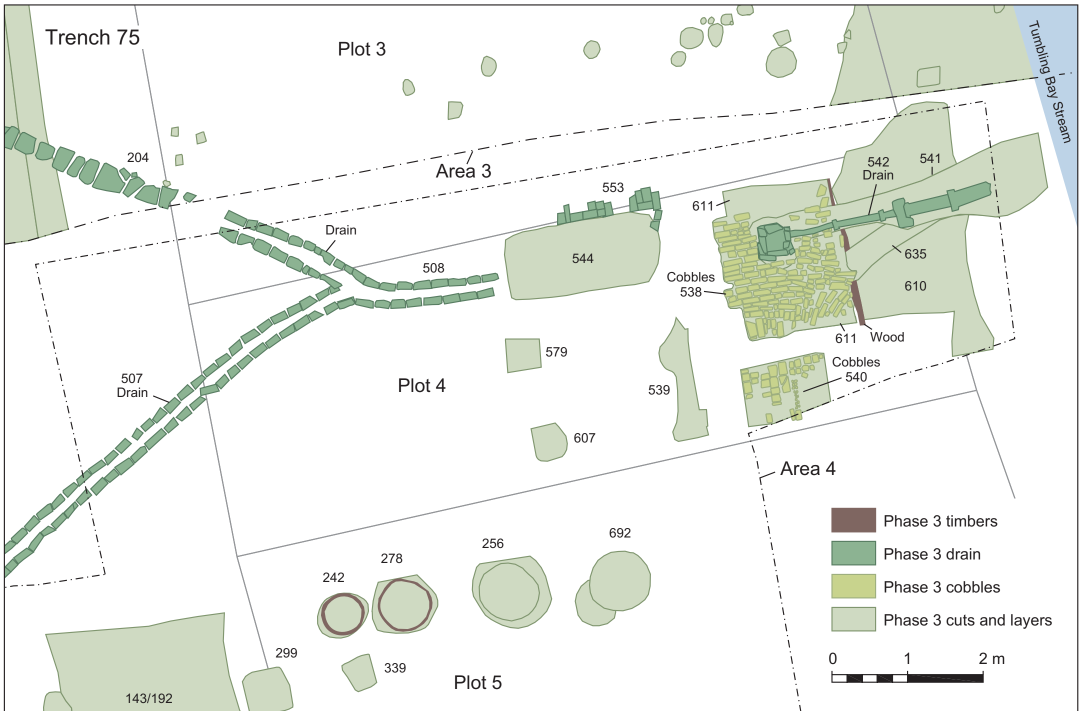
Four sub-rectangular post-holes (671, 778, 866 and 918) lay on the eastern side of the annexe, all of broadly comparable

Plate 5.10: Pit 184 Trench 75

maximum width (0.24–0.3 m) (Fig. 5.32). Post-hole 918 lay near its north-east corner and may have been paired with a similar post-hole (671), 1.7 m to the ENE, which would have lain close to the north-west corner of the western of the small structures in Plot 5 (Fig. 5.31); if so, they may have formed a gateway between the northern and southern parts of the plot. Post-hole 866 lay immediately east of the south side of the annexe's east-facing doorway, and post-hole 778 lay *c.* 1 m south of its south-east corner.

There was a short arc of three ovoid post-holes, with maximum widths of 0.32–0.46 m and 0.15–0.2 m deep, *c.* 2 m east of the annexe (Fig. 5.31). They lay on the western boundary of the small 'yard' south of the western of the two small attached buildings in Plot 5 (above).

To the north of the Building 4 annexe, there was a group of ten sub-rectangular post-holes most lying close to the western side of Plot 5 (Fig. 5.31). There were also remnants of a brick surface (407) overlying the demolition rubble from the furnace in Phase 2 Building 2. Most of the post-holes, the axes of which broadly matched the building and the plot boundary, lay in a rough line from the annexe, some intercutting. They varied in size from *c.* 0.3–0.7 m wide and *c.* 0.1–0.4 deep, but generally had vertical sides and flat bases. Post-hole 339 had a fill of degraded wood representing the remains of the post. Pottery found in post-hole 299 was dated 1770–1830, and 19th century pottery was found in others.



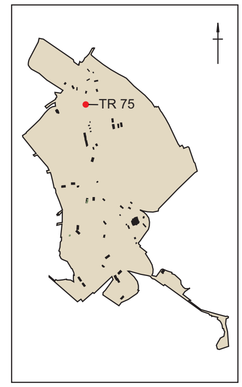
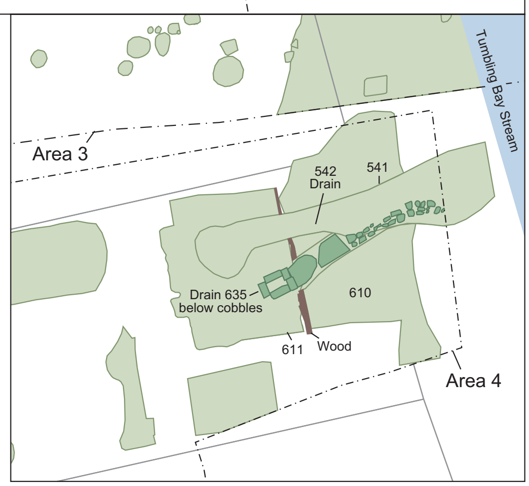


Figure 5.33:
Trench 75: detail of Phase 3a–b drains, and associated features



There were also four sunken casks set in circular pits with vertical sides and flat bases, arranged in a 4.5 m long line parallel to, and just south of the plot's northern boundary (Figs 5.31, 5.33). Pit 242 was *c.* 0.7 m wide and survived to a depth of 0.12 m, the cask inside being 580 mm in diameter; pit 278 was *c.* 0.9 m wide and 0.3 m deep, and the cask 670 mm in diameter; pit 256 was *c.* 1 m wide and 0.4 m deep, and the cask 790 mm in diameter. Pit 692 was *c.* 0.8 m wide and 0.17 m deep, and all that remained of the cask was a 740 mm diameter iron hoop; it cut the eastern side of a shallow oval pit.

The spaces around the casks had been back-filled with sandy silt, the fill from pit 256 containing pottery dated 1770–1830. It is not clear what function the casks had, although it is likely that they played some role in one of the industrial processes on the site, probably that undertaken within the Building 4 annexe, and possibly involving a washing, dyeing or refining process.

A similar feature (pit 184) was recorded in section in Area 1, in the plot south of the cottages (Plot 7) (Fig. 5.31). That pit was 0.9 m wide and survived to over 0.9 m deep, the cask (182) appearing in section as 570 mm in diameter and at least 500 mm tall (Pl. 5.10). Four timbers from the cask were sampled, three being narrow, radially faced elm staves with fragments of iron hoops attached, the other timber being a narrow, tangentially faced piece of oak with bevelled edges and pierced by several small ferrous nails, which may have been a batten to hold the cask heading boards together. A section of 18th century leather feed hose was recovered from the fill of this cask (see Mould, Chapter 7, Fig. 7.8, Pl. 7.24).

Rainwater gullies and features in Plot 4

Two brick-lined rainwater gullies ran eastwards from the terraced cottages, crossing the roadway and converging into a single east-flowing gully (508) in Plot 4 (Figs 5.31, 5.33). On the 1850 Town Plan this plot's western boundary is set back slightly from those of Plots 3 and 5, but by the 1869 map it is on the same line, the plot measuring 3.4 m wide and extending 10 m from the road at the west to the edge of Tumbling Bay Stream at the east. It is shown unshaded on the 1869 map, suggesting that it was an open plot at that date. A short length (1.4 m) of brick wall (553) near the midpoint of its northern boundary, is probably a remnant of the south wall of the building indicated in Plot 3. Plot 4, however, contained a complex series of features, including gullies and drains, post-holes and floor surfaces which suggest that it had a very specific function.

Plate 5.11: Rainwater gully 204 in Trench 75, from the east

The western ends of the rainwater gullies mark the likely positions of the down-pipes from the roof guttering of the cottages. There were no remains of any shafts at the ends of the gullies because these had been truncated. One (204) ran south-east from between Nos 2 and 3 crossing the south-west corner of Plot 3 into Plot 4 (Pl. 5.11); the other (507) ran north-east from between Nos 4 and 5. Their construction cuts were *c.* 0.4 m wide and at least 0.24 m deep, with vertical sides and flat bases. Nineteenth century pottery was found in the backfill of the construction cut of gully 508. Gully 507 was lined on its base with reused Flemish floor tiles, and on its sides with two random courses of reused, unfrogged brick (some with traces of mortar adhering), and capped with reused medieval worked Reigate stone. Gully 204 also had a tile base, brick sides and ashlar capping, but gully 508 was capped with brick. Internally the gullies were *c.* 0.10–0.15 m wide and 0.2 m deep.

Gully 508 was recorded for only *c.* 2 m before it was cut by a sub-rectangular feature (544), *c.* 2.3 m long, 0.9 m wide and 0.3 m deep. South of this point were two, probably associated, sub-square post-holes (579 and 607), *c.* 0.8 m apart, both 0.44 m wide and *c.* 0.5 m deep, the latter containing pottery dated 1840–1870. Both cut Phase 1 made-ground deposit 568/660 (Fig. 5.23). Establishing the relationship between these features, and those further east was hampered, however, by the presence between them of a substantial cut for a later land-tie anchor (see Chapter 6, Fig. 6.8) supporting the revetted western bank of Tumbling Bay Stream.

Overlying the Phase 1 made ground east of the land-tie cut there was a 0.05 m thick spread of material (630/632, not illustrated) described either as *scorched ground*, *fired clay* or *crushed brick*, and which appears to have formed some kind of surface. The eastern edge of this layer was cut by the brick-lined shaft of a masonry drain (635) running east into Tumbling Bay Stream (Fig. 5.33 inset). The drain, the slightly sinuous line of

Plate 5.12: Cobbled floor in plot 4, Trench 75, from the south

which was similar to, but not exactly the same as gully 508, was almost 0.5 m lower than the eastern end of gully 508 (*c.* 4 m to the west). Like the rain gullies to the east of the drain, however, it was *c.* 0.4 m wide and 0.4 m deep, with near-vertical sides and a flat base, and is very likely to be associated with it. The square shaft was of mortared brick, while the drain was lined on its base with unmortared cobbles and broken brick, and along its sides by unmortared brick. The drain was capped, where this survived at its western end, by green sandstone slabs. The construction cut had been backfilled around the drain with clayey silt.

Overlying layer 630/632 was a layer of dark sandy silt (611), 0.06 m thick, which formed the bedding for a brick and cobble floor (538) (Fig. 5.33). The layer was abutted, along its eastern edge, by a 2 m long plank, 25 mm thick, set on edge, to the east of which there was layer of dark silt mixed with crushed brick (610), probably deriving from these two deposits. The cobbled floor surface, recorded also to the west (539) and south of the land-tie construction cut (540), covered an area *c.* 3 m square, not extending east of the plank. It consisted mainly of reused frogged and unfrogged stock bricks, the latest of which were dated 1780–1850. Most of the bricks in the northern half were orientated east–west, but the pattern was less regular towards the south and south-east, where the floor overlay the shaft of drain 635. Pottery recovered from the floor is dated 1770-1830.

The laying down of the cobbled floor was associated with the construction of a new ceramic drain (542 in construction cut 541), replacing and cutting the eastern end of masonry drain 653. The new drain comprised a larger brick- and cobble-lined shaft (0.5 m square externally), set within the regular arrangement of bricks in the northern part of the cobbled floor (Pl. 5.12), and a 3.2 m long ceramic drain which ran east from it. The shaft lay in a rounded construction cut, *c.* 0.7 m wide and 0.22 m deep. The ceramic drain comprised four connected sections each *c.* 0.7 m long, the two at the west being *c.* 70 mm in diameter. These were connected via another short length, set in what was probably a cement block, to the two at the east, which were *c.* 160 mm in diameter, and may represent a later repair. The drain's construction cut was backfilled.

The function of all these features together is unclear, although they are almost certainly related. What is evident, however, is that some effort and care was taken to collect the rainwater from the roofs of the terraced cottages and channel it below the road into Plot 5 to the east. It may have been collected within feature 544 for use in some industrial process undertaken on the cobbled floor, before draining into Tumbling Bay Stream, first through drain 635, then its more substantial replacement 542.

Post-holes in Plot 3

A cluster of almost 50 post-holes and stake-holes was revealed in the southern part of Plot 3, but formed no obvious pattern or structure (Fig. 5.31). Nine of them lay either on the western edge of Tumbling Bay Stream, or half way down its side; three of these were close to the revetment, but not associated with it as they cut through a layer of silt (247) which overlay the possible revetment backfill deposit (376, above).

The post-holes were of variable shape and size, the largest (536) being 0.5 m in diameter and 0.13 m deep, but the majority were less than 0.2 m in diameter. Only two produced any dating evidence, post-hole 438 containing pottery dated to 1770–1840 and clay tobacco pipe dated 1820–1860, and post-hole 436 containing pottery dated to 1830–1900 and clay tobacco pipe dated 1840–1910.

Discussion

The developments at Temple Mills can be viewed almost as a prelude to the industrial developments seen later and far more extensively within the lower Lea Valley. Significantly, however, the site was to remain isolated from many of those developments until well into the 20th century, and remained as a small island of localised, predominantly craft-based industry, different in character from sometimes noxious and anti-social industries to the south. Moreover, while the mid-19th century saw extensive residential developments in West Ham, such as 'Hudson's Town' built to accommodate the influx of workers in the railways yards and industry, the workers' residences at Temple Mills comprised, and remained the terrace of six cottages, although lived in by people with a wide range of occupations.

Documentary research has provided much information about the increasing range of manufacturing process that were undertaken at Temple Mills in the post-medieval to early Victorian period, of which calico works were an important element, although it is not easy to identify these with specific elements of the archaeological evidence. In 1793, for example, the lease-hold of calico works, as advertised for sale in *The Times*, comprised 'a spacious well-constructed calico printing house, mill house, workshops, pencilling rooms, madder house, counting house, outhouses, large yards and stabling, convenient dwelling house, offices and garden adjoining with extensive bleaching grounds, seven brick dwelling houses and gardens to each eligibly situated at Temple Mills'.

The clearest archaeological evidence for an industrial process is provided by Building 2, with its furnace and some form of water-powered machinery, from which copper alloy slag was recovered (see Andrews, Chapter 7), which may be related to the documented manufacture of brass kettles and tin and latten plates. The function of Building 4 and its annexe is less clear, although the likely association of sunken casks may give some clue as to the activities undertaken. Furthermore, the complex of drains, pits and floors focused on a narrow plot of land on the edge of Tumbling Bay Stream also indicate some specific, if unknown, activity probably associated with an industrial or manufacturing process.

The combination of documentary and archaeological evidence also illuminates the lives of those who lived and worked on the site, more clearly perhaps than the massed workforce of industry and infrastructure. Census returns give us the names and ages of the families living in the Temple Mills Cottages, and indicate the diversity of their manufacturing and in some cases still agricultural occupations, such as (in 1841): *Thomas Murphy* (51), *Silk Printer*, with wife *Elizabeth* (50), son *Thomas* (21) and daughter *Elizabeth* (10); other occupants were a *Labourer*, a *Cow Keeper*, and an *Engineer*. Even as the process of industrialisation accelerated in the second half of the 19th century (see Chapter 6) the Temple Mills site retained much of its character as an island of activity rather isolated from the wider developments.

The Origins of the Modern Industrial Landscape

Although little of the Olympic Park's industrial built heritage survived at the time of survey, the buildings and structures selected for recording cover more than a century of industrial development – from the earliest fabric incorporated into the complex of buildings at 39–45 Marshgate Lane (BHA 9–12) (Fig. 5.13), which was first developed between 1848 and 1862, to the final storage shed erected at Sun Wharf in the late 1960s.

The period between 1800 and 1860 saw the establishment of 34 permanent firms within the borough of West Ham as a whole, with chemicals, and engineering and metals being the two dominant groups (represented by eight and seven firms respectively). However, these were sited mainly on the valley floor to the south of the High Street, and while there had been substantial infrastructure developments in the form of railways and waterworks north of the High Street, Stanford's Map of 1862 (see Chapter 6, Fig. 6.1) shows that this area had seen very little industrial development. A notable exception was J.P. Murphy's Tar and Turpentine Distillery which was established as early as 1818 at the north end of Marshgate Lane.

39, 41, 43 & 45 Marshgate Lane (BHA 9–12)

Only one of the industrial premises recorded within the Olympic Park appears to retain built fabric pre-dating 1860. Cartographic evidence indicates that the site of nos. 39, 41 and 43–45 Marshgate Lane (BHA 9–12) was first developed between 1848 and 1862, at which later date it is identified on Stanford's map as a Patent Tanning Works (Fig. 6.1, below). Its location between the High Street and the railway line, on a narrow site between the newly constructed Marshgate Lane and Pudding Mill River, was both easily accessible and provided the large quantities of water required both for the tanning process, and for the disposal of its water-based waste products.

It is clear from the evidence of the trade directories that the premises changed hands a number of times during their life (see Chapter 6), and cartographic evidence shows that they were subject to numerous phases of rebuilding, alteration and adaptation. However, evidence from more detailed later mapping suggests that the premises always comprised two conjoined premises: a smaller northern grouping, arranged around the north, west and south sides of a small square yard with access from Marshgate Lane to the east, and a larger grouping to the south with a series of interconnecting yards accessed from the east-west section of Marshgate Lane to the south.

Although the footprint of the buildings at the time of recording bore little relation to the layout of the later and more extensive factory shown on the 1869 OS map, a comparison of the locations of certain wall alignments suggests the retention and reuse of walls, and the incorporation of earlier structures within the complex of conjoined premises recorded (see Chapter 6, Fig. 6.19). The north wall of Buildings 4 and 5 (BHA 11 and 12), the south wall of Building 2 (BHA 10), and the north and west walls of the central structure of Building 2 may all represent elements of the mid-19th tanning works.

Conclusion

In many respects, the character of the developments within the valley described in the previous chapter continued unbroken through post-medieval period. The valley floor continued to be used primarily as grazing land. The deep alluvial sediments encountered in many of the trenches reflect the continual flooding to which the valley must have been subject. However, it was an agricultural landscape that required continual management, balancing the renewal of the ground's fertility though the slow accumulation of these fine sediments, with the problems caused by uncontrolled flooding. This involved the cutting and maintenance of ditches both to ensure the land's drainage and to reclaim new areas of marshland.

It was a management, however, that brought farmers into conflict with mill owners, for whom the penning of high volumes of water behind their weirs, flooding the farmland if necessary, ensured the optimum operation of their mills. As millers diverted water into their millstream, they in turn came into conflict with the barge owners, who could only navigate the river on short surges of water released from flash locks interspersed up the river channel. Weirs and fish traps also caused obstructions, and by the end of the period large volumes of water were being drawn out of the river by the water supply companies.

Such conflicts resulted not only in ever tighter regulation of the waterways, but also increasing levels of investment in them as a form of 'natural infrastructure'. The channels were revetted, and their courses altered and straightened. New navigation canals were cut, and locks built, and by the end of this period a large compensation reservoir had been created to maximise the water available to the mills.

By now, however, these mills had progressed far beyond the processing of agricultural produce, and had diversified into a wide range of industrial and manufacturing processes. While Temple Mills, somewhat isolated from the centre of economic activity at Stratford, is in some sense atypical, it was nonetheless such water-powered medieval mill sites which remained the focus industrial activity well into the 19th century.

While some of the infrastructure developments had been for the benefit of the local community, it was ultimately the economic and social demands of the city of London that were decisive in the rapid spread of new infrastructure across the valley – the new navigation canals and compensation reservoir, the waterworks reservoirs and canal, and the railway line. These marked the start of the rapid transformation of the valley. In 1860 the land was still predominantly agricultural in its use, but its character and coherence had changed irreversibly, access across it restricted and views of it blocked by the bridges and embankments. It was land ripe for development.

Chapter 6

From Farmland to Factories, 1860–1960: A Century of Industrial Development

Introduction

The second half of the 19th century saw the transformation of the lower Lea Valley. While its rural character had already been disrupted in the first half of the century by the developing infrastructure, as shown on Stanford's map of 1862 (Fig. 6.2), the second half of the century brought about a radical change from a still predominantly agricultural landscape, to one increasingly encroached upon by a range of dirty, polluting industries. The localised industrial activity that had become established in the post-medieval period, closely focused on the sites of the medieval mills and exploiting the same sources of water (and wind) power, was overtaken by new industries spreading into the surrounding fields as new forms of power – steam, oil and electricity – became available.

It is regularly stated and generally accepted that dirty industries moved eastwards out of the city as a result of the *Metropolitan Buildings Act* of 1844. This Act contained two sections which dealt specifically with constraints on the siting of new buildings for businesses involved in dangerous or anti-social activities. One concerned 'Businesses dangerous in respect of Fire or Explosion' which included the manufacture of gunpowder, matches, vitriol, turpentine and varnish. The other concerned 'Businesses offensive or noxious' which included blood-boiler, bone boiler, fellmonger, soap-boiler, tallow-melter, tripe-boiler and slaughterhouse. The Act stipulated that no such business could be established '*in any building or Vault or in the open Air, at a less Distance than Forty Feet* (12.2 m) *from any Public Way, or than Fifty Feet* (15.2 m) *from any other Building'*, and in the case of explosives, *'any vacant Ground belonging to any other Person…'*. The Act also outlawed the building of any new dwellings within 50 feet of any such established industries.

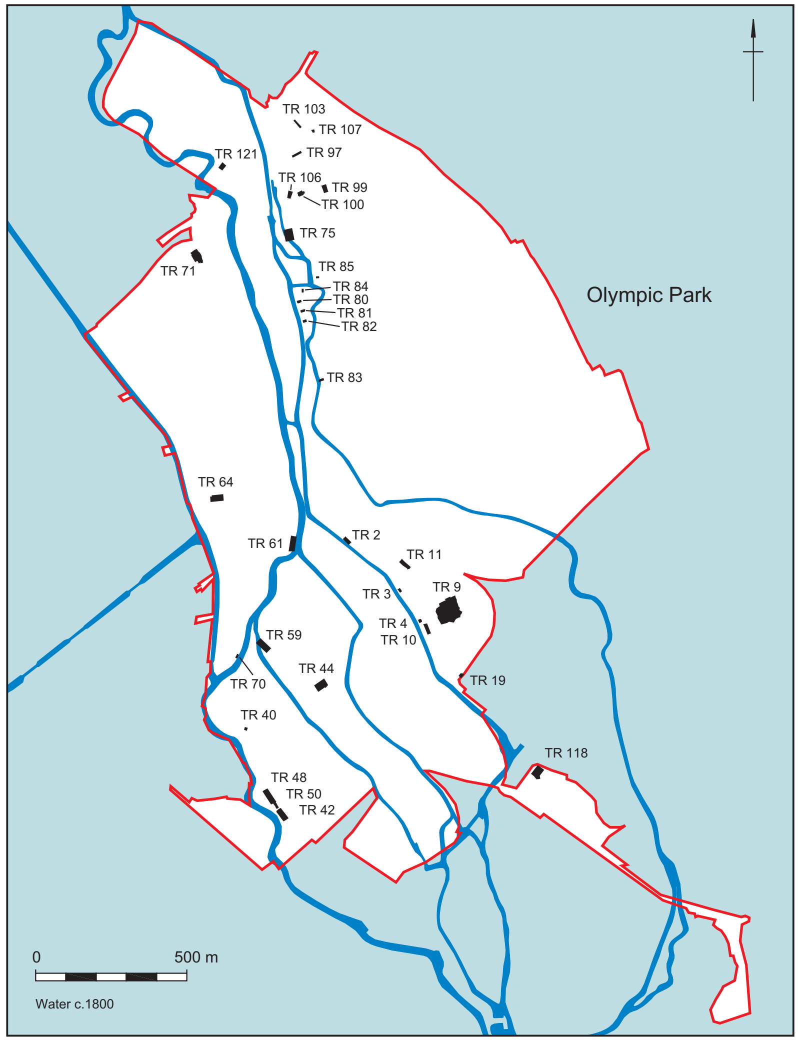
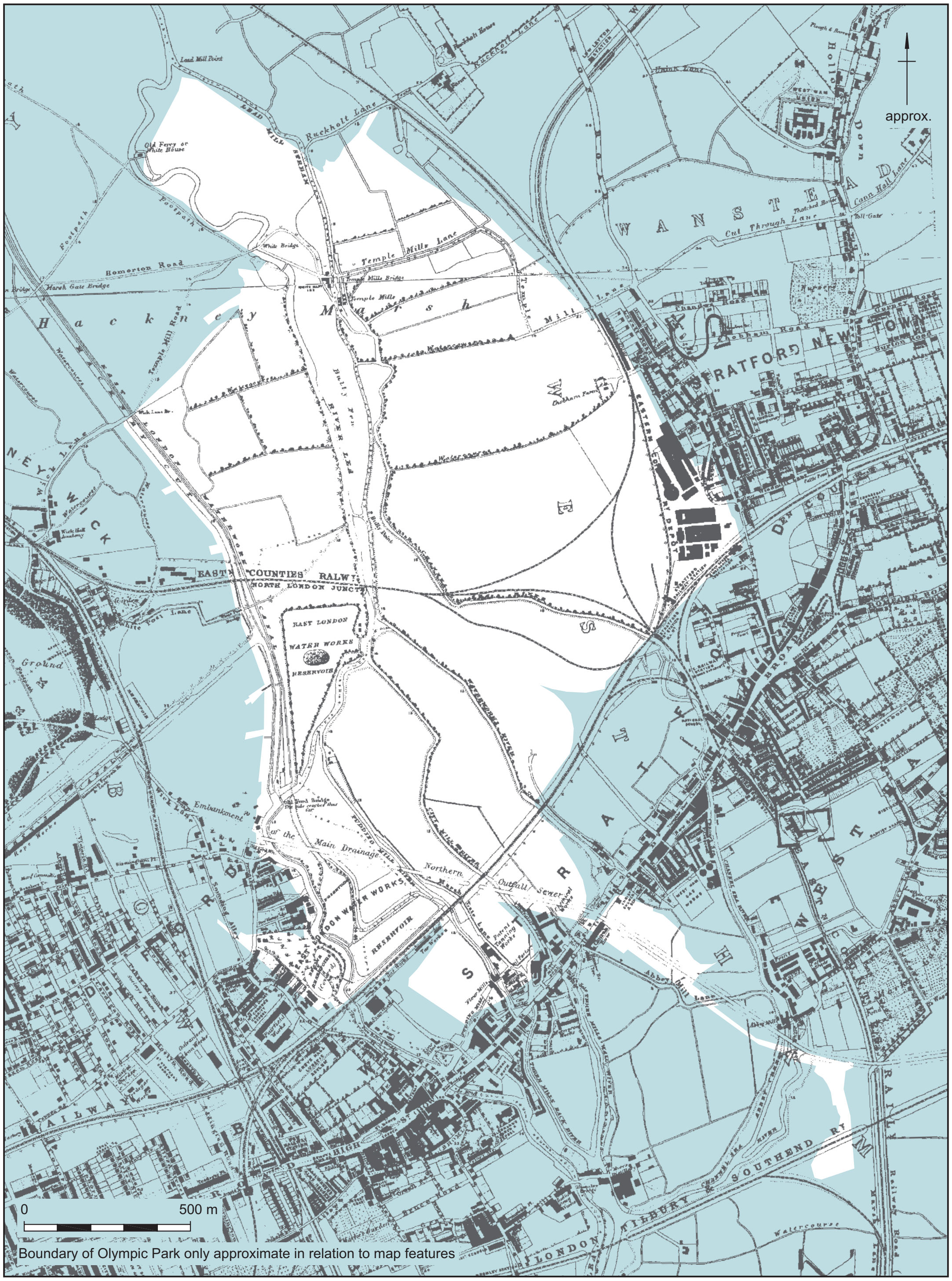


Figure 6.1: Location of trenches mentioned in text

By the mid-19th century, the marshland of the lower Lea Valley represented one of the few large undeveloped areas close to the metropolis, but outside the area of its jurisdiction, where these industries could locate in proximity to the docks and the markets of the capital. Controls over these anti-social industries were far more lax in West Ham, and it was not until 1885 that a relevant bye-law was passed which

Figure 6.2: Detail of Stanford's Library Map of London and its Suburbs 1862



imposed similar restrictions within the newly created Borough. Even then, however, it appears that it was some time before the new restrictions were fully enforced, as these industries, and the employment that they provided, were of considerable benefit to the borough.

A study of the cartographic record shows that, while the areas of marshland to the south of Stratford High Street, and to the west of the Hackney Cut, saw rapid development during the mid- to late 19th century, presumably as a result of the Act, much of the area of the Olympic Park remained as

Figure 6.3: Location of BHAs mentioned in text

agricultural land and undeveloped for industry for at least three decades (ie, until after 1890). There were several reasons for this. First, the available land on the valley floor was dissected by waterways, railway lines, and the embankment of the Northern Outfall Sewer. This divided it into a series of often isolated land blocks, access to some of which would have required costly engineering solutions in the form of bridges or underpasses. Secondly, this low-lying area, crossed by so many watercourses, was highly susceptible to flooding, so that locating industrial premises here would have required the regular maintenance of flood defences such as river walls and embankments. Thirdly, the soft alluvial soils of the flood plain necessitated deep and expensive building foundations, adding further to the cost of locating here.

Plate 6.1: Bridge carrying the Northern Outfall Sewer across the Channelsea River

However, as potential development sites elsewhere in West Ham and Hackney became increasingly scarce, the development of even this marginal land eventually became a more viable proposition, and gradually certain land blocks within the Olympic Park area were developed for industry. Archaeological and built heritage features relating to all these types of land-use – industry, infrastructure, waterways and agriculture – were recorded across the Olympic Park (Figs 6.1 and 6.3).

Infrastructure Developments 1860–1920

In the three decades between 1871 and 1901, West Ham underwent a period of very rapid growth, its population increasing over four-fold from 62,919 to 267,358 (*Vision of Britain* website, www.visionofbritain.org.uk), reflecting the influx of workers to service the growing industrial development. This put enormous pressure on the still largely primitive infrastructure, and led to measures being taken to repair and improve the sewers, waterways, railways and roads.

Water Management and Exploitation

The arrangement of the main river channels, firmly established by 1800 (see Chapter 5, Fig. 5.4), saw little alteration during the 19th century. However, the uses to which they were put, and their resultant management, changed significantly. Although new forms of power came to replace water, there were new demands placed upon its limited supply – from the incoming industries, for navigation and for the supply of drinking water.

Despite the large-scale water-related infrastructure developments that had taken place during the first half of the century, severe cholera epidemics in 1831–2 and 1848–9 were linked to the supply of drinking water and the disposal of sewage. In 1856 the Metropolitan Board of Works was established, and tasked with finding an engineering solution to these problems. The sewage problem reached a crisis in 1858 when soaring summer temperatures resulted in the 'Great Stink' caused by open sewers in the streets, and cesspools draining into rivers like the Thames and the Lea. Part of the Board's answer was the Northern Outfall Sewer.

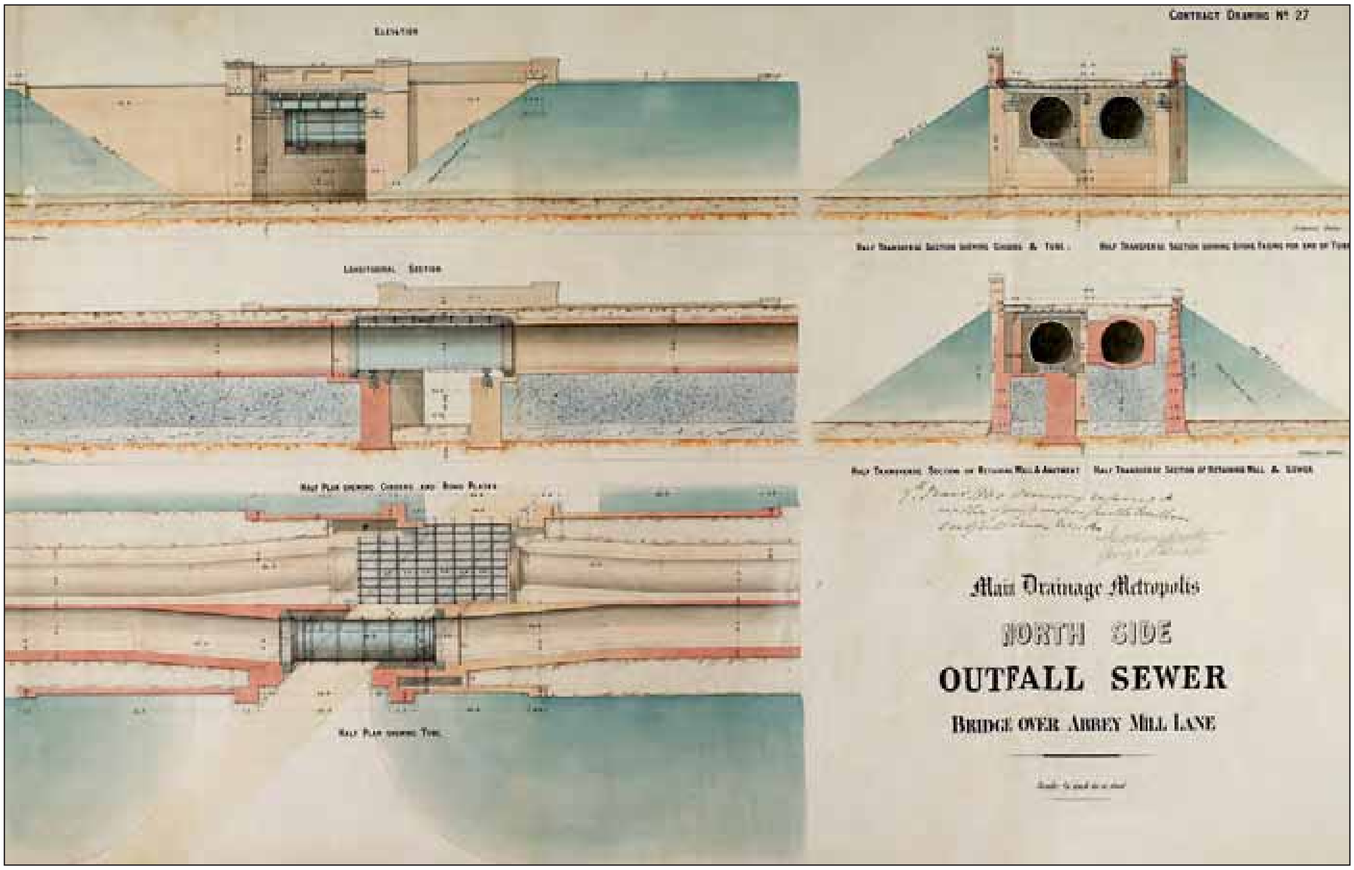


Figure 6.4: Original contract drawing of Northern Outfall Sewer bridge over Abbey Mill Lane (BHA 42)

The Northern Outfall Sewer

The Northern Outfall Sewer (BHA 38; Fig. 6.3) was designed as part of a network of intercepting sewers to take sewage and waste water from the city to the new pumping station at Abbey Mills (opened in 1868). Work began on the sewer in 1859 to specifications set out by Joseph Bazalgette, the Board's Chief Engineer. Construction required the raising of large embankments and bridges to carry the outfalls over the valley floor and river channels, and to negotiate the infrastructure hurdles of existing roads, and the railway lines and embankment.

Original construction 1859–1863

The form of construction of one such bridge – that over Abbey Lane (*Abbey Mill Lane*) (BHA 42) – is clearly illustrated by an original contract drawing dating to 1860 (Fig. 6.4). The drawing has a plan, at two levels of the bridge, showing the two parallel sewer pipes and the plate and girder construction of the bridge deck; it also has two cross-sections, a longitudinal section and an elevation of the finished form of the bridge. It clearly shows the tapered brick retaining walls, and the fill material upon which the sewer pipes were to sit.

The sewer survives in the modern landscape as an earthen embankment along the top of which runs the public footpath and cycleway known as 'The Greenway'. Although most of its original structural components have been heavily modified, and obscured from view behind 20th century reinforced concrete and steel, several structures were recorded to varying levels prior to their removal or alteration. These included the bridges over the River Lea (BHA 39), Pudding Mill River and Marshgate Lane (BHA 40), Abbey Lane (BHA 42) (Fig. 6.4), Channelsea River (BHA 43) (Pl. 6.1), and the GER's North Woolwich branch line (BHA 44). Also recorded was a subway through the embankment east of City Mill River (BHA 41) constructed between 1869 and 1894.

Plate 6.2: Additional pipes of Northern Outfall Sewer under construction

The dominant original building materials comprised yellow stock brick and blue engineering brick, with Bramley Fall stone used to accent abutments and piers; this palette of materials was repeated in the various structures relating to the sewer.

Expansion 1900–1907

By the end of the 19th century, the sewer was no longer adequate for its task. As a result, the Metropolitan Water Board, formed by the 1902 *Metropolis Water Act*, drew up plans for its expansion, and by 1907 two additional pipes had been added to increase its capacity (Pl. 6.2). Recorded elements of the sewer reflect some of the modifications made at this time, such as the riveted steel plate sections forming the upper substructure of the bridge over the River Lea (BHA 39), and the wrought iron riveted plate girders on the bridge over Pudding Mill River (BHA 40).

The differences in architectural detailing between the first and second phases of sewer construction are illustrative of a shift in aesthetic perceptions and values. The original sewer architecture was more ornate in its style and execution, reflecting a civic pride in pioneering new engineering projects. In contrast, the early 20th century fabric comprises plainer copings and mouldings, reflecting a shift towards a more functional and utilitarian perception of the sewer network.

Reservoirs

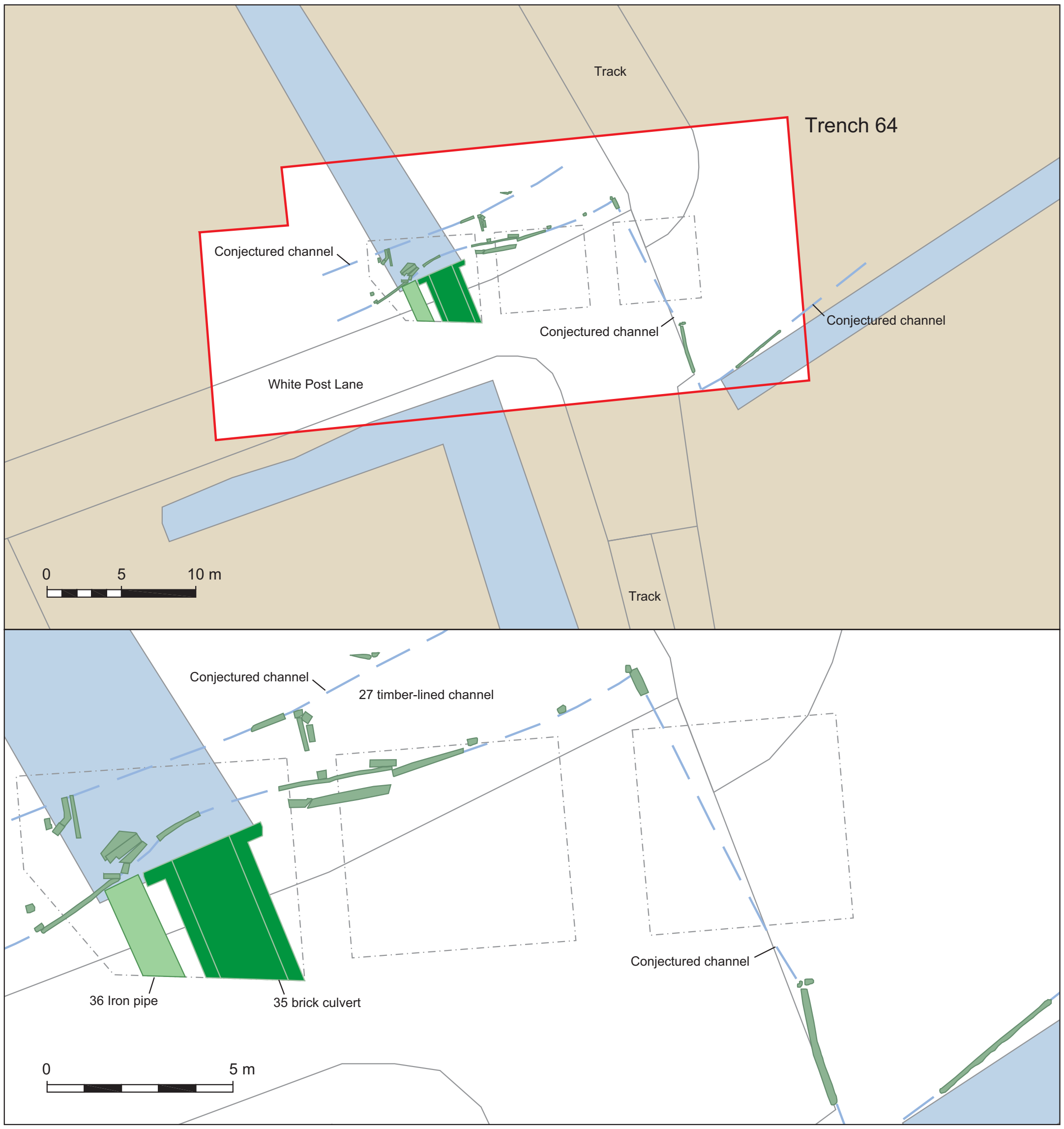
Water supply

Despite the construction of the Northern Outfall Sewer, there was a resurgence in the number of cholera outbreaks towards the end of the 1860s. In 1867, following one devastating outbreak, the source of infection was traced to unfiltered water supplied by the East London Waterworks Company (ELWC) from their reservoirs at Old Ford. In response to the ensuing public outcry, a filtering area was provided for one of the covered reservoirs on the west bank of the River Lea, while the adjacent reservoir, along with two open, settling reservoirs on the east side of the river were decommissioned and infilled (as noted in Trenches 42 and 48, see Chapter 5). In 1868, the *Lea Conservancy Act* gave responsibility for the management of the River Lea and its tributaries to the Lea Conservancy Board and the surviving west bank reservoir was infilled by the early 1870s.

These cholera epidemics ultimately led to the enforced closure of the ELWC. This had a dramatic impact on the landscape. By 1892, the waterworks land, including the in-filled and levelled reservoirs, had been sold off, and built over by railway sidings including, by 1893, by the Bow Goods Yard on the west side of the river. The construction in the 1890s of the Old Ford Pumping Station, on the east side of the River Lea, opposite Old Ford Lock, pioneered a new method of water provision and reflects a significant response to changes in sanitation law in response to the condemned East London Waterworks.

Compensation reservoir

The ELWC compensation reservoir further up the west bank of the River Lea continued to have a role as long as the company drew water from the river below Chingford Mill. However, by the 1880s it had become redundant due to the construction of a new reservoir further upriver at Walthamstow in 1867, the Thames intake above Sunbury in



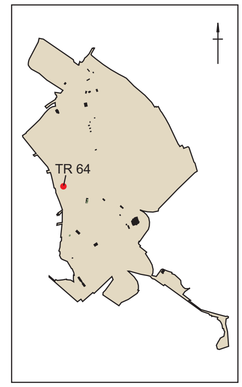


Figure 6.5: Trench 64

1872, and the Chingford intake in 1882. The reservoir was therefore filled in, evidence for which was noted in Trenches 61 and 70 in the form of deep deposits of mixed dumped 19th century industrial and commercial waste (see Chapter 5). The 1896 OS map shows the reservoir as largely filled in with only an area of marshy ground at its northern end.

That marshy ground was cut through by a stream which flowed out into the River Lea through the former main intake gate, all visible traces of which had gone by 1916. The stream was a continuation of the channel that had originally fed the reservoir at its north-west corner (see Chapter 5), where it was investigated in Trench 64 (Fig. 6.5).

Trench 64

The trench lay immediately north of White Post Lane (as shown on the 1869 OS map). Although the course of the channel during the period of the reservoir's use was not identified in the trench, a possible diversion following a period of waste dumping appears to be represented by the fragmentary remains of a timber-lined or revetted channel (27) cutting west–east through the dumped material along the north side of White Post Lane. The timber lining appeared to consist of vertical posts, horizontal planking and internal braces, made from re-used 19th century building timbers. At its east end, where the lane turned to the south, the channel also appears to have turned to the south to link up with another drainage ditch aligned south-west–north-east.

The timber-lined channel may have been short-lived, as it was overlain by further dumped waste. Subsequently, the full depth of the dumped waste (3.4 m), and the underlying pre-dump soil (31, possibly a ploughsoil) as well as the earlier alluvial clay (34), were cut through by a 22 m wide construction cut (23/32) for a brick culvert (35) which carried the water southwards under the lane. The culvert was *c.* 1.6 m wide and 1.3 m high internally, with vertical walls and an arched roof; brick facing continued either side of its opening. An iron pipe (36), *c.* 1 m in diameter, lay parallel to the culvert to its immediate west. This was probably inserted at the same time, perhaps as a water mains, as no later cut was observed in the construction cut backfill (22).

Waterways

An incidental consequence of the closure of the water supply and compensation reservoirs was the improvements made along some of the waterways, particularly along the River Lea where the banks required stabilisation following the large-scale importation of material to fill in the reservoirs. Some of the bends in the river north of the GER bridge were made less acute and the banks rebuilt, although parts of the pre-1860 wharves at the Iceland Ammonia Works at Old Ford survived (BHA 32, see Chapter 5).

The 1880s and 1890s saw alterations and modifications at other locations along the waterways, to improve access, navigability and wharfage, and so facilitate the movements of goods and materials between the developing factories and their markets. Extensive stretches of the banks of the Lea between Bow Bridge and Old Ford Lock were rebuilt or repaired at the turn of the 19th and 20th centuries, with new construction methods demonstrated by the steel coffered bank comprising Larsen steel piles tied into the banks with steel tie-bolts, used to reinforce the east bank between the Bow Interchange and Old Ford Lock. Also by 1896, a jigger lock and towpath were in use at Old Ford Lock (BHA 30).

Despite these changes, however, there was little in the surviving built heritage to indicate that the potential for water transport, either by canal from the north or from the docks to south, had been a significant factor in attracting industry to the area. Many of the factory sites were built well above the level of the adjacent watercourse or towpath, and had high retaining walls. This, combined with the fact that much of the waterway network was tidal, somewhat precluded the construction of the private canal basins which were such a common feature of the industrial landscape of the Midlands.

Archaeological remains associated with the waterways reflect some of the development in this period. Significant changes were made, for example, to the configuration of water channels towards the north of the Olympic Park in the late 19th and early 20th centuries (Fig. 6.6). A number of evaluation trenches cut through these channels: two through Channelsea River (Trench 85 at its north end, and Trench 83 *c.* 340 m further south), one through Potter's Ditch (Trench 84), and three (Trenches 80–82) through Waterworks River south of Potter's Ditch. In addition, a 35 m length of Tumbling Bay Stream was examined in the excavation of the Temple Mills site (Trench 75). All the channels showed evidence of having been recut and almost all the deposits and structures recorded within them were of 19th and 20th century date, largely reflecting their date of abandonment and/or infilling. The trenches are described here broadly from north to south, following the flow of the river.

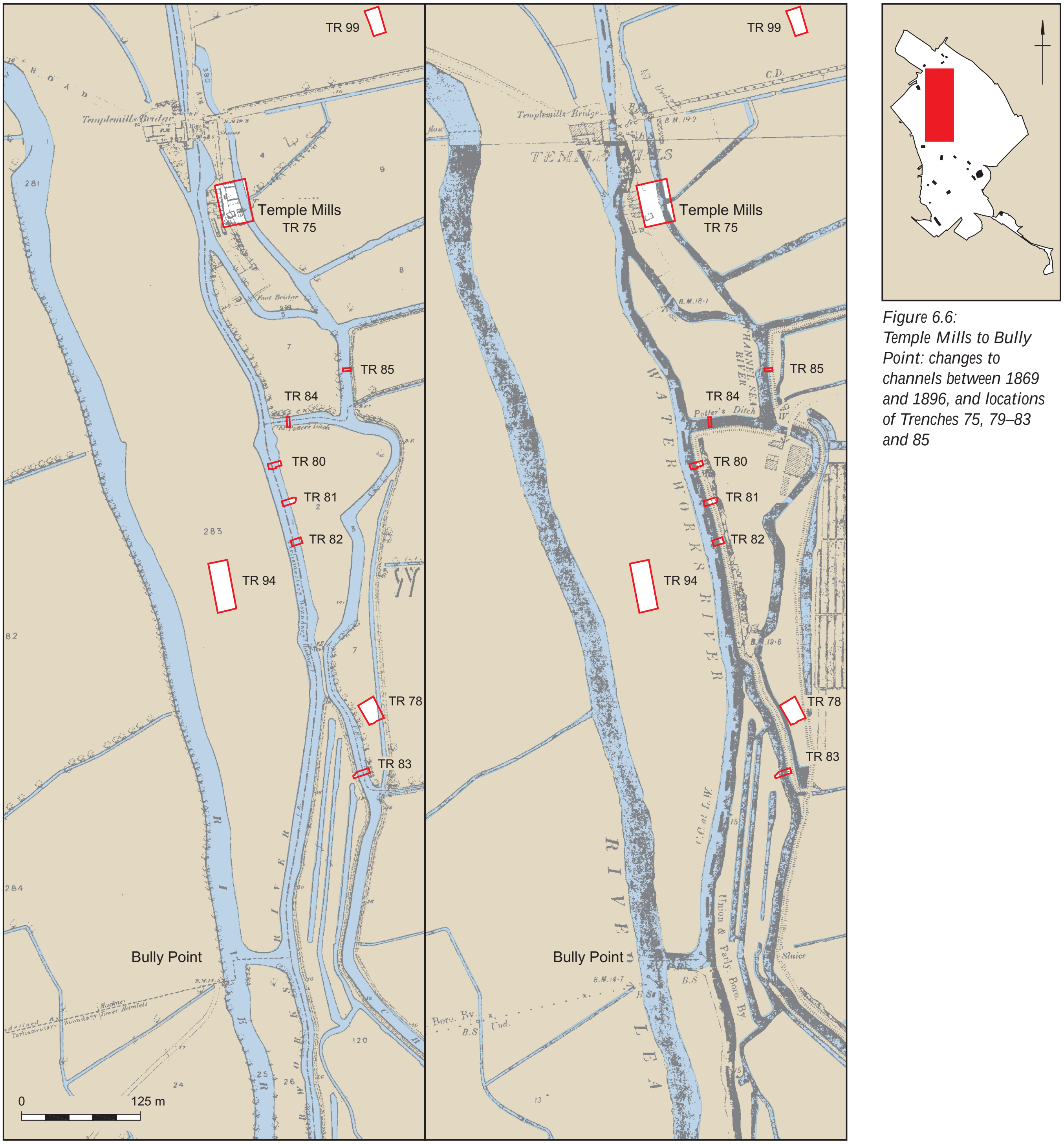


Figure 6.6: Temple Mills to Bully Point: changes to channels between 1869 and 1896, and locations of Trenches 75, 79–83 and 85

River Lea

In the 1890s the series of meanders along the River Lea, where it flowed through the southern part of Hackney Marsh to White Bridge (Fig. 6.2), were bypassed by new cuts, with the aim of making the water flow more freely and so reduce the chance of flooding. This followed London County Council's acquisition of the Marsh as public recreational space in 1893. The new cuts created a series of islands planted with trees, as shown on the 1915 OS map, presumably intended to be attractive features of the river landscape.

Plate 6.3: 1935 photograph showing the Stratford Works and High Meads junction, looking north-west to Temple Mills

The location of one of these meanders was examined in Trench 121, in which a very large feature (40) of uncertain form and dimensions was recorded cutting the natural gravels in the base. It had three deliberate backfill layers (36, 37 and 38), containing dumped modern material (including wood, copper mesh and wire, coconut fragments, iron slag and glass), and was overlain by made ground. This feature was initially interpreted as a possible World War II bomb crater (Pooley *et al.* 2008, 12), but given its location it is almost certainly the river meander which, like the others, was finally filled in between 1915 and 1935 (Pl. 6.3).

Plate 6.4: Tumbling Bay Stream and Phase 4 revetment revealed in Trench 75, from the south

Tumbling Bay Stream, Trench 75

Around 1890 (during Phase 4 on the Temple Mills site, Trench 75, see below) a new revetment, far more substantial than the Phase 3 structure (see Chapter 5), was built along the western bank of Tumbling Bay Stream, probably reflecting developments to the immediate west on the Temple Mills site (Fig. 6.7). The line of the revetment, the top of which was exposed extending across the whole excavation area (and which was fully excavated in Area 3) matches precisely the line of the channel's western side as shown on the 1896 map in the northern half of the site, and is very close to it in the southern half. This represents a further, if slight, eastward shift in the channel's course from that shown on the 1850 OS map.

Plate 6.5: Phase 4 revetment of Tumbling Bay Stream in Trench 75, from the north-east

Most of the fills within the stream, as recorded in Area 3, date from this phase, the Phase 4 cut (108/212) apparently truncating all but the western side of the Phase 3 channel (377) (Fig. 6.7). The cut was 7.6–9 m wide at the top and 1.4 m deep. The sides were moderately steep, the eastern side curving to a largely flat base 2.2 m wide, but the western side relatively straight before then dropping into a near-vertically sided, flat bottomed slot *c.* 0.8 m wide and 0.25 m deep (Pl. 6.4). It is possible that the slot was cut when the revetment (81/83), which lay on its eastern edge, was constructed; alternatively, it may be the base of an earlier, truncated cut (the record for its fill is missing). The space behind the revetment was backfilled (202 and 213) and overlain with made ground (214).

The revetment (81/33), which lay *c.* 0.7–1.0 m further into the channel than the Phase 3 fence/revetment, consisted of a line of *c.* 100 mm-thick vertically-driven softwood (of imported types) timbers, with horizontal planks attached to their outer faces (Pl. 6.5). The planks were held in place by strong, industrially-produced iron tie rods that were secured in pairs on the landward side to timber anchors, comprising large planks lying parallel to and *c.* 5 m to the west (Fig. 6.8). The tie rods were spaced at *c.* 2.2–2.5 m intervals along the revetment (Pl. 6.6), with bolt heads at their river ends and nuts at their landward ends; at both ends passing through metal plates lying against the timbers. The anchors and tie rods were set within 0.5 m deep slots (eg, 266 and 552) cut into a ground levelling layer (260, see below). Further backfilled deposits were

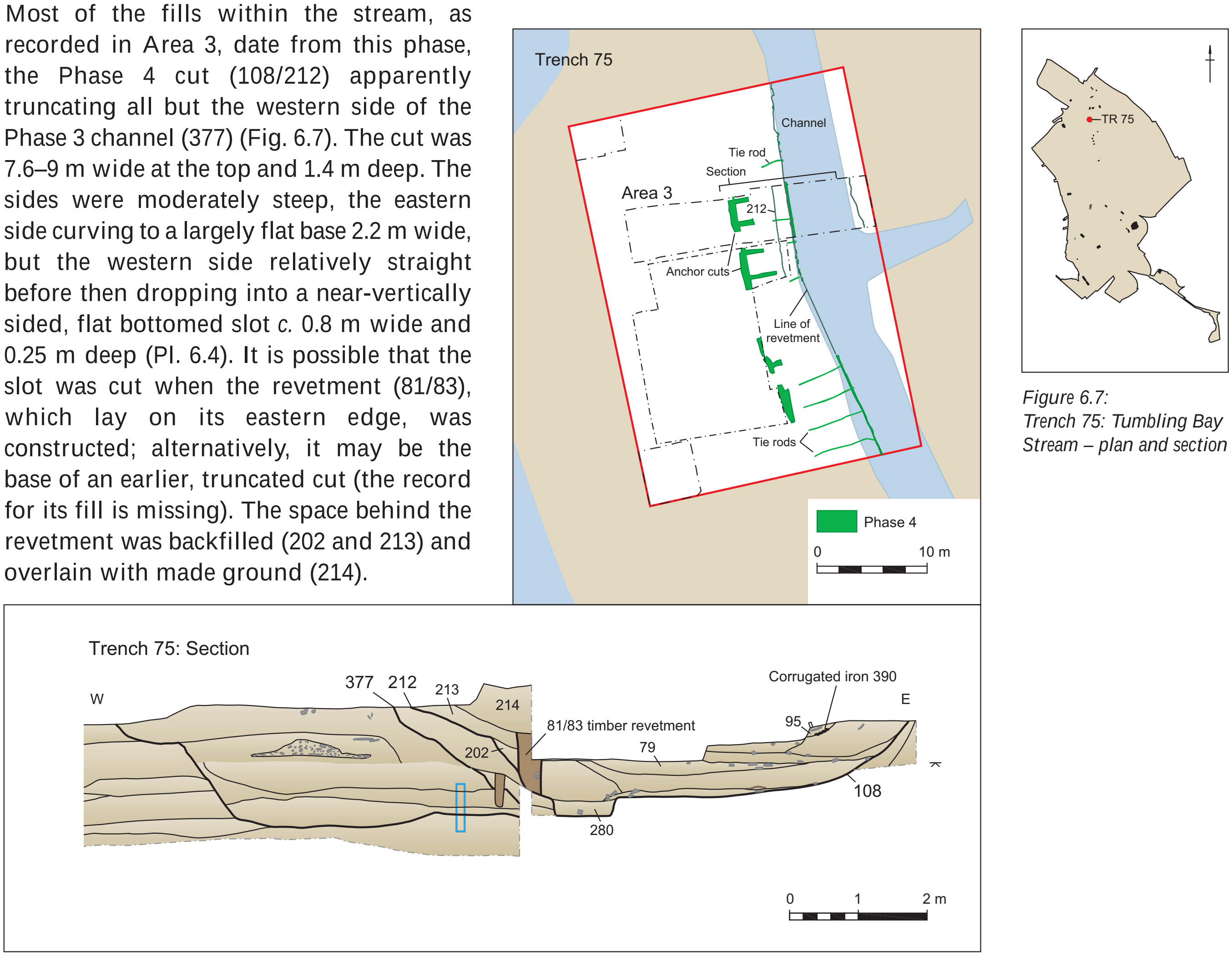


Figure 6.7: Trench 75: Tumbling Bay Stream – plan and section

Figure 6.8:
Trench 75: Phase 4 revetment of Tumbling Bay Stream with tie rods and anchors

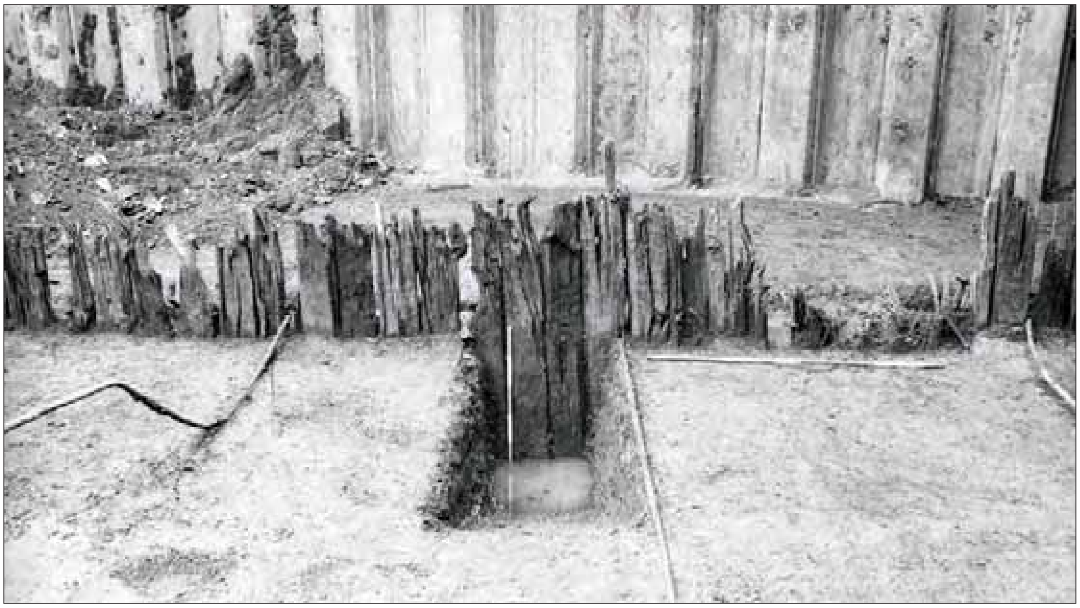


Plate 6.6:
Iron tie rods for Phase 4 revetment of Tumbling Bay Stream in Trench 75, from the west

dumped behind the revetment, consisting of silt and crushed brick and containing pottery dated 1850–1900+.

The exclusive use of manufactured and imported materials in the revetment contrasts greatly with the use of local and regional timber found in the earliest structures at the same site. The structure has some similarities with a softwood revetment with iron rod ties used in the mid-19th century phase of the Waterworks River mill at 150 Stratford High Street (MoL site code WHU08).

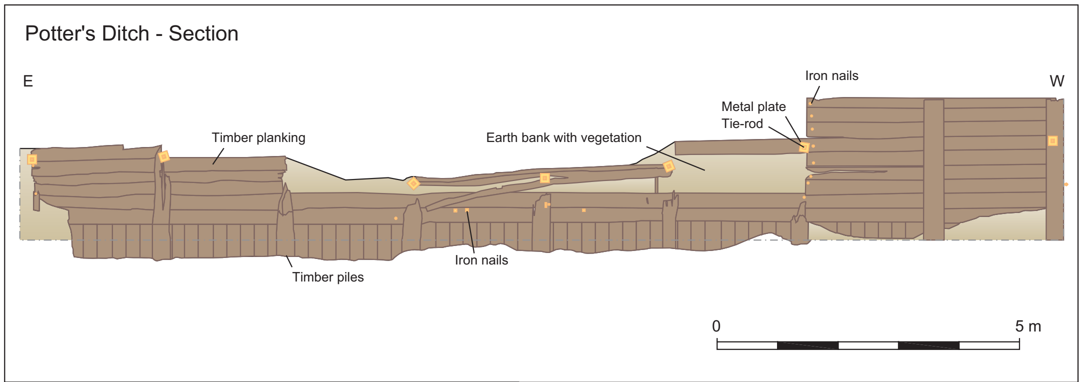
Channelsea River and Potter's Ditch

The 1896 OS shows a new river embankment laid down across the northern end of Channelsea River at the east end of Potter's Ditch, then running along the south side of Potter's Ditch, down the eastern side off Waterworks River before again cutting across Channelsea River and running down its eastern side. This isolated the northern, sinuous and no longer navigable section of Channelsea River, which now branched of Waterworks River *c.* 200 m south of Potter's Ditch.

In Trench 85, immediately north of Potter's Ditch, the earliest visible cut (96) of the river, of which only part of its eastern side was visible in section, dated from the 19th century, its sandy clayey silt fill (95) containing corroded 19th/20th century iron fragments. The channel was sealed by 20th century made ground deposits, which were cut by a subsequent recut (91), at least 5 m wide and 1.8 m deep with a U-shaped profile, lying slightly to the east. Its three fills were clearly recent, the lowest containing pieces of plastic bag.

Trench 83, *c.* 340 m further south along the river, revealed the full width of the river channel (406), here over 6 m wide and *c.* 1.3 m deep with gently sloping sides and a flat base. It had a single backfill deposit of dark black, charcoal-rich silt (408) containing 20th century domestic and industrial waste (ie, car tyres, metal and wood).

In Trench 84, the earliest contexts associated with Potter's Ditch were truncated by a subsequent recut, and the edges of the earlier cut(s) could not be clearly identified. Only the lower part of the channel's southern side (106) and its flat base were visible in section cutting alluvium, indicating that the channel was at least 0.8 m deep and over 5.5 m wide. Its primary clayey silt fill (105), containing fragments of 19th–20th century corroded iron and wood, was overlain by a



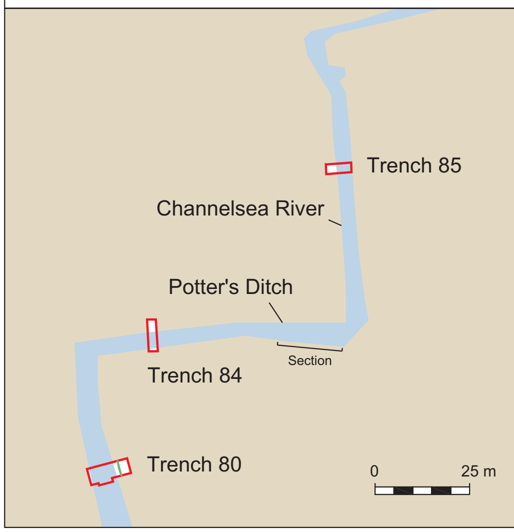


Figure 6.9: Part of the Potter's Ditch revetment recorded during Waterways survey (BHA 25)

series of made ground deposits dating to the 1950s–70s. These layers were subsequently recut by a narrower, flat-based channel (104), the lower half of the northern side of which was vertical, the southern side being moderately steep with an irregular profile.

During the Waterways survey (BHA 25) (Bower and Thompson 2008) an extant, although in places damaged and degraded, timber revetment was recorded lining the southern bank of Potter's Ditch towards its eastern end. It comprised vertical timber piles, with posts at *c.* 1.8 m intervals, tied into the bank by plates, bolts and tie rods, supporting stacked horizontal timbers behind them (Fig. 6.9).

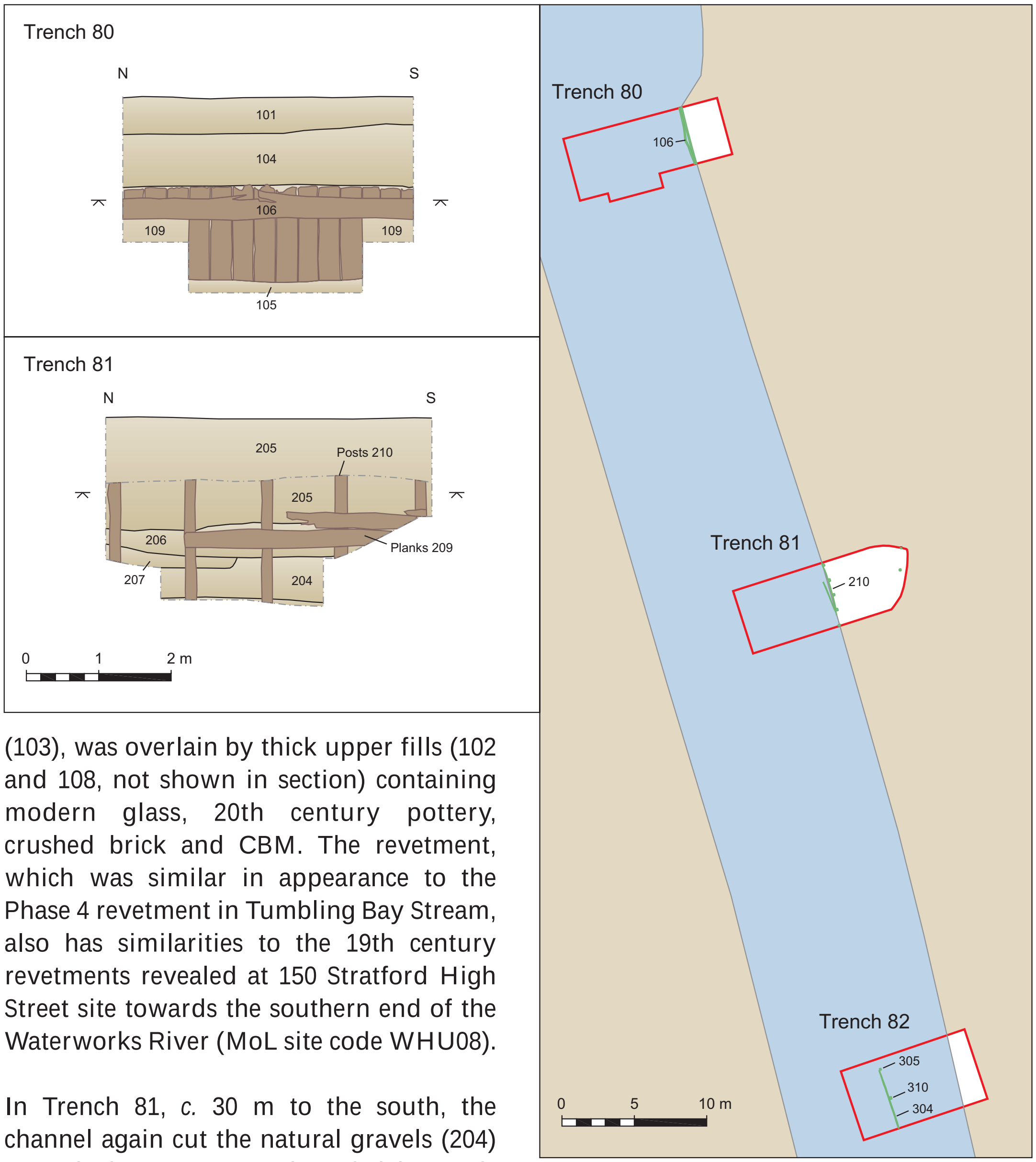
Waterworks River

By 1915, the eastern bank of Waterworks River running south from Temple Mills Lane was straightened and now aligned on the rear boundary of the Temple Mills cottages, the bowing out of the river to their north having been infilled (Fig. 6.6). The river bank continued this straight line past the mouth of the short channel, now also infilled, that had previously linked the river to the southern end of Tumbling Bay Stream. The former northern end of the now infilled Channelsea River had been built over with an Artificial Manure Works (making fertiliser from animal bone and other waste).

Potter's Ditch to Bully Point – Trenches 80–82

The three trenches excavated over a *c.* 70 m long stretch of Waterworks River (Trenches 80–82), south of Potter's Ditch (Fig. 6.6), all revealed evidence of probable timber revetting along its eastern side (in each case spanning the 4 m wide trenches) (Figs 6.9, 6.10). In each trench the earliest visible cuts were dated to the late 19th century/early 20th century.

In Trench 80, the channel cut through natural gravels (105) and a sequence of alluvial deposits (including 104) below 19th–20th century made ground (Fig. 6.10). Only its eastern, revetted side was exposed but it was at least 8 m wide and 1.2 m deep. The revetment (106) consisted of a continuous line of 1.2 m long timber posts, measuring 300 mm by 80 mm and resembling railway sleepers (although apparently unused), with a single cross beam (300 mm by 100 mm) nailed to their outward sides. There was a packing of clay (109) behind the revetment, but no evidence for tie rods supporting it. Within the channel, a thin primary fill of charcoal-rich gravelly clay



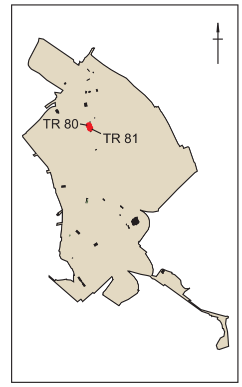


Figure 6.10: Trenches 80–81: plans and elevations of revetments

(103), was overlain by thick upper fills (102 and 108, not shown in section) containing modern glass, 20th century pottery, crushed brick and CBM. The revetment, which was similar in appearance to the Phase 4 revetment in Tumbling Bay Stream, also has similarities to the 19th century revetments revealed at 150 Stratford High Street site towards the southern end of the Waterworks River (MoL site code WHU08).

In Trench 81, *c.* 30 m to the south, the channel again cut the natural gravels (204) overlain by clay layers (205-7) (Fig. 6.10). The timber structure, however, was very different in construction, comprising 1.6 m long sawn cut posts (210), 160 mm square, cut into a two-sided point at base, and driven into natural sands and gravels at *c.* 1 m intervals. There were three horizontal surviving planks (209) nailed to their outward sides. Two isolated, rounded posts lay *c.* 5 m east of the revetment. The structure in Trench 82 appeared to be similar to that in Trench 81, the single surviving plank here (200 mm by 60 mm), identified as pine (304), nailed to the fronts of two square posts (305 and 310). Both these structures had the posts on the landward side. Although an apparently common feature of 17th century and later revetments (Goodburn 2009a, 21), it does not seem as if it would have been the most effective way of retaining any weight of ground behind the revetment, since the plank would have been held in place only by the nails; in the cases of similar structures in other trenches (see below) single nails were used. However, it would have provided a smoother face to the flow of water, providing fewer opportunities for debris in the river to become snagged on the timbers.

It is noticeable that the position of the revetment in Trench 82, appears to lie further to the west (*c.* 5 m) in relation to the riverbank, than those in Trenches 80 and 81. Establishing precisely the positions of these features in relation to the actual course of the river as mapped on early edition OS maps is difficult due to slight variations between different map editions, but the course of the river does not appear to have changed significantly between Trenches 81 and 82 during this period.

A 1908 survey of the river (following the diversion into its channel of Channelsea River) revealed that a short stretch of a newly constructed bank was reinforced with timber piles. The revetment sections found in these trenches most likely relate to these structures.

South of Bully Point – Trenches 2–4
Three trenches (Trenches 2–4) were excavated along the line of Waterworks River downriver from the point, south of Bully Point, where it branched off the line of the River Lea (Fig. 6.1).

Trench 2, on the east side of the river, revealed two phases of probable revetment, both phases consisting of vertical posts with no horizontal timbers recorded. The earlier phase consisted of a *c.* 9 m line of four pile-driven posts (323–326) spaced 2.7–3 m apart, with the top level observed at 3.26 m OD, placed just 0.2 m out from the edge of a linear cut (334) probably marking the edge of the river channel, and another two posts (327 and 328), perpendicular to them, running away from the channel at their north-western end. The latter may have defined the side of an inlet, although they were also on the approximate line of the north-western boundary of the Channel Sea Tallow Works, as depicted on the 1896 OS map. The posts were of varying shapes and sizes (see Goodburn, Chapter 7).

The four timbers along the channel were sealed by redeposited alluvium, while the others were covered by a layer of made ground. These layers were cut by the second phase timbers, which consisted of five more substantial machine-cut, pile-driven pine posts (319–322), *c.* 2.9 m long and 260 mm square in cross-section. These were spaced at 1.9 m intervals, also parallel to, but in this case immediately outside channel cut 334. Posts 320 and 322 had metal ties, reported as being connected to a wall (not recorded).

Further to the south along the same side of the river, in Trench 3, a number of timber planks and posts recorded in a layer of 19th century made ground, but probably shifted from their original positions during the construction of a concrete pipe support, are likely to represent the remains of a similar revetment. By the time of the 1882 OS map the ground to the east was occupied by a separate Tallow Works.

Further south again, in Trench 4, part of a revetment, consisting of three adjacent square posts, *c.* 200–300 mm wide, and another 1.3 m to the south-east, with planks bolted to their river-side faces, had been driven into a construction cut (378) up to 0.9 m wide, dug into the river bank. Two other similar posts (358 and 359), 1.2 m apart, lay parallel to the revetment *c.* 2.3 m to its rear, and are likely to be associated with it. At the north-east end of the revetment was a square timber-shuttered box (364), *c.* 1.6 m wide, containing a *c.* 1.1 m diameter iron pipe (376), probably representing a storm drain. The box had been backfilled around the pipe with silty clay (374) containing pottery and blue bottle glass dated to after 1830. Trench 4 lies close to the boundary between the Lea Bank Soap and Candle Works and the Lea Valley Distillery, as shown on OS map of 1896.

Pudding Mill River
In Trench 59, there was an earthen bank on the eastern edge of the river channel (Fig. 5.15, above), probably built as a flood prevention measure. A bank is shown in

this position on maps dating to both before and after the site's occupancy by Nobshill Mill (see Chapter 5), but not on the 1869 map which shows the complex of rectangular mill buildings. Although the mill was accessed from the south by Marshgate Lane, it is possible that a pre-mill bank was removed in order to facilitate access from the river. The timber revetment, with its rubbing posts, probably acted as a wharf, as suggested by the presence of the boat (see above).

The banking up of layers of material (229, 321, 298 and 297) over the alluvium (310) may represent the subsequent rebuilding of the bank after the mill's demolition. Layer 299, *c.* 0.15 m thick, contained post-medieval/modern brick fragments and flecks of slag. The upper two layers (298 and 297) trailed down into the edge of the river channel and may represent the beginning of the process of land-fill on the site. Subsequent made ground deposits of (322, 296 and 295) capped by a concrete surface, filled in the channel and levelled the ground.

Late 19th Century Railway Improvements

Demand for rail transport, both for the transportation of goods and passengers, increased dramatically during the later 19th century, as industry developed across the area. The commercial and social demands made by the rapidly expanding urban population necessitated constant repair and improvements to the Great Eastern Railway network. In 1877, a fourth track was added to the line between Bow Junction and Stratford (Connor 1999, vii), necessitating the widening of the embankment, bridges and viaducts along their north side, in particular from the River Lea to City Mill River (BHA 36).

Further expansion in the early 1890s involved the addition of tracks to its southern side (Dwyer 2008, 14) and the rebuilding of the bridges over Warton Road (formerly Wharton Road) (BHA 24) and Carpenter's Road (BHA 37) east of the Waterworks River. The recorded fabric suggests that these bridges were also lengthened to create a wider carriageway below, so as to accommodate the increasing levels of vehicular traffic accessing the industrial developments along these newly extended roads. This change is significant as it reflects the increasing use of roads, rather than the waterways, to transport goods and materials in and out of the locality. However, the 1896 map also shows the construction of the Carpenter's Road Goods Depot along the north-east side of Carpenter's Road, and although none of the new works premises on the west side of the road was served by rail tracks directly into their premises, the proximity of the goods yard would have allowed very easy transportation of raw materials and the output of production by rail. Further west, Bow Goods Yard was established on the site of the infilled ELWC reservoirs on the west bank of the River Lea, while new sidings were built over the reservoirs on the east side (see Fig. 6.13, below).

The GER's Stratford Works (Pl. 6.3), north-east of Channelsea River, also continued to expand dramatically. In 1891, an 0-6-0 tender locomotive was built and steamed at the Stratford Works in 9 hours 47 minutes, setting a new world record (Balkwill and Marshall 1971), and by the turn of the century Stratford was nationally recognised as a centre for railway production and innovation, from which evolved other forms of transportation, such as trams. In 1897, GER's wagon department at Stratford was moved just north to the expanding marshalling yards at Temple Mills, and by 1906 GER occupied over 30 ha west of the burgeoning residential area around Leyton Road, and employed over 6000 people. However, despite the scale of these hugely important industrial premises, all that remained at the time of the Olympic Park investigations was a section of the brick boundary wall on Angel Lane (BHA 16).

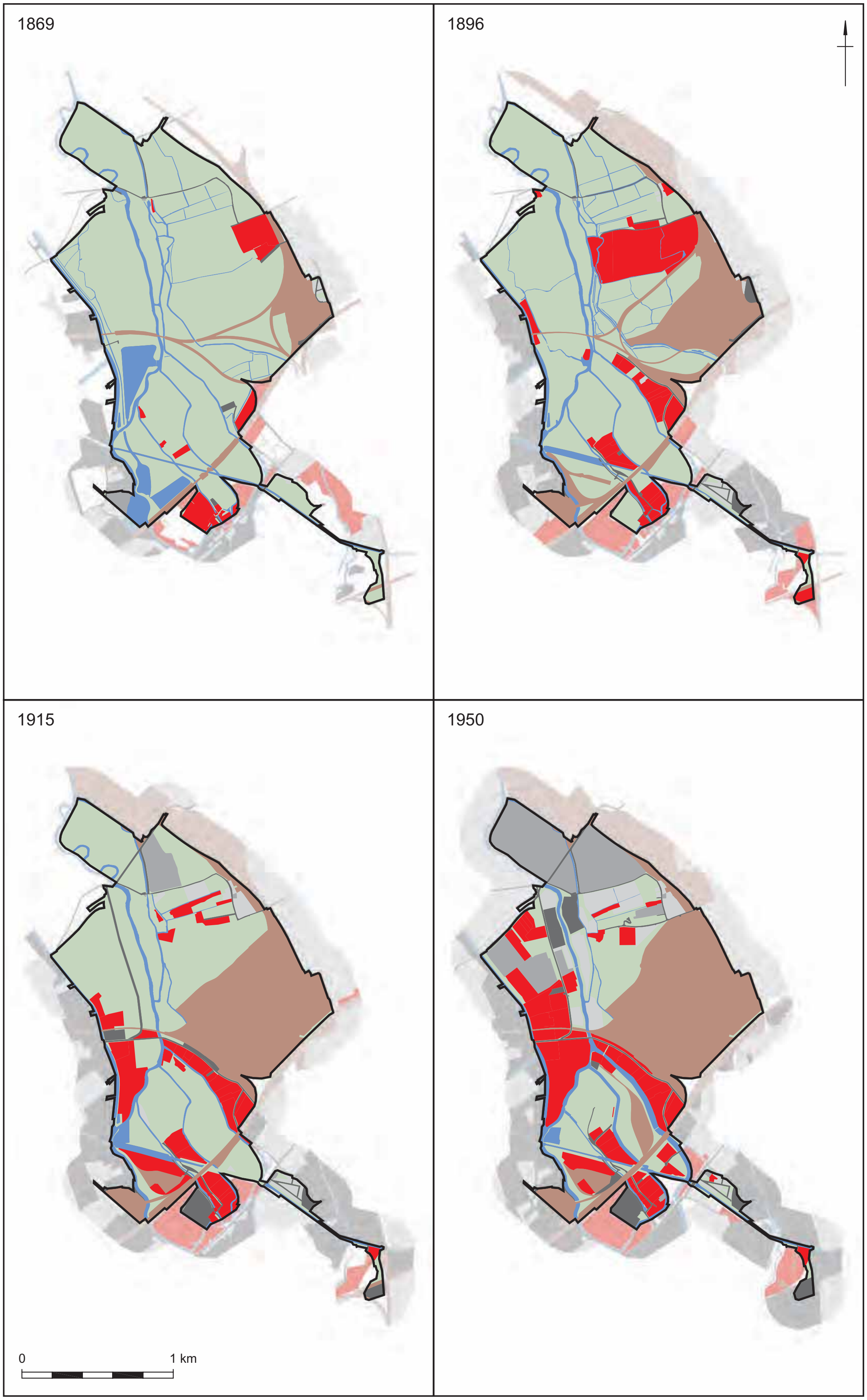


Figure 6.11: Land-use change over four map epochs (1869–1950)

Industrial Developments 1860–1920

Stanford's 1862 map (Fig. 6.2) indicates the very limited extent of development within the Olympic Park site at the start of West Ham's second period of industrial development, as defined by the *Victoria County History* (*VCH* 1973). Compared to the industrial landscape that was to develop at the end of the 19th century and during the first half of the 20th century (Fig. 6.11), the landscape in 1862 was still predominantly agricultural in character. However, it was becoming increasingly influenced by the various forms of infrastructure imposed upon and crossing the marshes, although not directly servicing the area itself. The pattern of the landscape, still structured by the sinuous courses of the southward flowing waterways, was now cut across by the lines of the GER and the Northern Outfall Sewer, while the banks of the River Lea were still dominated by the ELWC reservoirs, and the eastern marshes contained the developing Stratford Works.

These infrastructure features had created pockets of land largely disconnected from settlement nuclei. Some of them were virtually inaccessible, and therefore not readily suitable for industrial development. The subsequent gradual development of industry, would however, be accompanied by a new infrastructural framework that would directly serve the growing industrial suburb.

Development of the Road Network

Prior to 1860, the area was ill-served by roads, but expansion of the railways and the influx of industry and its associated workforce meant there was a need to improve road and pedestrian access routes. The most important of these were Pudding Mill Lane, Marshgate Lane, Warton Road and Carpenter's Road. Two of the road bridges – White Post Lane Bridge (BHA 48) over the Hackney Cut, and Angel Lane Bridge (BHA 50) over the Great Eastern Railway line (Fig. 6.3) – date to the late 19th century and post-1894, respectively; they therefore pre-date the car.

The development of motor transport during the early 20th century accelerated the investment in road infrastructure, with further modifications designed to improve access to the previously isolated areas of land. These included the Waterden Road Bridge (BHA 47) built *c.* 1902 over the GER Victoria Park Branch line, and connecting Carpenter's Road in the south with Ruckholt Road in the north.

In 1926, the Gainsborough Road Bridge was rebuilt (BHA 45) to accommodate increased traffic flow between Hackney Wick and Leyton; this was a long-established bridge over the Hackney Cut, previously called Wick Lane Bridge (now Eastway Road). The bridge deck is constructed of composite riveted steel girders and brick jack arches resting on sandstone pads set within abutments of blue-grey engineering bricks laid in English bond. The parapets, by contrast, were constructed in dark red/purple brick with moulded sandstone copings. The upper parts of the piers and parts of the parapets had been rebuilt at some time since the 1920s using blue engineering bricks, and later repairs were also recorded within their fabric.

The Bridgewater Road concrete bridge (BHA 46), built over Waterworks River by 1948, and the bridge carrying Temple Mills Lane over the GER Cambridge Old Main Line (BHA 49), also rebuilt in the mid-20th century, were also recorded, demonstrating developments in form, and in the materials used, for these functional structures.

Development of Industry

Up to 1869, industrial development within the study area was still extremely limited (Fig. 6.11). It was mostly confined to the banks of the Waterworks, City Mill, and Pudding Mill Rivers, in a narrow belt near these rivers' confluence immediately to the north of Stratford High Street. These works included lime kilns, soapworks, gas works, an oil factory, a large chemical works (with an associated terrace of houses) to the east

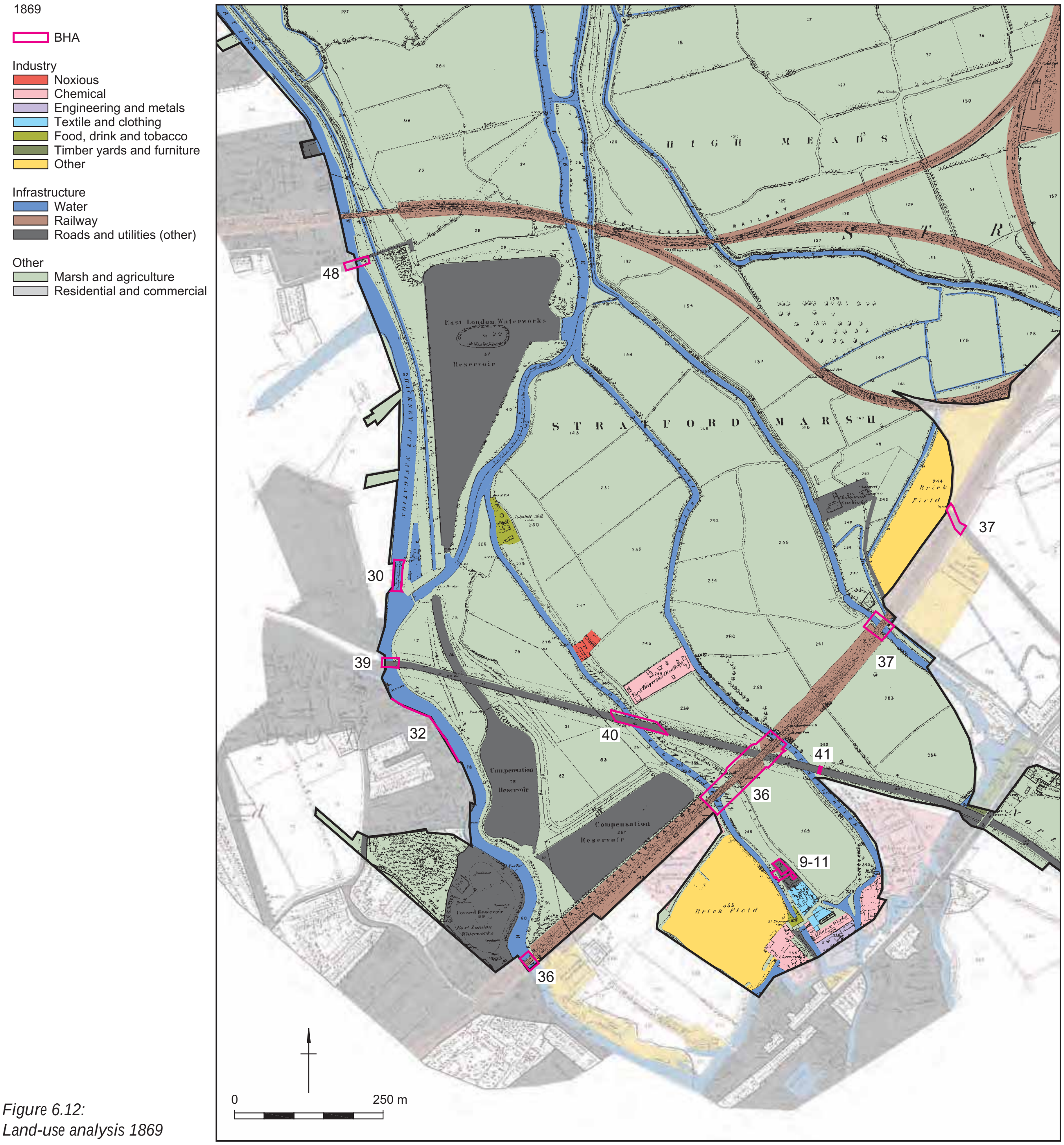


Figure 6.12:
Land-use analysis 1869

of the City Mill River, and large stone and timber yards fronting the High Street.

Few works, however, encroached on the areas north of the railway embankment – a Photogenic Gas Works on the east bank of the Waterworks River, and a Tar & Turpentine Distillery between the Pudding Mill River and the City Mill River (Fig. 6.12). Although both were situated adjacent to waterways, they were only established following the extension of Warton Road and Marshgate Lane, respectively, suggesting that road rather

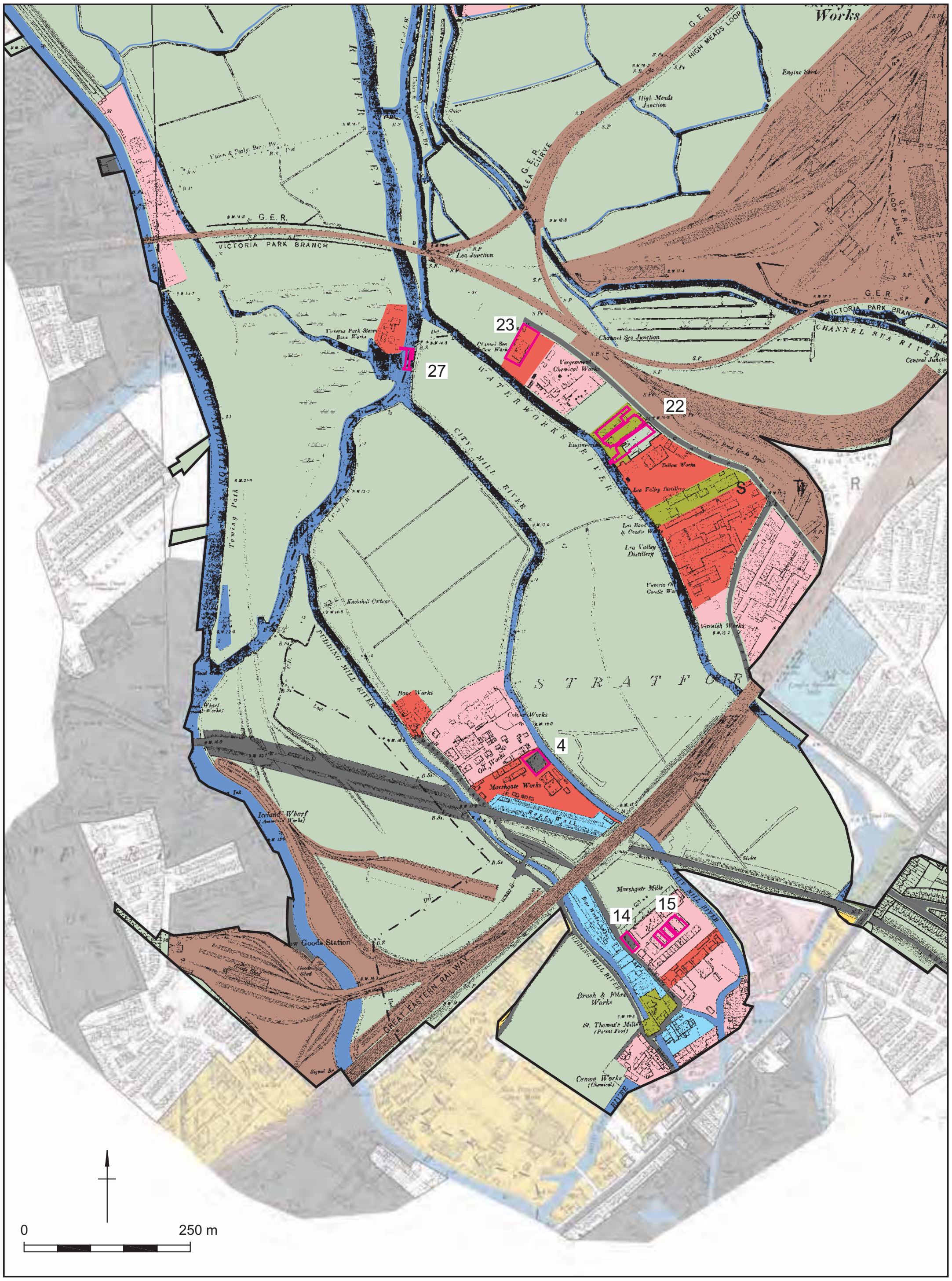


Figure 6.13: Land-use analysis 1896

than river access was the key factor in their location. This had already been observed with respect to the Patent Tanning Works (later the Brush and Mat Manufactory) (BHA 9–12) further south on Marshgate Lane (see Chapter 5). Nonetheless, the requirement for large quantities of water for certain industrial processes, and for the disposal of waste products would clearly still have been a major factor in the siting of certain industries.

Comparison of the 1869 and 1896 OS maps (Figs 6.12 and 6.13) indicates the scale of

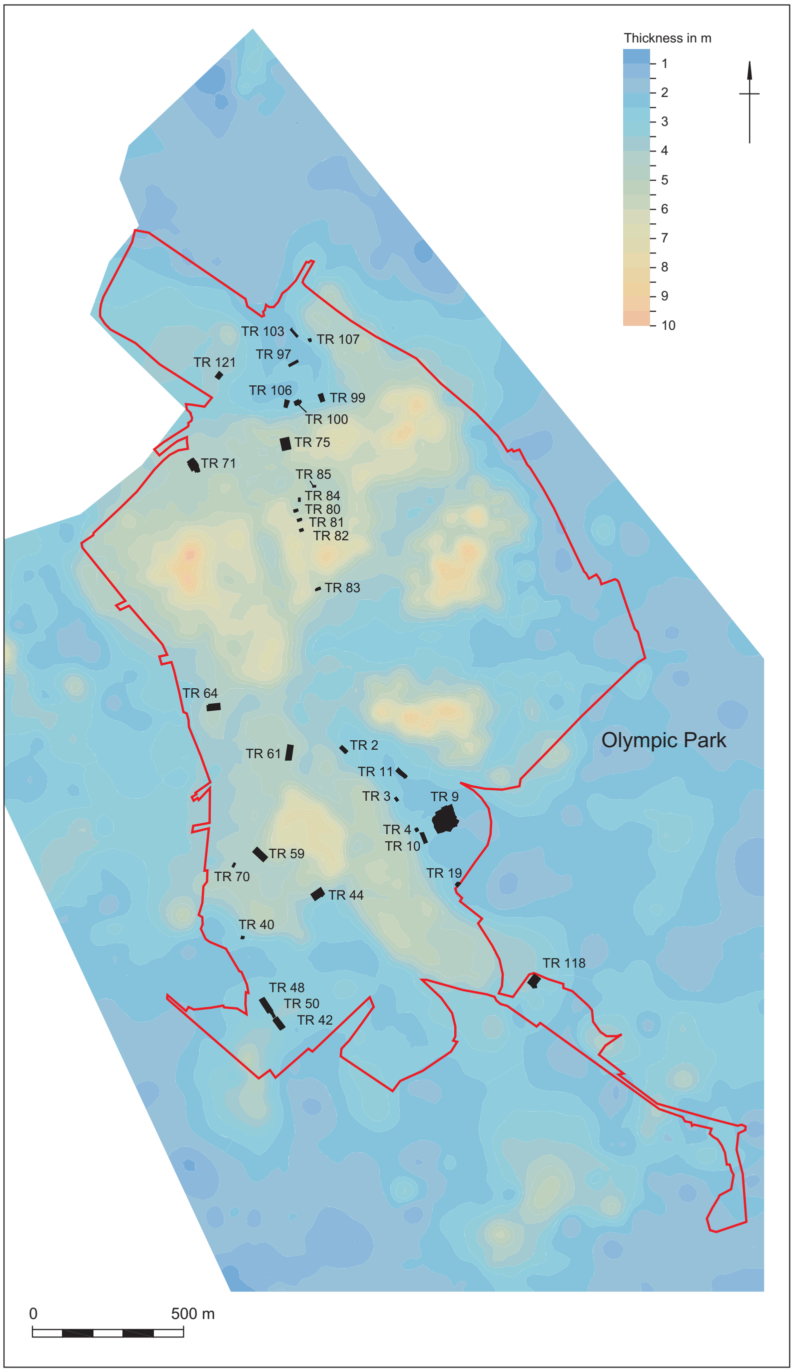


Figure 6.14: Depths of made ground deposits recorded during geoarchaeological survey

industrial development that had taken place in the nearly 30 years between them. However, this still remained largely confined to three areas of the valley floor – two of them between Marshgate Lane and City Mill River, to north and south of the GER line; and a third extensive new area east of Waterworks River, served by the newly constructed Carpenter's Road. The exact reasons for this zoning of early industrial development remain unclear, and while it could simply reflect the availability of development land for sale, or of plots already served by adequate roads, it might also indicate those areas of former marshland which were less prone to flooding, and therefore not requiring significant and expensive remedial works.

Evidence from a detailed examination of the made ground deposits across the study area (see Chapter 8) suggests that the earliest industrial development was in areas with the least depth of made ground (Fig. 6.14). This suggests that the driest and most stable sites were selected for development first, without the need for costly ground-raising. This meant, in turn, that these sites were no longer available for the deposition of waste material such as demolition debris and, therefore, these areas could not be used for later, particularly post-war, waste disposal (see below).

Mix of Early Industry

It has been generally accepted that many of the industries which located to West Ham from the mid-19th century were those involved in the range of either dangerous or offensive processes that had been outlawed to the west of the River Lea following the passing of the 1844 *Metropolitan Buildings Act* (see above). In order to test this assumption, and to more fully understand the mix of industries, a programme of detailed historic land use analysis was carried out for the Olympic Park area and its immediate surroundings. Much of this work was carried out through the Community History Project (see Chapter 1) primarily using the resources of the Newham Archives.

The analysis revealed the scale and locations of the main types of industry at the times of the 1869, 1896, 1915 and 1950 OS map editions (Figs 6.12–6.13 and 6.15–6.16). This work was supplemented by data from a study of the mix of industry in

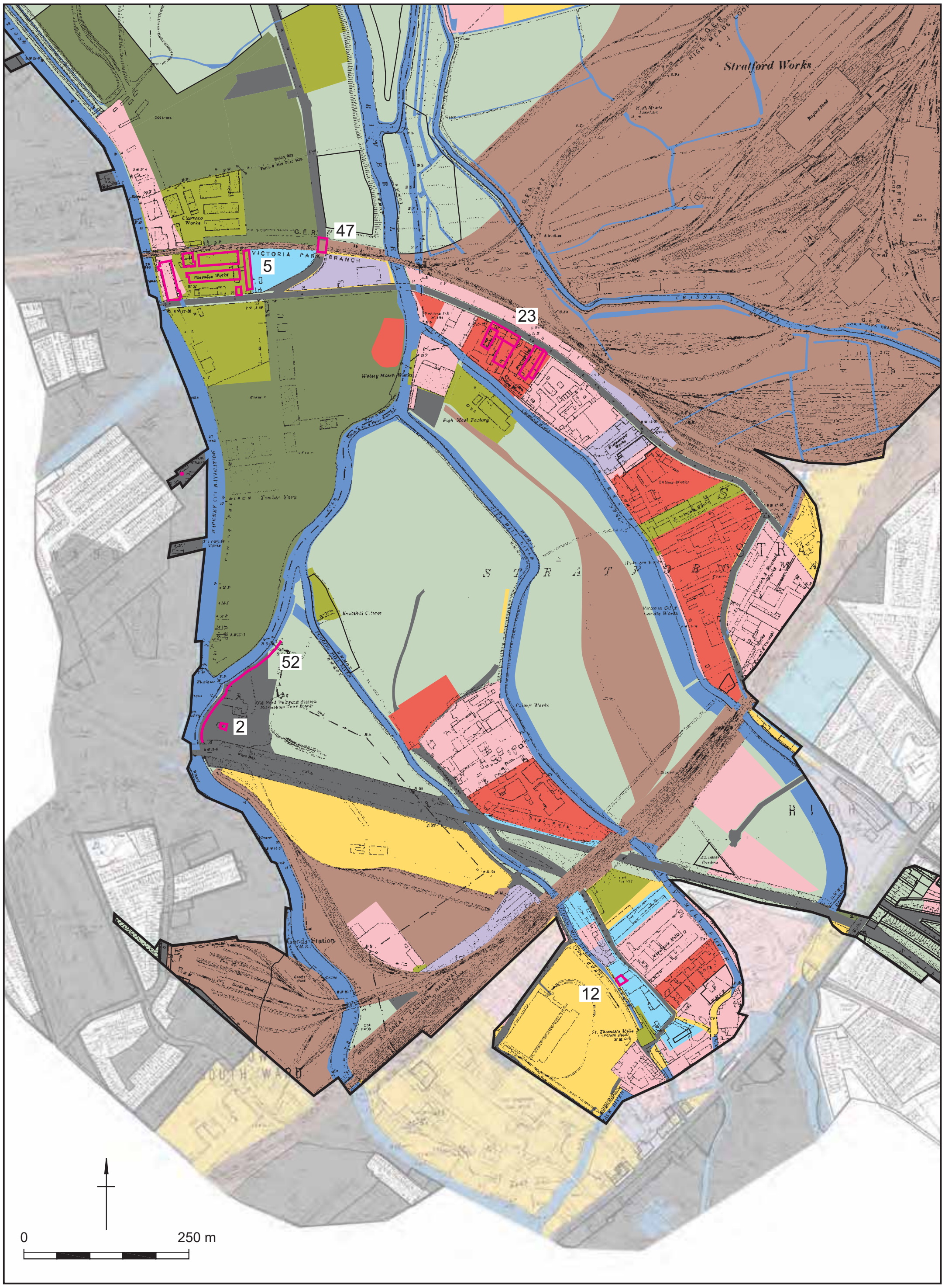


Figure 6.15: Land-use analysis 1915

1969 (Addington 1969) which provided information for the final map epoch (Fig. 6.17) marking the end of a century of development. For the purposes of graphic presentation, the works premises were divided into seven key 'types' – 'noxious'; chemical; engineering and metals; textiles and clothing; food, drink and tobacco; timber yards and furniture; and other (including brick, pottery, cement and glass). This allowed comparison of the mix of industries within the Olympic Park area, with that identified for the whole borough of West Ham (*VCH* 1973).

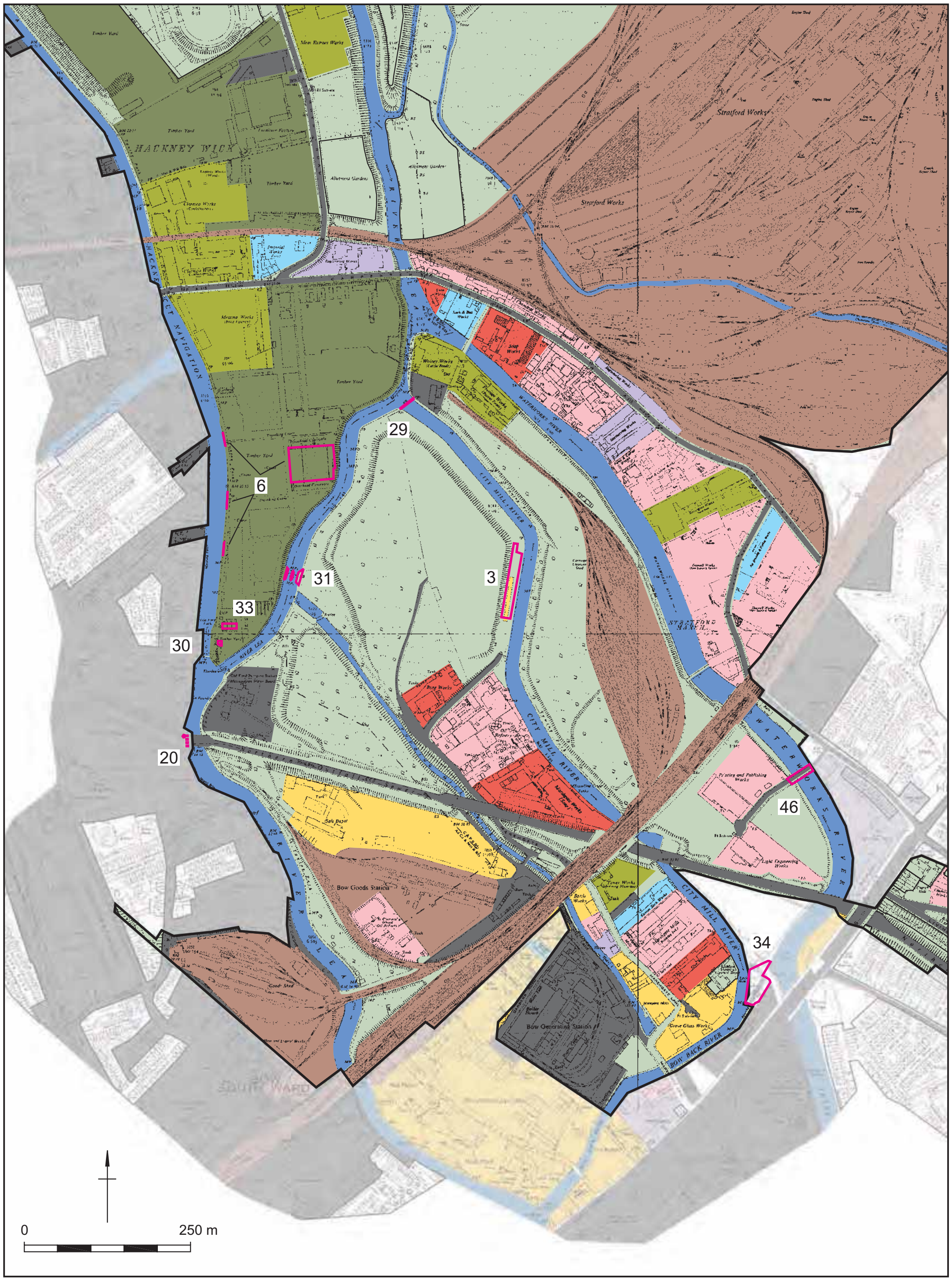


Figure 6.16:
Land-use analysis 1950

The analysis revealed significant changes in land-use in the latter part of the 19th century. In 1869 industrial manufacturing accounted for 29% of industry in the study area, followed by the chemical industry (20%) and then food, other manufacturing and brick/cement, each representing 12.5% (Fig. 6.13). Although the area has had a long-held reputation for offensive industries, and the unpleasant forms of pollution which they produced – leading to its moniker 'stinky Stratford' – the analysis indicated that in 1869 there was only a single premises carrying out a 'noxious'

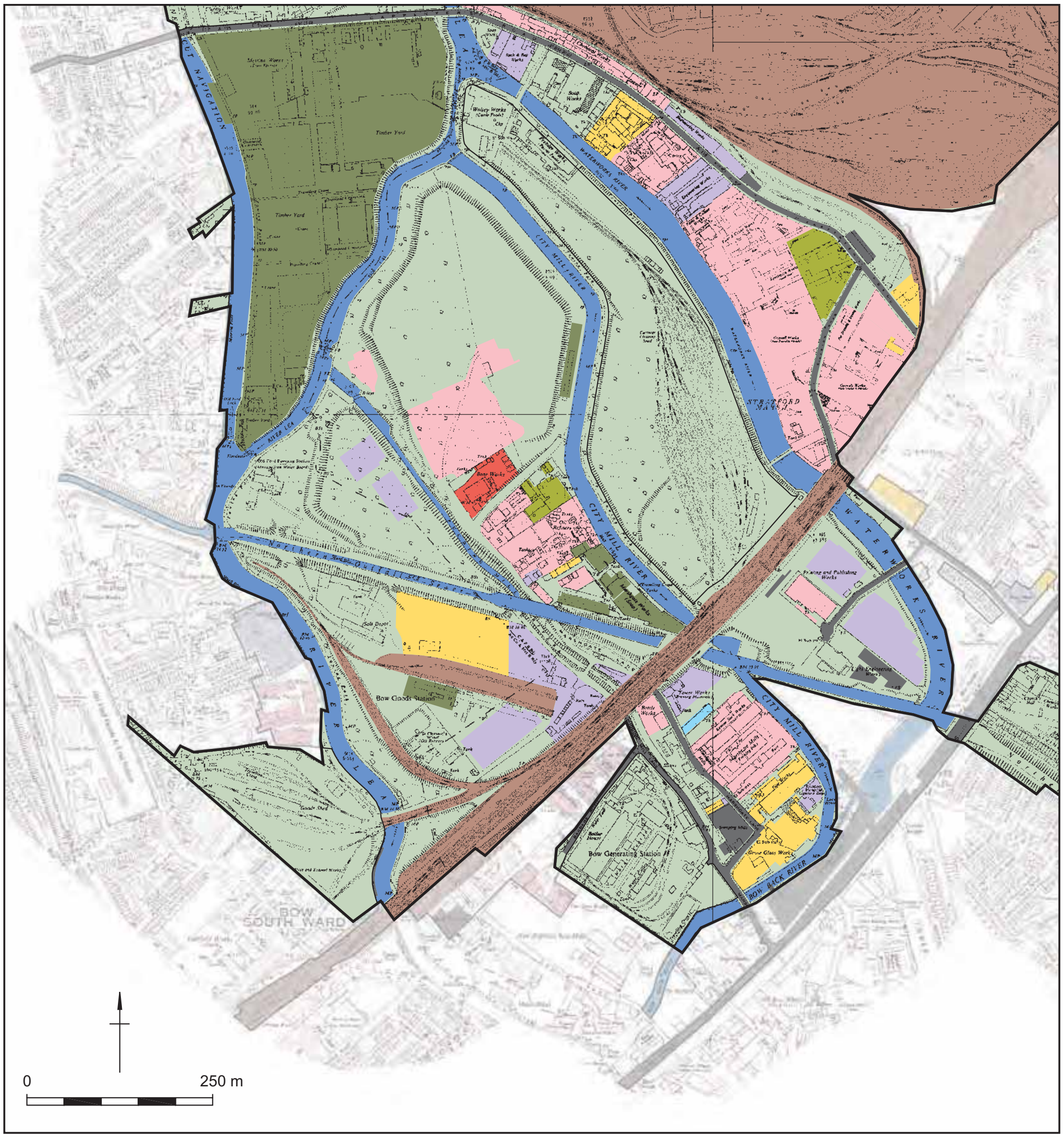
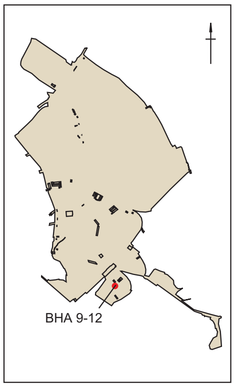


Figure 6.17: Land-use analysis 1969

trade (4%). This is surprising, since by then the prohibitive *Metropolitan Buildings Act* had been in force for over 20 years, and the study area would have provided an obvious place for these trades to relocate.

Perhaps just as surprising, however, is the fact that by 1896 the chemical industry had risen to 37% and 'noxious' trades to 16% (with other types showing only modest changes). This was in spite of the fact that West Ham's incorporation in 1886 as a municipal borough had given it powers to tighten controls over these anti-social and offensive trades. Public opinion had supported the borough's endeavours to check such trades through the more rigorous enforcement of the local bye-law, which led to their being largely confined to the borough's western and southern fringes (*VCH* 1973).

As the data for the borough does not differentiate between noxious and other chemical industries (*ibid.*), data from the community history land use analysis has been manipulated to allow comparison. The breakdown of dates for the *VCH* data is also not as detailed as for the in-house analysis, and the comparisons are therefore indicative rather than exact.



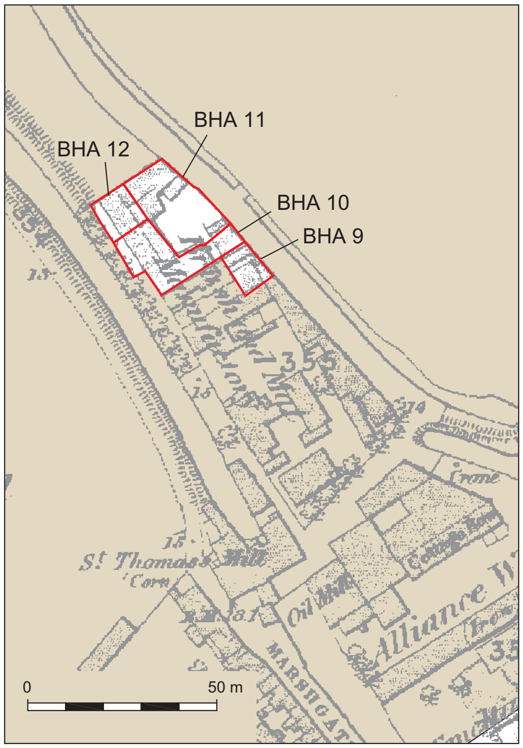


Figure 6.18: Recorded buildings at A. Smith Brush and Mat Manufacturers (BHAs 9–12) with 1869 OS map

Comparison of these datasets reveals both similarities and differences between the mix of industries in the Olympic Park site alone, and the borough as a whole. In 1869 chemical and noxious industries together represented *c.* 38–39% of all industry across the borough, compared to only 23% in the Olympic Park, whereas there were 10% fewer premises within the borough associated with the food industry and 15% fewer associated with the brick/cement industry, than in the Olympic Park. The significant increase in the chemical industries in the Olympic Park by 1896 appears not to have been matched across the borough. However, throughout the period the engineering and metal industry was very poorly represented within the Olympic Park, lagging behind that in the borough by 15% in 1869, and 23% in 1896.

The analysis of soil samples from the boreholes across the site (Chapter 8) provided information about the levels and types of contamination present in the ground beneath particular industrial sites. For example, concentrations of arsenic were recorded at a small number of locations, including the site of Marshgate Mills where printing ink was produced between 1869 and 1945; arsenic was used to enhance colours in the pigments used in wallpapers and, more worryingly, in food wrappers. Similarly, very high concentrations of mercury were recorded within the triangular area between the Northern Outfall Sewer, the railway line and the south end of Waterworks River, where a large Printing and Publishing works was located from the second quarter of the 20th century; the main industrial use of mercury at this time was in electrolysis for separating chlorine and sodium from brine, the chlorine being used for the bleaching of paper.

The Early Industrial Townscape

Developments on Marshgate Lane

The area of early industrial development towards the southern end of Marshgate Lane was described in 2003 as the 'rare survival' of a '*c.* 1900 townscape of small scale industrial and warehouse buildings' (PCA 2003), but by the time of the Olympic Park built heritage survey in 2008 this townscape had suffered further degradation. Nonetheless, a number of BH Assets which contributed to this townscape were recorded and provide an indication of the historic character of the wider area – nos 39–45 (odd) Marshgate Lane (BHAs 9–12), and Units 1 and 5–7 Vanguard Estate (BHAs 14–15) (Fig. 6.13).

39, 41, 43 and 45 Marshgate Lane (BHAs 9–12)

The 1869 OS map (Fig. 6.18) indicates that the former Patent Tanning Works on Marshgate Lane (Fig. 6.2) had, since 1862, become Augustus Smith's Brush and Mat Manufactory, and been further developed with additional buildings on the southern half of the site. The western side of the premises were set back from the bank of Pudding Mill River, with a vegetated strip, continuing as a raised embankment to the north, suggesting that the manufactory did not utilise the waterway, but gained access from roads to the south and east.

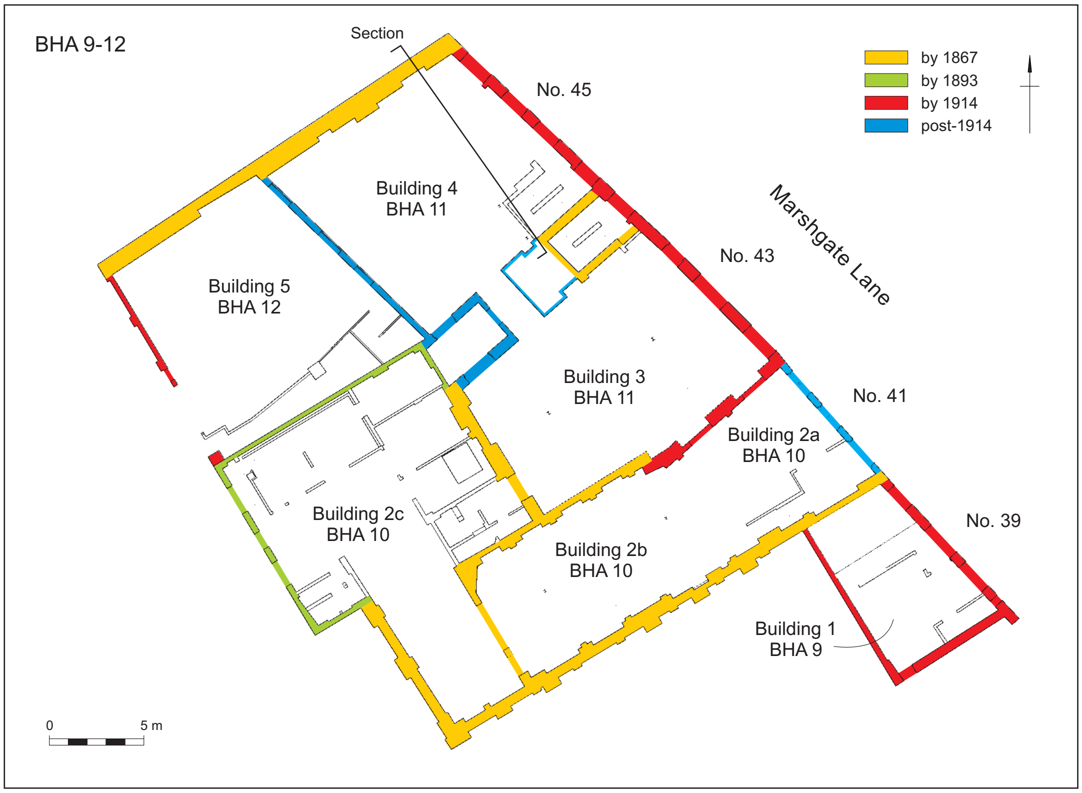


Figure 6.19: Phased ground floor plan of BHA 9–12

The recorded buildings occupy only the northern third of the extensive works premises shown at this date. While it appears that they retained elements of the fabric dating to the 1860s tanning works (see Chapter 5), their footprint and layout bear little correlation with those shown on the map. There is no clear evidence of their use to suggest the functional relationships between the north and south building complexes, for example whether one represents manufacture and the other warehousing, or one focused on the manufacture of brushes and the other mats.

A tentative phased ground floor plan of the building group (Fig. 6.19) illustrates the apparent complexity of its built fabric, in respect of both the continuity of alignments within the map regression, and the fabric and construction of its surviving walls. This suggests that the north wall of Buildings 4 and 5 and the north–south wall separating Building 2c from Building 3 are retained from this early period, and that Building 2b represents an early building surviving in its entirety, though later embedded within the re-configured complex. It is also possible that one or both of the walls enclosing the stair between Buildings 3 and 4 may be survivals from the small building shown on the 1869 and 1896 maps.

This manufactory provides an interesting example of the interdependence of many of the early industries that located to the study area. The manufacture of brushes was obviously reliant on a good supply of bristle, and the location of John Barber, Pig Dealer and Jobber, recorded in Kelly's 1882 *Directory of Merchants, Manufacturers and Shippers* as also on Marshgate Lane, is unlikely to have been a coincidence.

While the map regression (Figs 6.12–6.13 and 6.15–6.16) suggests that there was large-scale rebuilding of the premises between 1896 and 1915, the evidence of the built fabric suggests that the radical change to the building's footprint over the intervening 20 years had resulted from a series of more incremental constructions, alterations and incorporations. Certainly, Building 4 displays all the standard

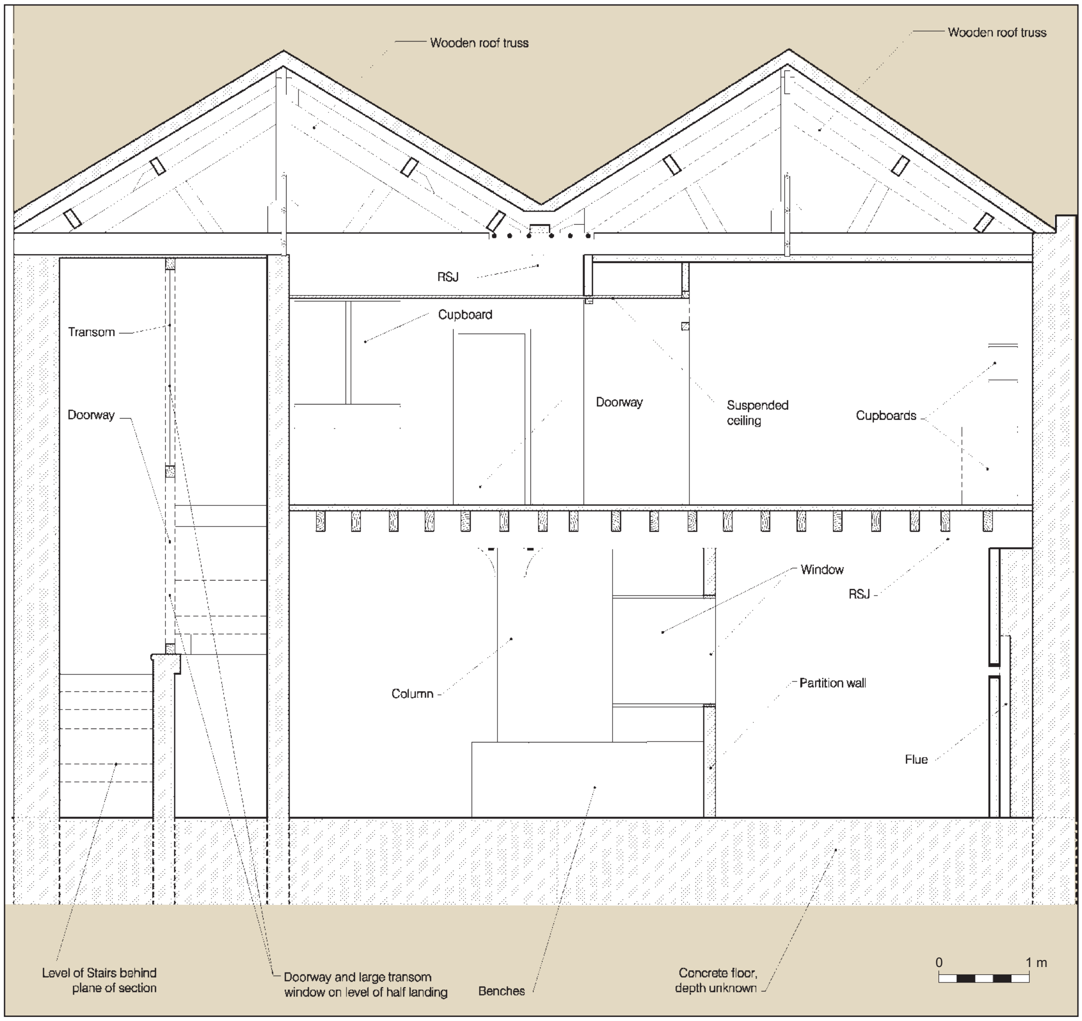


Figure 6.20: Cross-section through 45 Marshgate Lane (Building 4) (BHA 11)

elements and techniques of a late Victorian industrial building: cast iron columns, a parallel pair of robust timber king post roofs bearing on thick brick walls (Fig. 6.20). However, the late date of the building within this tradition is marked by the use of rolled steel joists (RSJ) supporting the timber first-floor structure, and I-section steel columns supporting the valley between the two timber roof trusses (Fig. 6.20). This combination of components marks this building as 'transitional' in construction terms, between the iron and timber structures of the 19th century, and the steel frames of the 20th.

Similarly, despite having had a new steel structure inserted to support a later upper floor and roof, the brick fabric of the ground floor walls of Building 2b clearly demonstrates their earlier origins. A series of four regularly-spaced, blocked segmental-headed arches separated by brick piers in the north wall of the building, illustrate its former fenestration when it fronted onto an open yard, before the construction of the east wall of Building 2c which had blocked two of these windows by 1869.

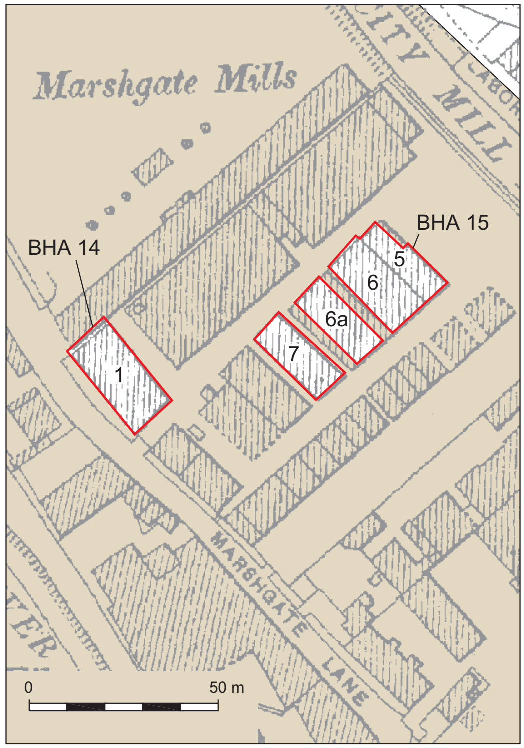
Unfortunately, the built fabric surviving at the time of survey, associated with the site's function as a brush and mat manufactory until the end of the 19th century, was too limited and too compromised to allow any understanding of the early functions of its various parts, or how the manufacturing process operated in and around the buildings represented.

Units 1 and 5–7 Vanguard Estate (BHAs 14–15)

While the buildings on the west side of Marshgate Lane retain built fabric relating to their mid-19th century origins, their character at the time of survey was more consistent with their turn of the century redevelopment. By contrast, the recorded buildings on the east side of Marshgate Lane, shown for the first time on the 1896 OS map (Fig. 6.21) (situated within what later became the Vanguard Trading Centre) largely retained their late 19th century character. Together they provide some detail of the range of forms, building materials and quality of construction that were common to buildings constructed in this area in the decades either side of the turn of the 19th and 20th centuries.

This group of four buildings was constructed between 1869 and 1882 when Slater & Palmer Ltd, printing ink manufacturers, are first documented in Kelly's 1882 Directory. They were all built as elements of the moderately extensive Marshgate Mills works on the east side of Marshgate Lane, and appear to represent two distinct phases of development of the site. Unfortunately, by the time the premises are first shown in the cartographic record (Fig. 6.21), all of the recorded buildings are in place, so those two phases were only identified on stylistic grounds.

The works as shown on the 1896 OS map occupy a large rectangular plot bounded to the east by City Mill River. They comprised three main ranges of buildings with narrow linear yards between, accessed by two entrances on Marshgate Lane. The northern range (not recorded), which marked the northern boundary of the works, originally comprised two large buildings, connected by a small central component. Although large-scale in plan, it is not known how many storeys these buildings possessed, or their specific functions. Unit 1 (BHA 14) comprised a rectangular, three-storey building aligned with the street frontage at the western end of the north range. Units 5–7



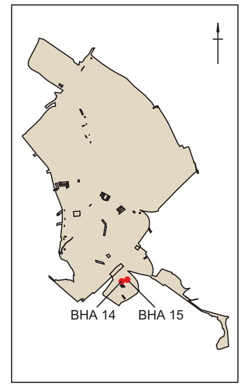


Figure 6.21: Recorded buildings at Marshgate Mills Ink works (Vanguard Estate) (BHAs 14–15) with 1896 OS map

(BHA 15) consisted of all but two of a line of rectangular buildings, each aligned NNW–SSE, down the centre of the works. This line lay between the two yards and was aligned with a second building on the Marshgate Lane frontage. A continuous alignment of small buildings to their south (no longer extant by the time of survey) marked the southernmost buildings of the works, with a linear open yard to their south.

Units 1 and 7 had similar styles of architectural detail and are considered to be contemporary. They were constructed of yellow stock brickwork laid in English bond, and their original door and window openings had segmental-arched heads, and were dressed with dark blue engineering brick, bull-nosed at projecting corners. Internally, their robust construction and detail bear all the hallmarks of late Victorian industrial building.

Unit 1, which was 28 m long by 13 m wide (Pl. 6.7), and of three storeys, had substantial flitched timber bridging joists supporting the floor joists and timber boarding of the first floor. The bridging

Plate 6.7: North and east elevations of Unit 1, Vanguard Estate (BHA 14)

Plate 6.8: Ground floor cast-iron column and flitched joist, Unit 1, Vanguard Estate (BHA 14)

joists were located roughly between each of the nine window bays, and were supported mid-span by cast iron columns (Pl. 6.8). Although not visible at upper floors because they were hidden by later ceilings, the presence of the cast iron columns on each floor might suggest that the floor structures were the same throughout the building, and this is likely to have been the case originally. However, the external brick-work of the south gable end and the rear (north-east-facing) elevation suggest a major later intervention comprising the insertion of an *in situ* concrete floor slab, and the rebuilding of the top floor brick-work of these elevations (Pl. 6.7). It is likely that this was carried out at the same time as the creation of one or both of the concrete staircases inserted at either end of the building. Evidence from the County Borough of West Ham Civil Defence World War II Bomb Damage Map suggests that a number of incendiary bombs fell on the east side of Marshgate Lane, and it is likely that these works of alteration or repair were implemented as a result of fire damage to the timber structures of the upper floor and roof (not inspected during the recording). Certainly, the brickwork of both gables of the building is clearly different from the walling beneath, as is the upper storey of the rear (east) elevation.

The original timber staircases through the building had been replaced by concrete stairs at its north and south ends, and it is considered likely that at one or other of these locations there would have been some form of internal goods hoist, as the external hoist situated at the south end of the rear elevation was associated with only a single loading bay door at second floor level. If the building were to have functioned as a warehouse, as is considered likely, there would need to have been a means of transferring goods to the first floor. The three floors would have been originally single open areas, interrupted only by a single line of cast iron columns, therefore providing maximum storage area.

Unit 7, by contrast, was of only two storeys. Its exterior had been painted, obscuring the detail of its brickwork and dressings, but it appears to have conformed to the palette of yellow stock brick with blue engineering brick dressings utilised in the rest of the group of buildings, and with segmental-arched window heads as in Unit 1. Although the ground floor had been later subdivided by modern stud partitions, it had clearly originally been a single open space, interrupted only by a central line of cast iron columns along its long axis. Each end elevation had central wide doorways at ground and first floors, flanked by windows to either side, and an iron bracket represent-ed the former location of a crane adjacent to the loading bays on the north elevation. The number of windows in the long east and west elevations were not recorded, so the level of natural light to the interiors, from which to interpret function, is not known. No blocked openings are shown on plan at ground floor level, and this would have made it most unlikely that a manufacturing process was undertaken here.

The remaining buildings (Units 5, 6 and 6a), although using the same palette of materials as Units 1 and 7, originally had narrow, pointed arched windows in the late Victorian, Gothic style which was in fashion for industrial buildings until the 1880s (Pl. 6.10). Units 5 and 6 were contiguous; sharing a party wall along the long axis, which had a primary central wide opening, suggesting that the two units were contemporary. Both were tall single storey structures with walls of load bearing brick laid in English bond, giving way to thinner Flemish bond brickwork in the end gables. The wider Unit 6 had an exposed timber roof structure comprising five queen post trusses with post and tie-beam joints reinforced with iron stirrups and cottered pins (Pl. 6.9). There was evidence of a former continuous skylight to either side of the ridge which would have provided good natural light to the interiors and might suggest a manufacturing function.

The narrower Unit 5 had a king post roof structure comprising five trusses delineating the six former window bays of the east elevation. Of the original six pointed arched windows, three had been in-filled and three had been replaced with larger square openings with flat concrete lintels, and subsequently blocked. Both end elevations had a very large opening with a concrete lintel and a pointed arch window opening adjacent. It would appear from brickwork patching, however, that the openings in the north gable end originally comprised a central doorway flanked by two arched windows, identical to the north end of Unit 6a.

This final unit (Unit 6a), although of similar external character to Units 5, 6 and 7, had been much altered internally, with the introduction of a partial timber first floor and access stair, and much of its original fabric had been hidden behind later wall and ceiling finishes, and the building retained no evidence of its former industrial function.

Plate 6.9: Interior of Unit 6, Vanguard Estate (BHA 15)

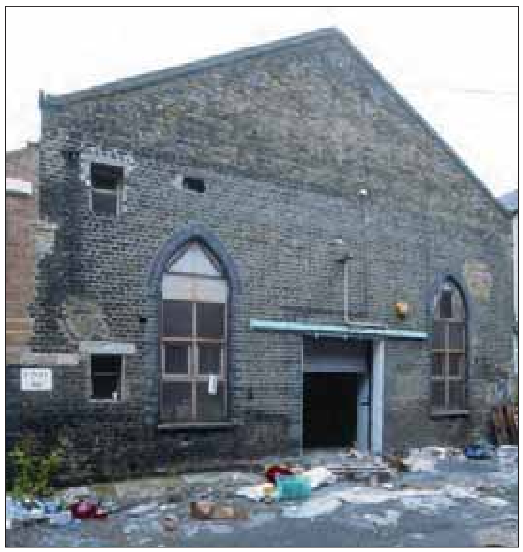
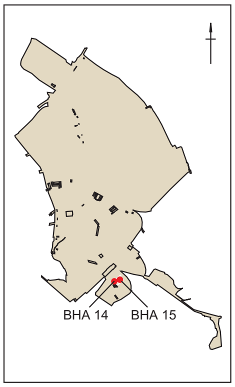


Plate 6.10: Exterior of Unit 6a, Vanguard Estate (BHA 15)

Unfortunately, in the absence of a record of the other late 19th century buildings of this complex, it is not possible to determine the precise industrial process flow through the premises. This is made more difficult by the recorded buildings having been largely devoid of fixtures and features relating specifically to their original functions. However, an understanding of the various processes inherent in the manufacture of black and coloured printing inks suggests a possible interpretation of how the works as a whole may have functioned.



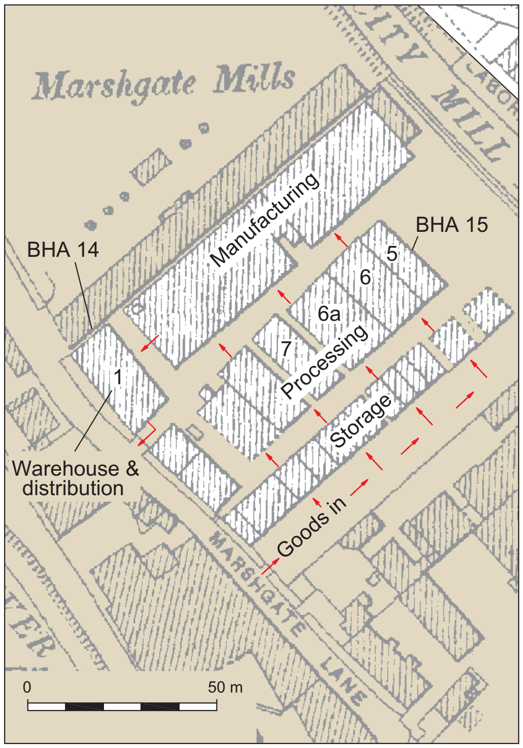


Figure 6.22: Process diagram through Marshgate Mills Ink works (BHAs 14–15) against 1896 OS map

Ink manufacture involved a great range of organic and inorganic-based materials including pigments, dyes, binders, and solvents. It was important that the stores were laid out to prevent cross-contamination of the materials, for ease of access, and so that volatile materials such as solvents were isolated and stored in 'high risk' storage areas where fire could be easily contained. With reference to the tentative process flow diagram (Fig. 6.22), based on the layout of the works shown on the 1896 OS map, it is suggested that raw materials were delivered through the southern entrance from Marshgate Lane, and that the range of small sheds along the south end of the works site would have provided segregated storage for a range of low-bulk materials such as dyes and pigments, with detached sheds at the east end for the storage of flammable materials. Unit 7 may also have provided storage for some of the bulkier materials, such as liquids in drums or barrels.

Ink manufacture relies on a number of processes, the most important of which was the pre-mixing and dispersal of pigments into the solvent base. This process could involve pug mills, edge runners, single or triple-roller mills or ball mills, and it is possible that some of these pre-mixing processes were carried out in the double-ended large sheds along the middle of site, such that the raw materials were brought in from the sheds to the south, and the mixed solution transferred from the north end to the main manufacturing buildings along the north side of the site. The main manufacturing buildings were normally multi-storey, in which the materials entered at the top of the building and went through a series of final processes as they descended through to the packaging department on the ground floor. The finished goods would then be transferred to the warehouse (Unit 1) for despatch to the customer via the northern site entrance.

Discussion

While the Marshgate Mills buildings recorded at the Vanguard Estate appear to have undergone only modest alteration during the first half century of their function, those on the west side of Marshgate Lane (BHAs 9–12) bear evidence of a number of phases of alteration, extension and re-configuration. This is likely to have been the result of two main factors. First, the Marshgate Mills buildings were constructed to function as the premises for the manufacture of printing ink; a function that they continued until 1945 when Usher Walker finally ceased production there, over 60 years later. This continuity of function is relatively unusual, and certainly not shared by their close neighbour. The buildings of 39–45 Marshgate Lane (BHAs 9–12), in contrast, demonstrate an ongoing process of evolution and adaptation, largely resulting from the changes of use to which the buildings were put. Secondly, the different outcomes of the two groups of buildings relate to their primary form, and adaptability to new uses. The Marshgate Mills buildings, and particularly Units 5–7, once emptied of their internal plant, effectively provide large open volumes which could be easily adapted for a wide range of industrial uses or storage. By contrast, the complex plan form and layouts of the multi-storey buildings west of Marshgate Lane made them less easily adaptable to new uses without modification.

Developments north of the GER

While industrial development had thus far been largely confined to land south of the GER, the penultimate decade of the 19th century finally saw large-scale industrial development to the north of this significant physical barrier across the landscape (Fig. 6.13). The two major areas of development were between the Pudding Mill and City Mill Rivers to the west, and between the Waterworks River and the GER Victoria Park Branch to the east. While the western area was already served by Marshgate Lane, which had been extended during the 1860s to serve the Tar and Turpentine Distillery (Fig. 6.12), the eastern area necessitated the extension of both Warton and Carpenter's Roads, though both utilised pre-existing bridges carrying the GER over their alignments.

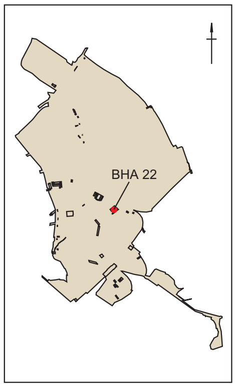
The western area was developed almost exclusively for dangerous or offensive trades, where Colour Works and Oil Works joined a pre-existing Bone Works (see Table 6.1, below, Trench 44). A Rope Walk along the north side of the Northern Outfall Sewer was the only non-anti-social industry. The eastern area demonstrated a slightly more mixed environment, with chemical and engineering works joining the tallow, candle and varnish works. This early phase of development to the north of the GER is represented in the built heritage record by the earliest buildings of the former S.H. Johnson & Co.'s engineering works on Carpenter's Road (BHA 22) (later Jerome Engineering) in the eastern area, and by the last surviving buildings of the former Marshgate Works of T.H. Harris & Sons (BHA 4) in the western area.

The establishment of Johnson & Co. in the 1880s provides a further example of the location of inter-dependent industries in close proximity to one another. It was a firm of chemical engineers, producing specialist plant and equipment for the chemical industry. It would, therefore, have had a market for its goods right on its doorstep, among the 100 chemical firms which set up in West Ham between 1860 and 1919.

Jerome Engineering, 98–100 Carpenter's Road (BHA 22)

The five components of BHA 22 recorded at this site (numbered from south-east to north-west) were buildings J1, J3 and J5, and interstitial external spaces and gateways J2 and J4 (Fig. 6.23). The OS mapping for the site (Fig. 6.15) indicates that the footprint of most of building J1 and nearly all of building J3 and J5 had been established by 1896, thus creating the enduring site plan of long rectangular buildings with narrow access roads between, terminating in a large riverside wharf on the Waterworks River, served by a crane, as depicted on the 1915 OS map (Fig. 6.23). Unfortunately, demolition of these buildings had already commenced at the time of survey, and no detailed analysis of the fabric could be undertaken. It was therefore not possible to identify which elements of the recorded fabric were primary, and which resulted from later alteration. Although the footprints of the recorded buildings conformed closely to that shown on the 1896 map, the use of steel-framing at that date (see below) would be surprising.

Building J1 was a long, rectangular, largely steel-framed building, comprising 12 full structural bays, and two storeys. The southern wall was of brick with regularly spaced buttresses on both sides, though not conforming to the spacing of the bays of the steel frame, and it is assumed that this wall represents a plot boundary wall, constructed prior to the building. The exterior of the other elevations were simply clad in corrugated asbestos cement sheet. The first



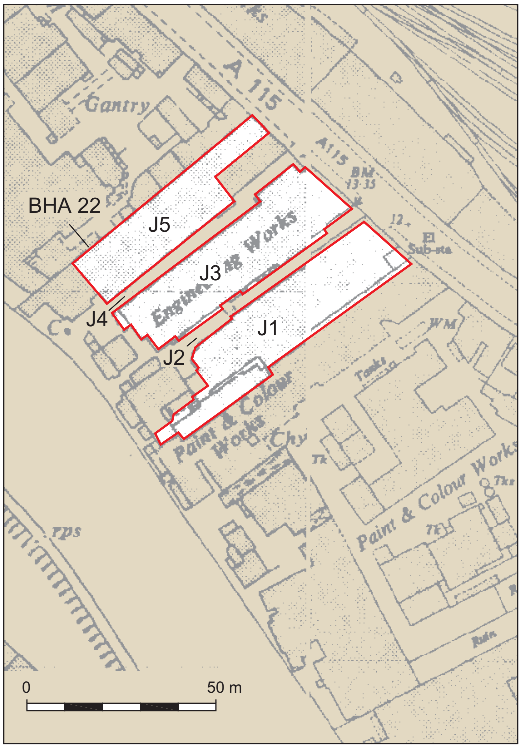


Figure 6.23: Recorded buildings at former S.H. Johnson engineering works on Carpenter's Road (BHA 22) with 1950 OS map

floor structure comprised pre-cast concrete beams (planks) supported on steel girders, and the roof structure comprised light-weight steel 'Fink' trusses. The northern half of the building had both overhead travelling crane rails and steel tracks set into the floor. These apparently exited the building at the south-west end, but terminated within the building at the north-east end; therefore they did not extend as far as the large roller-shuttered opening in the building frontage. Although referred to as a 'warehouse' in the original built heritage report (Dixon 2004, 16) the recorded presence of a number of scars on the concrete floor, representing the former locations of fixed plant, and the three 50 cwt (2.54 tonnes) travelling cranes set on a pair of crane rails along the length of the building, which could have served multiple assembly locations, suggest a manufacturing rather than storage function for the building.

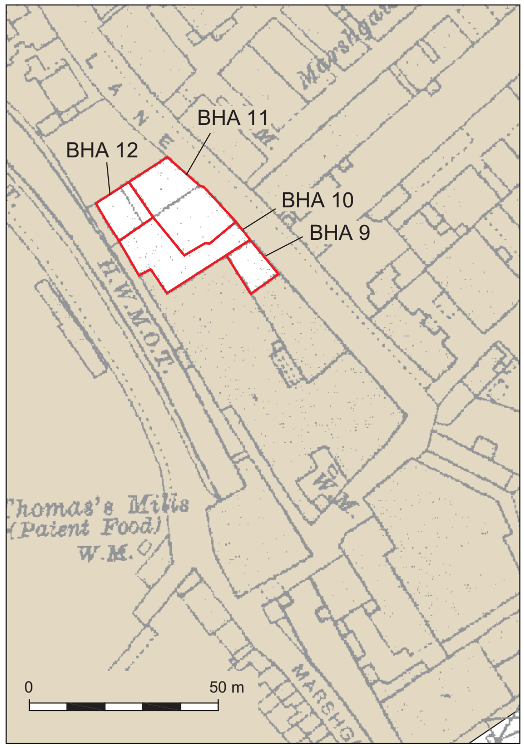
The surviving elements of building J3 were thought to suggest a modern replacement building, but the use of a steel-frame of similar I-section columns and beams to building J1, clad along the south with corrugated asbestos cement sheet, suggests that the brick curtain walling and studwork internal partitions surviving at the time of survey at the west end were localised later alterations to provide office accommodation.

Building J5 was a three-storey, narrow brick building of one double and four single bays. The single recessed bays, set between brick piers, each contained a double casement window at each floor. The ground floor of the double bay housed a large roller-shuttered doorway and the upper floors each had four casement windows forming a continuous strip. The building again had an internal structure of steel I-section columns and beams, and the roof, which was hipped at the north-east end, was covered in corrugated asbestos cement sheet.

If the fabric recorded was primary, the construction of these buildings would mark a transition within this industrial area, from the robust, masonry and timber industrial buildings of the early and mid-Victorian period, to a new type of industrial building – of lighter-weight steel components, quickly and easily assembled from a pre-fabricated kit of parts, and therefore a much cheaper option.

Industrial Expansion in the Early 20th Century

The start of the 20th century saw not only an increase in the number of firms locating to the area, but also the expansion of existing works premises, as demand increased and companies prospered. In some instances, companies were able to purchase adjacent vacant sites or existing factory sites in order to expand production. Another trend, as production became more mechanised and processes flowed more seamlessly from one stage to the next, was that existing sites changed in character from one of narrow, naturally lit ranges of building set around and within a number



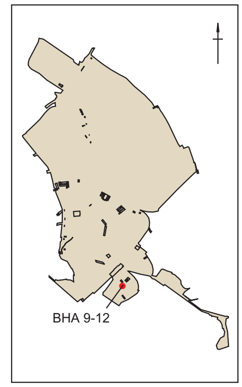


Figure 6.24: Recorded buildings at 39–45 Marshgate Lane (BHAs 9–12) with 1915 OS map

of connected external yards, as seen at Augustus Smith's Brush and Mat Manufactory (BHAs 9–12) in 1869 (Fig. 6.18), to one in which the buildings of a works site occupied the majority of the space available, such as seen at the same premises by 1915 (Fig. 6.24).

39, 41, 43 and 45 Marshgate Lane (BHAs 9–12)

Augustus Smith & Co. is last recorded at these premises in the trade directories of 1896, after which the site is recorded as being occupied by John Alderson, Rope Maker, as an extension of his large rope works to the north of the railway. It is not clear whether it was Alderson, or W. Sydney & Co. who took the premises over in 1908, who was responsible for the re-configuration and re-fronting of the premises, but by 1915, the Marshgate Lane complex had largely achieved the footprint which survived at the time of the survey.

As previously discussed, the building complex as recorded had a complicated layout (Fig. 6.19), largely due to the incremental construction and remodelling of its component parts. However, it is clear that the premises had undergone a form of 'consolidation' by 1915, as the frontage to Marshgate Lane is predominantly of a uniform palette of materials (yellow stock brick with blue brick dressings) and architectural detail (shallow segmental arches over openings, robust timber casements and external loading bays) (Pl. 6.11). This harmonious frontage, however, hides the great range of construction materials and techniques in the various parts of the buildings behind; testament to their different phases of construction.

Plate 6.11: Frontage elevation to Marshgate Lane (BHAs 9–11)

Whilst the works premises at 39–45 Marshgate Lane (BHAs 9–12) and the Marshgate Mills (Vanguard Centre) (BHAs 14–15) conformed closely to the late Victorian tradition for industrial buildings in terms of form, palette of materials, and detailing, the buildings of Clarnico's Kings Yard works (BHA 5), barely 20 years later, demonstrate a shift towards 20th century construction techniques, even though they continue the earlier tradition in terms of form and layout. The group of six buildings recorded on this site represents the fairly comprehensive survival of an early Edwardian works complex, and a rare recorded example of one of the significant industries in this area of West Ham, in that they were constructed for use within the food industry.

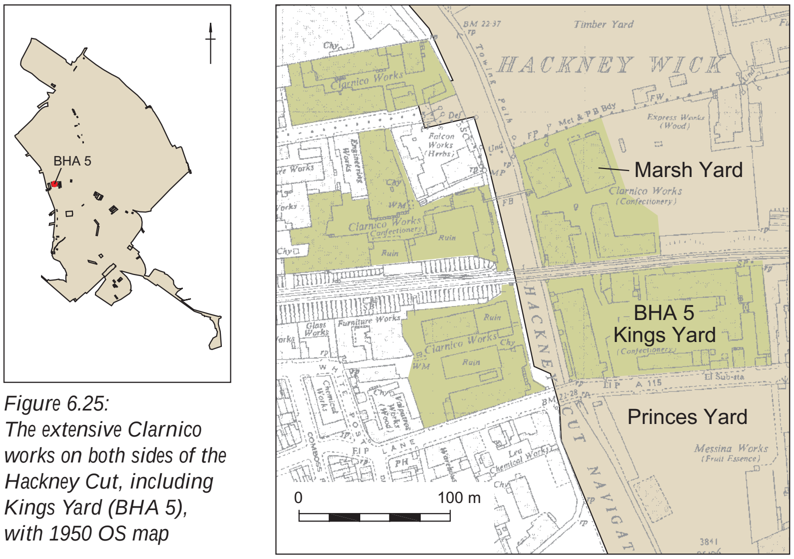


Figure 6.25: The extensive Clarnico works on both sides of the Hackney Cut, including Kings Yard (BHA 5), with 1950 OS map

Plate 6.13: Clarnico Kings Yard works (BHA 5), viewed from the east

Clarnico's Kings Yard works, Carpenter's Road (BHA 5)

The Kings Yard complex represents an expansion of the factory sites in Hackney Wick of Clarke, Nickolls & Coombs Ltd (CNC or Clarnico), jam and confectionary manufacturers founded in 1872. At the time of their flotation on the Stock Exchange in 1886, their premises already covered 1.8 hectares, on a site to the north of the GER Victoria Branch line and on the west bank of the Hackney Cut. However, the continued success of the business led to expansion of their factory capacity, firstly onto a large site to the south of the GER embankment, and then across to the east side of the Hackney Cut with the development of Marsh Yard to the north of the GER line, and Kings Yard (BHA 5) to its south (Fig. 6.25). The full extent of the resulting Clarnico manufacturing sites can be seen on an aerial photograph dating to 1921 (Pl. 6.12), while the layout of the Kings Yard works, and the form, scale and massing of the recorded buildings are clearly shown on a survey photograph (Pl. 6.13). The Starch Department in Kings Yard will be the only building to be retained within the Park, and will form part of the Energy Centre after the Games.

Plate 6.12: Aerial photograph dated 1921 showing the Clarnico Kings Yard works (BHA 5) in context

The construction of the buildings at Kings Yard ranged in date from 1903 to 1908. They comprised (Fig. 6.26):

Building 1: Starch Department – 1904–5

Building 2: Lozenge Department – 1907–8

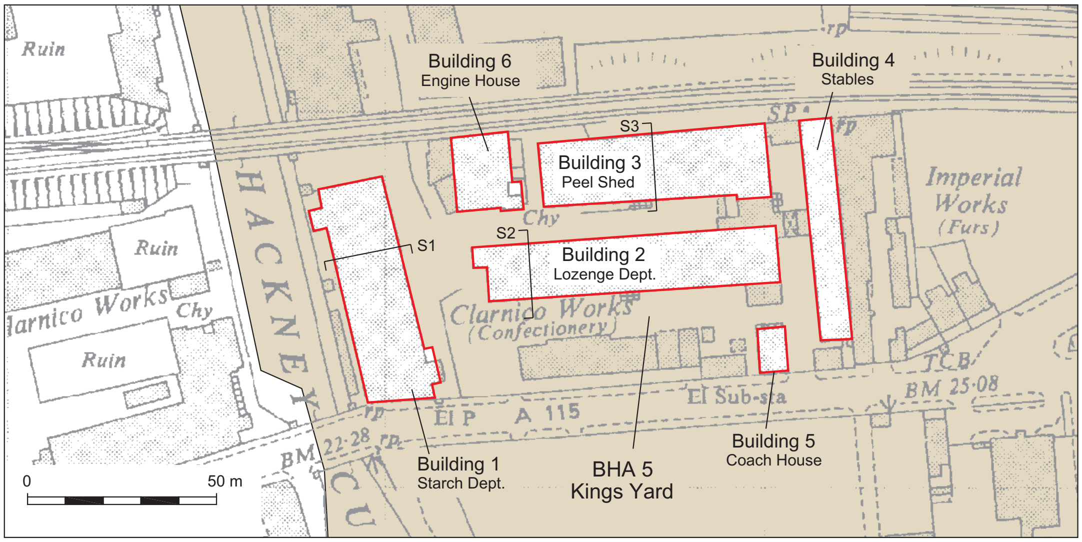
Building 3: Peel Shed – 1906
(additional storey added 1908)

Building 4: Stables – 1903–4

Building 5: Coach House
(Fire Engine house) – 1904–5

Building 6: Engine House – 1904–5

The buildings had a similar external appearance to the earlier recorded buildings at Marshgate Lane (BHAs 9–12, 14–15), with load-bearing brick walls punctuated with regularly spaced multi-paned



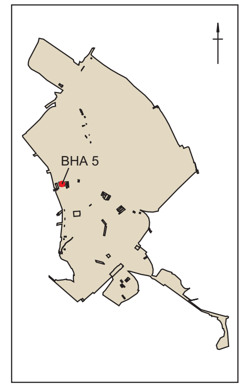


Figure 6.26: Recorded buildings at Clarnico's Kings Yard works (BHA 5), with 1950 OS map

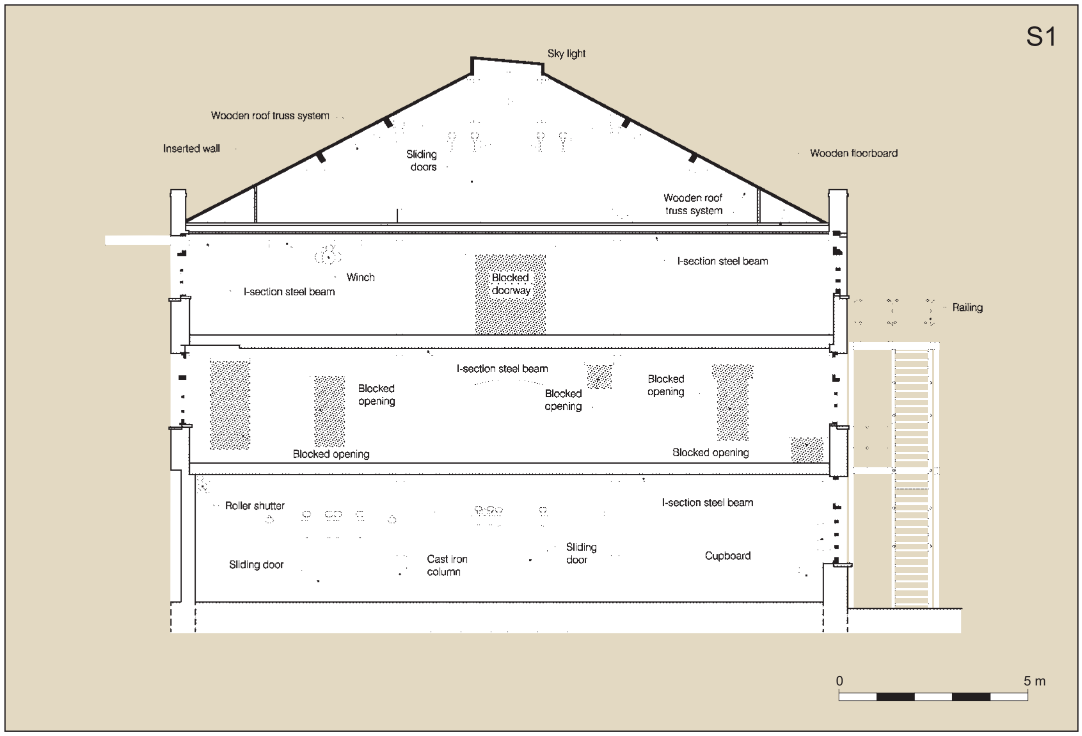
windows with segmental-arched heads, and the modest use of blue bull-nosed bricks to door reveals and window sills. However, the internal structures of these buildings were 'transitional' in character, demonstrating the shift from 19th to 20th century constructional materials and techniques. Rather than traditional timber floor joists spanning between robust timber beams supported on cast iron columns, with timber king post or queen post roof trusses, here was the utilisation of a hybrid kit of component parts including traditional cast iron columns, Dorman Long I-section rolled steel stanchions, steel girders, herringbone braced timber floor structures, Belfast roof trusses, and lightweight steel Fink trusses. Importantly, however, both constructional types produced similar large, uninterrupted interior volumes, providing flexible working areas which could accommodate a wide range of processes, and in which ancillary features, such as stairs and staff welfare facilities, were confined to the extremities. Somewhat surprisingly, the individual manufacturing buildings within this roughly contemporary group, display different combinations of traditional and modern materials and constructional forms.

Externally, the three-storey Starch Department (Building 1) looks like a traditional 19th century load-bearing brick industrial structure, with uniform and regularly spaced, segmental-arched openings through all floors (Pl. 6.14). Internally, however, although utilising the traditional structural configuration of column and beam, this building employed an all-steel frame comprising two lines of Dorman Long steel stanchions supporting transverse I-section girders, in turn supporting the timber first-floor and concrete second-floor structures.

Plate 6.14: West elevation of the Clarnico Starch Department adjacent to the Hackney Cut (BHA 5)

The 16-bay long building was divided in two by a central brick fire wall which extended above the roof line. This wall was breached by two segmental-arched doorways at ground floor, and a central one at first, second and attic floors (Fig. 6.27). These openings were protected by top-hung sliding fire doors on either side which survived *in situ* at ground and attic floors. Somewhat surprisingly, despite the

Figure 6.27: Cross-section through Clarnico's Starch Department



steel framing of the floor structures, the roof structure comprised traditional timber queen post trusses and purlins: the most common timber roof structure for 19th century industrial buildings, giving a clear open space between the often widely-spaced queen posts (Pl. 6.15). Early aerial views of the building show that it originally had a raised skylight the length of the ridge, but this had been reduced to a flat skylight by the time of survey.

Plate 6.15: Internal view of queen post trusses of Clarnico's Starch Department (BHA 5)

Although modern partitioning had been introduced to some of the floors in recent years, it was clear that the building was designed to provide completely open-plan work spaces at each floor, with WCs, and enclosed staircases beyond the main building envelope at north-west and south-east corners. An external steel fire escape stair had been added midway along the west elevation to provide a secondary means of escape from each of the two fire compartments into which the building was divided. Goods were originally moved in and out of the building by means of two sets of loading bay doors at each floor; one in the centre of the north elevation, giving access to the riverside wharf, and another roughly central to the northern half of the east elevation. These had all been blocked by the time of survey.

As with the majority of the recorded buildings within the Olympic Park, all plant and machinery had long been removed by the time of survey, and the location and interrelationships of different processes were no longer legible in the building.

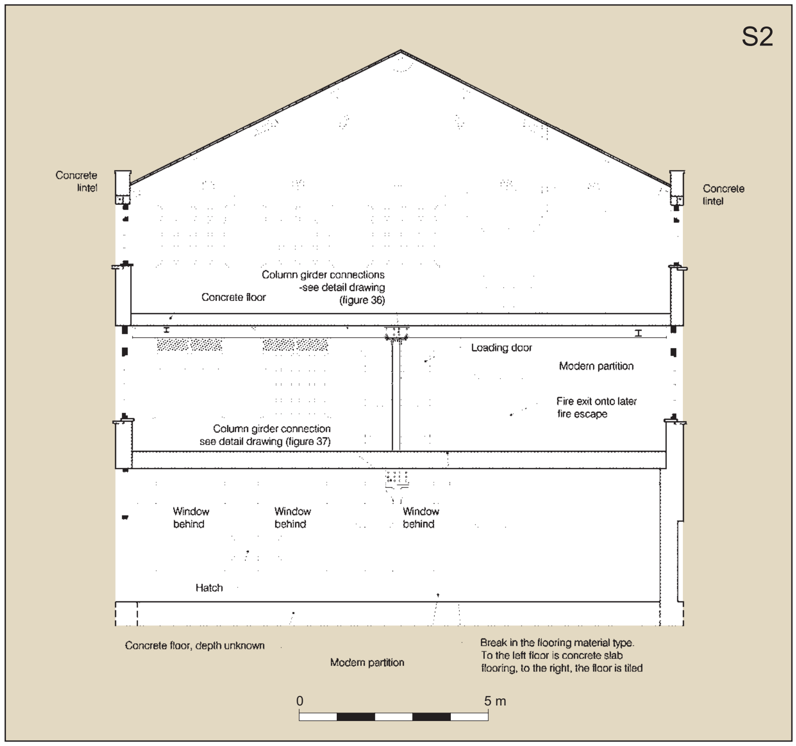


Figure 6.28: Cross-section through Clarnico's Lozenge Department

The Lozenge Department (Building 2) was a similarly long narrow building with a load-bearing brick envelope, but its internal structure was quite different (Fig. 6.28). The ground floor, which was common throughout the entire length of the building, had a hybrid structure comprising circular cast iron flanged columns supporting riveted steel girders mid-span, which required a complex connection with bolted plates (Fig. 6.29). The westernmost 12 bays of the building were of three-storeys, while the eastern 10 were of only two. The first floor of the western structure was of similar configuration to that at ground floor level, with the exception that the cast iron columns were substituted here by steel I-section columns.

This eastern part of the building retained its timber Belfast roof trusses giving the roof its distinctive elliptical barrel-arched profile. This specialised form of timber bowstring latticed truss (used also in the Peel Shed, Fig. 6.30) was introduced in the early 1900s and, although most commonly associated with World War I aircraft hangars, they also became popular for industrial buildings as they provided a cheap solution to spanning wide spaces without the need for intermediary support, thus providing clear open workspaces. It is understood that the western half of the building had originally also had Belfast trusses spanning the 13.5 m/48 ft between the external walls, but that bomb damage during the war had necessitated the rebuilding of the upper floor, and its re-roofing with lightweight steel Fink trusses. One unusual feature was the presence of longitudinal bracing between the trusses, providing improved lateral wind resistance. The choice of Belfast roof trusses may be related to their widespread usage on the adjacent site of Gliksten's Timber Yard (BHA 6, below).

A small structure at the east end of the building – reduced to a single storey – represents a surviving element of a long rectangular, two-storey hip-roofed building, aligned north–south, which once abutted and connected the east ends of the Peel Shed (Building 3) to the north and the Lozenge Department (Building 2) to the south. A second element of this lost building also survived at the east end of the Peel Shed, and the cross-section at this location shows the structure to comprise steel girders supported mid-span by steel I-section columns but carrying a timber first floor, with a steel Fink truss roof. The lack of any blocked openings in the west wall of this building indicates that it was built at the

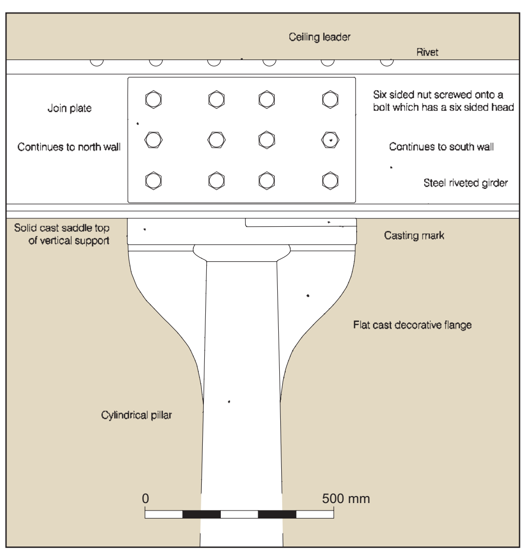


Figure 6.29: Detail of column/girder connection in Clarnico's Lozenge Department

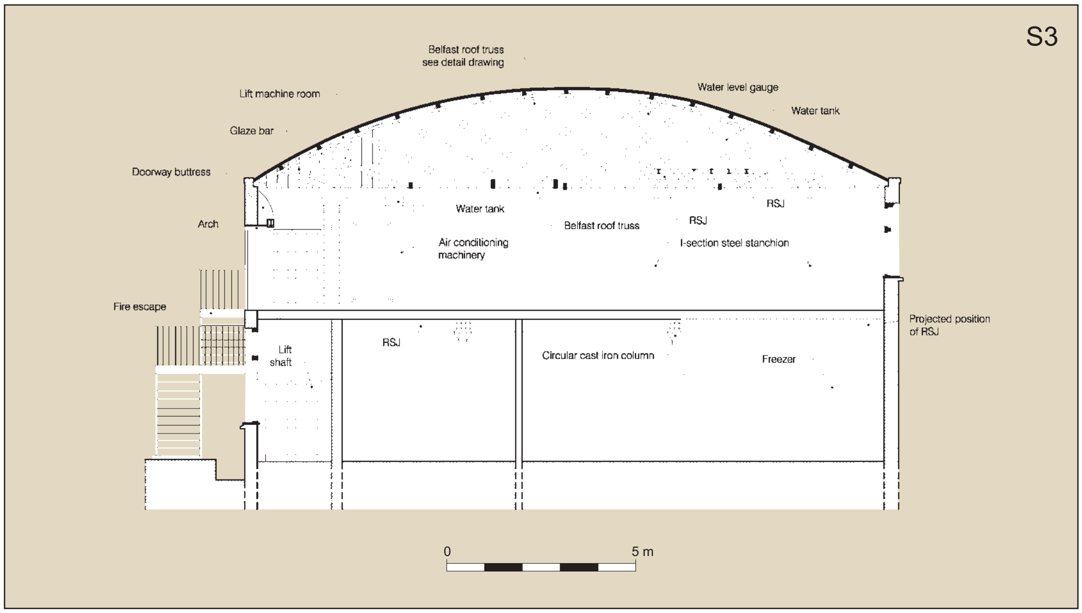


Figure 6.30: Cross-section through Clarnico's Peel Shed

same time as the Peel Shed, while the east wall retained its original multi-paned windows with segmental-arched heads at first floor. The ground floor appeared to have originally comprised a series of large openings between brick piers with chamfered black brick quoins to prevent damage; suggesting that the building may have originally housed vehicles of some sort.

The main body of the Peel Shed (or 'Preserving House') (Building 3), by contrast, was of more hybrid 'transitional' construction, with two lines of round cast iron columns supporting steel girders and a concrete first floor, roofed over by an elliptical Belfast truss roof (Fig. 6.30). The building was set hard up against the embankment of the GER Victoria Park Branch, and was said to have been built in 1906 as a single-storey structure, with an upper floor added in 1908 (Dixon 2004), and the Belfast trusses retained over the raised building. The building was traditionally lit by uniformly-spaced windows in the north and south long elevations, though those at ground floor along the north elevation had been blocked or concealed behind an internal dry lining of the wall as part of the later internal fitting out of the building. Access to the upper floor appears to have always been by means of external staircases at either end of the two-storey structure. Whilst the eastern doorway was later blocked and its function replaced by a doorway in the south gable elevation of the reduced eastern building, served by a replacement stair, the original staircase serving the west door survived and displayed a good level of decorative detail, particularly of the stair risers.

These three buildings represent the full range of manufacturing processes which were undertaken on the Kings Yard site. All other recorded buildings housed ancillary functions such as the stables, coach house and engine house. Although no historical images were found of the activities which took place within the manufacturing buildings of Kings Yard, early photographs of processes elsewhere within Clarnico's extensive premises provide a good impression of the types and scale of equipment used, the methods of transmission of power, and the general level of staffing and activity which would have populated the recorded buildings (Pl. 6.16).

The 59 metre-long range of red brick-built Stables which formed the eastern boundary of the Kings Yard premises (Building 4) was, along most of its length, divided into a series of inter-connecting three-bay units by cross

Plate 6.16: Employees in Clarnico's Jam Boiling Room (BHA 5)

walls with large openings in them. The south end of the building was occupied with a wider, sub-divided bay, probably serving as a tack room and mess room. The shallow, mono-pitched timber roof is supported on a series of timber beams, supported mid-span by square timber posts (Pl. 6.17). The original articulation of the west elevation appears to have comprised a series of wide, segmental-headed doorways with blue brick quoins in the central bay of each three-bay unit, and separate shallow high-level windows in every bay, though the pattern of openings had been much altered over time, and a concrete floor laid. With the exception of the occasional timber bridle-peg attached to a square post, and a single steel tethering ring, the building had lost all of its fixtures and fittings relating to its authentic function as a stables, and new windows and skylights had been inserted to light the workshops into which it was converted.

To the south-west of the stables, and situated immediately adjacent to the main site entrance from Carpenter's Road, was the three-bay, two-storey building known as the Coach House (Building 5). It was constructed in 1904–5 of yellow stock brick

Plate 6.17: Interior view of the Clarnico stables (BHA 5)

laid in English bond, but was later rendered on three sides. Although at the time of the survey sub-divided internally by later partitions into a series of offices, the basic structure of the building comprised three bays. This was expressed on the east elevation by three former wide openings framed by bull-nosed bricks with later full-length windows inserted, with three segmental-arched windows at first floor level. The west elevation was punctuated by a central pedestrian door flanked by two windows at ground floor level, and three windows above. Access to the first floor was by an external iron stair against the north elevation. The first floor had also been partitioned-out for modern offices, leaving no evidence of the original layout.

Plate 6.18:
The Clarnico fire brigade in the early 1900s

While referred to as the Coach House, it is known that this building served a much more significant role in the company's premises – that of fire station. Although the *Metropolitan Fire Brigade Act* of 1865 had led to a publicly-funded fire service for London, Clarnico felt it necessary, due to the fire risk of the many hot processes involved in the confectionary and jam making business, to have its own fire appliances and a dedicated fire brigade. The construction of the Stables and the Coach House as two of the first buildings to be built on the new Kings Yard site suggests an imperative to get this important safety feature established. Surviving historical photos show the fire brigade in full uniform and brass helmets in the early 1900s (Pl. 6.18), but whether this dedicated brigade continued through later years is not known. One of the oral history interviewees (interviewed as part of the community history project, see Chapter 1) was the son of one of the Clarnico designated firemen, who was also an employee in the confectionary business during the day. In return for being on call at night, his family, and those of the other members of the fire crew, were given company cottages to live in on Wallis Road, on the west bank of the Hackney Cut Navigation, close to the firm's premises.

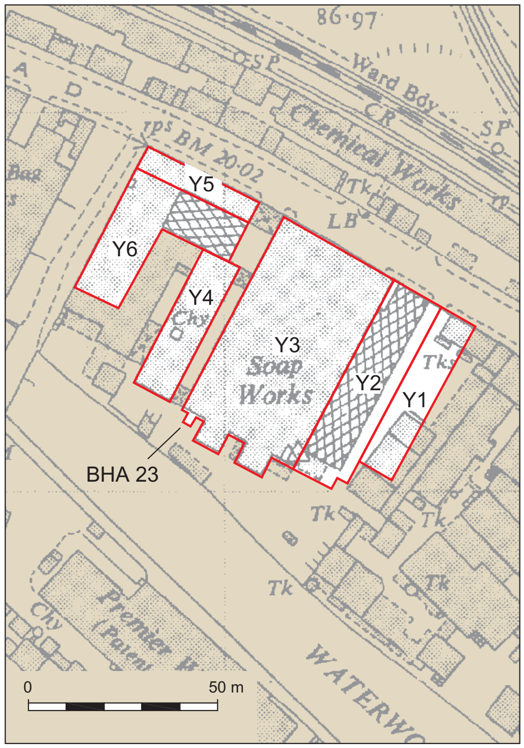
In view of the serious risk of fire, one might assume that Clarnico would have been quick to adopt the new materials of steel and concrete, yet several of these early 20th century buildings employ traditional timber floor and roof structures. One of the reasons for this is thought to be to prevent the threat of steam from the boiling and preserving processes from condensing on the cold steel and dripping back into the preserving pans and polluting the mix; something that was not a problem with the warmer and more absorbent timber.

Yardley (BHA 23)

Another important firm which located to the study area in the first decade of the 20th century was Yardley & Co. Ltd, perfumery manufacturers, which had been established in 1770. Yardley built a small soap works on Carpenter's Road in 1905, on undeveloped land to the north-west of the Channel Sea Tallow Works (Fig. 6.15). Although better known for their strikingly Art Deco 1937 Offices and Box Factory building on Stratford High Street, Yardley was an exceptionally important firm in the locality, not only by virtue of the numbers of the local population that they employed, but through their wider impact on the local community through the 'extracurricular' activities they provided for their staff and families in terms of social and sports facilities, and outings further afield.

Of the six surviving buildings recorded on the Yardley site, Buildings Y4–6 occupy the original soap works site established in 1905, although only Y5 and Y6 appear to date to this original phase (Fig. 6.31).

Building Y5 provided a continuous two-storey frontage to the original premises in a very simple classical idiom, with a number of clearly Edwardian features (Fig. 6.32). Constructed in yellow stock brickwork above a blue brick plinth, the long narrow range had, at its centre, a slightly expressed pedimented element, comprising three single window bays at first floor, above a wide elliptical arched carriageway, later in-filled with a timber framed window above a blue brick plinth (Pl. 6.19). The arch was constructed of panels of red brick alternating with white painted sections, including a central keystone, and sprung from a white painted impost band which ran the length of the building. The elevation was articulated with shallow flat pilasters creating three bays to either side of the central element. Each bay contained a single large round-headed window at ground floor, with red brick arch and white keystone, and a pair of timber sash windows above.



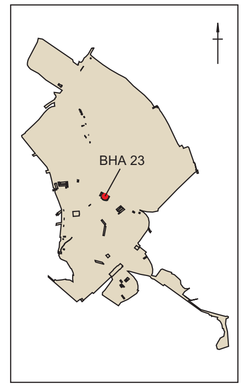


Figure 6.31: Recorded buildings at the Yardley soap and perfume works (BHA 23), with 1950 OS map

Plate 6.19: Central pedimented element of Yardley's building Y5 (BHA 23)

This original soap works appears to have been on a relatively modest scale, with the carriageway giving access through to an external yard, with a large building to the south-west, and a smaller narrow range along the south-eastern property boundary with a free-standing chimney to its south, and a further small building beyond. The

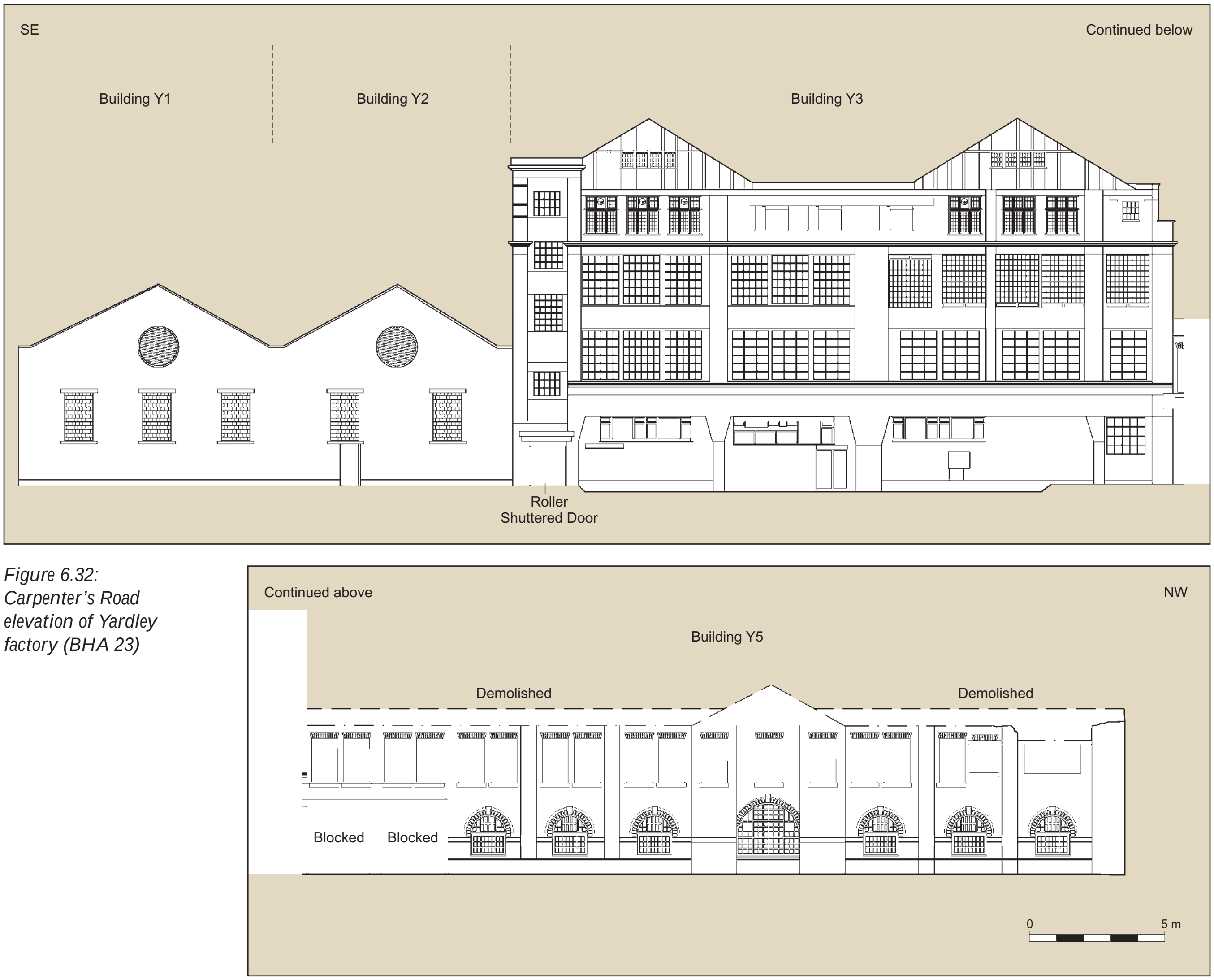


Figure 6.32: Carpenter's Road elevation of Yardley factory (BHA 23)

chimney was later enclosed within the two-storey building Y4 when the works were extended in the 1930s (see below).

Location and Mix of Industry in 1915

The considerable influx of new industry during the first decades of the 20th century, resulted in a shift in the mix of industry (Fig. 6.15). The number of chemical works reduced by over 50% from their late 19th century numbers, possibly as a result of ever-tighter restrictions over both their location and their use of the waterways for the discharge of waste products. In contrast, the number of firms involved in industrial manufacturing almost doubled, and there was a small increase in the number of food and drink manufacturers, such as Clarnico, who had, by this date, expanded their works premises to the east bank of the Hackney Cut. A large *Timber Yard* (Glikstens's, see below) had been established on the former triangular reservoir site to the south.

Most of the land block between Waterworks and City Mill Rivers remained undeveloped, cut off at the south from the rapidly developing areas around it by the rivers and the GER embankment. Only at its north end, where a new bridge had been built across Waterworks River, was development starting in the form of a Fish Meal Factory and a Match Works. Perhaps more surprising was the halt in the northward development of the land block between the City Mill and Pudding Mill rivers, served

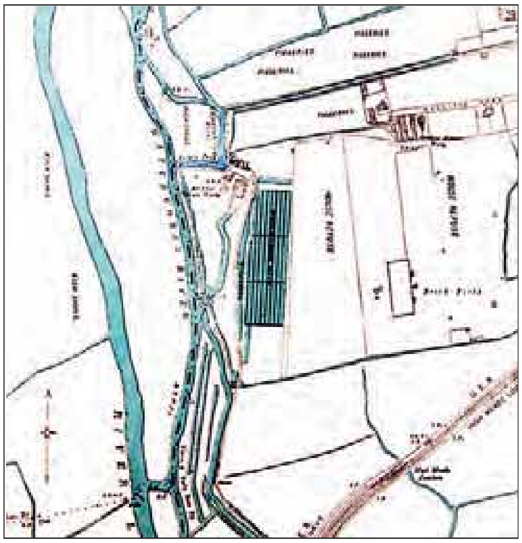


Figure 6.33: Map by Hackney Borough's Medical Officer for Health showing location of watercress beds

by Marshgate Lane. Its later use as a refuse disposal site, suggesting that it was naturally low-lying and therefore prone to flooding, may provide an explanation for this.

While the main distribution of industrial premises, therefore, reflected the availability of road access principally from Stratford High Street, there was also a gradual infilling of areas towards the north of the Park, with premises for predominantly offensive or anti-social trades, accessed from Temple Mills Lane. The presence of these industries would not only have had a negative impact on the quality of life of the local residents, but in some cases it would have impacted directly on their health. At the start of the 20th century, for example, there were watercress beds laid out to the east of Channelsea River, south of Temple Mills, immediately east of the possible watercress or osier beds recorded in Trench 79 (see Chapter 5). These were closed, however, after two major outbreaks of typhoid in 1903 were traced back to them; the Borough's Medical Officer for Health reporting that the beds were 'fed by almost undiluted sewage' (Warry 1903). The map accompanying his report shows them surrounded by plots labelled as *house refuse*, *piggeries*, *artificial manure works*, and *fish skins* (Fig. 6.33).

Temple Mills

The 19th century mills on the original Temple Mills site were demolished in 1854, following the transferral of the Temple Mills lease to the East London Waterworks Company, leaving only a public house, the White Hart Inn (said to have been built in 1513; Mitton 1908, 14), standing on Temple Mills Lane on the western side of the mill stream. By the time of Stanford's 1862 map (Fig. 6.2) it is the group of buildings, further to the south between the Temple Mill Stream and Tumbling Bay Stream, that are indicated as Temple Mills. These buildings are shown in detail on the OS map of 1869, where they can be seen to comprise Building 3 (the terrace of six cottages) and Building 4 (as described in Chapter 5; Fig. 5.31), as well as other buildings flanking Tumbling Bay Stream. To the south, the eastern side of the island between the two channels is open ground accessed by the narrow gap between Buildings 3 and 4, while the western side is enclosed, containing a glass house, a fountain and other buildings.

Phase 4 (mid-late 19th century)

The general arrangement of buildings and plots shown on the 1869 OS map remained largely unchanged on the 1882 OS map. On the 1896 map (Fig. 6.34), too, the terrace of cottages (Building 3) remained in place, as did Building 4 and its eastern annexe, and the plots and buildings to their south-west (outside the excavation area) (although the enclosed yard at the southern end of Building 3 is no longer shown). The boundary running north from Building 4 (formerly the western boundary of Plot 5) is still shown in 1896, probably marking the edge of the access to Building 4 via the Phase 3 metalled surface (143/192) (Fig. 5.31, above).

However, by this date there had also been significant developments which are reflected in the archaeological record (Fig. 6.34). All the buildings and plots flanking Tumbling Bay to the east of the

Figure 6.34: Trench 75: Phase 4

terraced cottages (Plots 3–5) had been cleared away, creating a large open yard space north and east of Building 4. Only Plots 1 and 2, which lay at the north end, remained – apparently as a single plot (Plot 1–2) that was now slightly foreshortened at the west. These changes are associated with the closing of the narrow gap between the south end of the terrace and Building 4, which had marked the entrance to the calico works to the south.

Access was now gained around the east side of Building 4, cutting across the former plots. The 1896 map shows a new trackway starting east of the Building 4 annexe and curving round to the SSW to join the line of the earlier trackway. The opening up of Plots 3–5, and their use as the access route to areas to the south of the site, may have been the main reasons for the construction of the substantial revetment (81/83) along the western bank of Tumbling Bay Stream (see above). The yard and new trackway overlay the revetment's anchors.

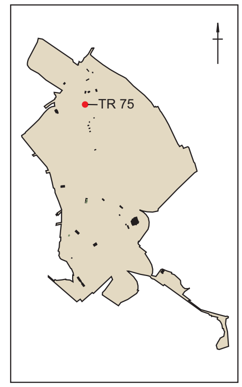


Figure 6.35: Trench 75: Phase 5

Demolition, infilling and ground levelling

The features and structure in Plot 4 (Fig. 5.33, above) were demolished, as represented by dumped deposits 534, 535 and 546 (not illustrated), containing crushed brick, slag, coal, gravel and sand, that overlay part of the Phase 3 structure's cobbled floor and feature 544. The brick-lined gullies, which had carried away rainwater from the terrace of cottages, would have lost their function of supplying water to the plot, and became infilled; they produced an interesting assemblage of small finds, including jet and glass beads, a copper alloy two-piece oval locket frame, wire dress hooks, a small perforated bone disc, possibly a button, numerous copper alloy pins along with fragments of textile, a slate pencil, and fragments of a tin or pewter container. These probably date both from the period of the drains use and from their infilling.

The features in Plot 5, which had probably been associated with the use of Building 4, in particular the sunken barrels, were also decommissioned and filled in. Pottery

Plate 6.20: Water/gas pipes for the Temple Mills cottages, Trench 75

dated 1850–1900 was found in their gravel and silty sand fills (along with earlier residual material). The other sunken cask (182), in Plot 7, was also filled in, but this need not have occurred at the same time.

The area formerly occupied by Plots 3–5 was then covered by extensive spread of made ground *c.* 0.3 m thick (260, not illustrated), comprising sandy silt and building rubble, that levelled the ground towards Tumbling Bay Stream.

Phase 5 (early 20th century)

Building 4 and its annexe are still shown on a 1901 *Plan of Land for Workmen's Dwelling, Temple Mills*, but at some date after that, but before 1915, these were also demolished, and the Phase 4 trackway, which had curved around their eastern side, was replaced by a new, straight cobbled road (Fig 6.35). The laying down of a thick bedding layer for the new road (over Phase 4 ground levelling deposit 260, above), and then the cobbles themselves, meant that the road surface was now *c.* 0.5 m higher than the Phase 3 ground level; this phase therefore saw a corresponding ground raising across the rest of the site, with a new metalled surface between the cobbled road and the terraced cottages, and a new raised pavement in front of the cottages themselves.

Terraced cottages and pavement

There were few apparent structural changes to the terraced cottages themselves, although slabs of concrete (36 and 25) were laid down in the entrances to No. 1 and No. 4. A significant development for their occupants, however, was indicated by the installation of either mains water or gas. A *c.* 35 mm pipe main was laid in a trench (139/148, not on plan), up to 0.4 m wide and 0.3 m deep, that ran parallel to the front of the terrace (under the new pavement), with narrower header pipes branching off to each cottage and passing through cuts made in the terrace front wall (Pl. 6.20). It has not been possible to establish whether the piping supplied water or gas; lead pipe was used for both in this period (Maurice Martin, pers. comm.). It did not survive within the cottages, having probably been salvaged from under the wooden flooring when the cottages were demolished, and cut off at the line of the front wall (but left in place under the pavement outside).

The pavement laid down in front of the terrace represented a significant raising of the ground level outside the cottages, overlying the earlier steps outside the doors (Pl. 6.21). Its bedding, which overlay the upper layer (150) of the Phase 3 metalled surface (above), comprised a 0.2 m thick layer of gravelly sand (132), overlain by a similar depth of mixed broken tile/brick, mortar, gravel soil and charcoal (129), then a compact layer of sandy silt (126) on which the flagstones (8) were laid. The paving was edged to the east by an edging of single coarse of granite cobbles (117), the top of which was level with the paving, giving a total width of the pavement of 1.5 m. Outside the cobbles were substantial granite kerb stones (131), *c.* 0.5 m wide, 0.3 m thick and between 1.0–1.8 m long, the tops of which were raised *c.* 0.1 m above the paving.

Plate 6.21: Phase 5 pavement in front of the Temple Mills cottages, Trench 75

The cobble edging and the kerb stones were laid within a cut into the underlying layer, with the kerb resting on a bed of sandy mortar (290/291). There was a kerbstone across the northern end of the pavement in line with the end of the terrace.

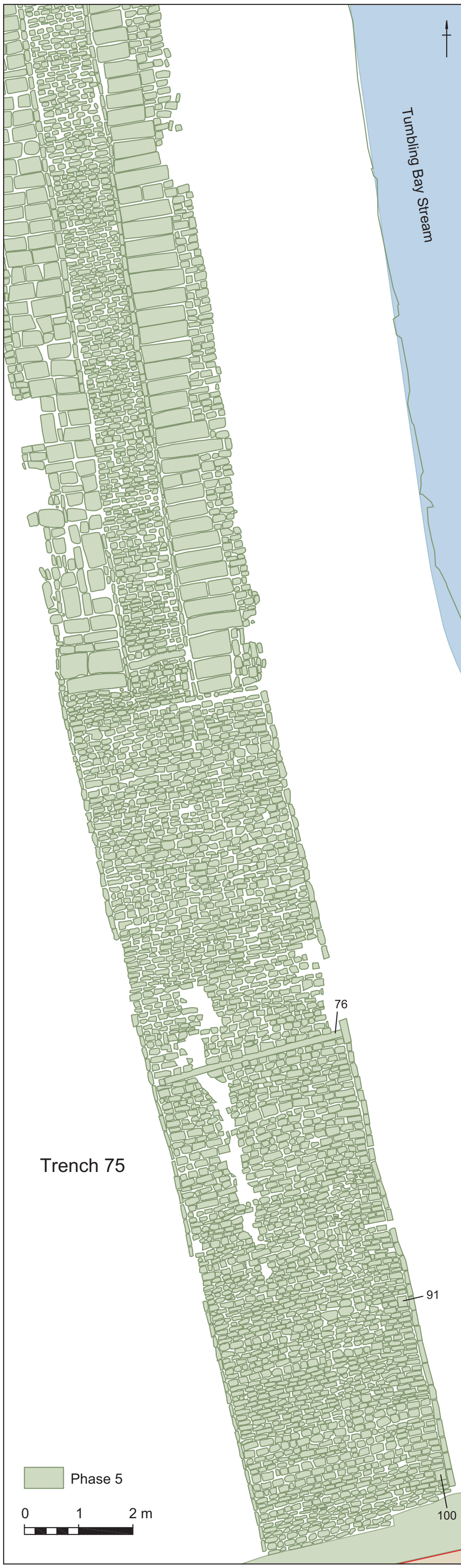
The cottages are visible in a 1935 photograph (Pl. 6.3), but an aerial photograph taken at the end of World War II appears to show them as derelict, their walls still standing but their roofs gone, possibly due to bomb damage. The London County Council War Damage Maps show that two V1 flying bombs fell within 150 m of the cottages (Saunders 2005).

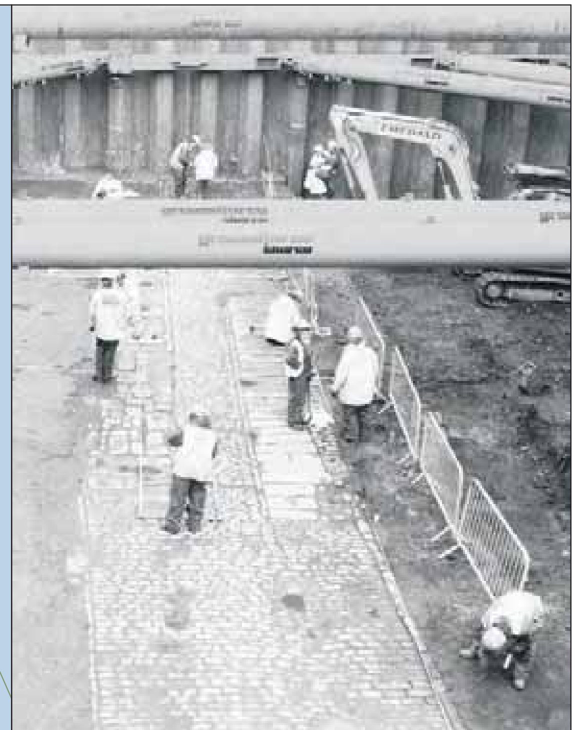
Demolition of Building 4, and metalled surfaces

This phase saw the demolition, by 1915, not only of Building 4 and its annexe, but also of the buildings to the south of the terraced cottages (in Plot 7). This was followed by the laying down of an extensive deposit, *c.* 0.3 m thick, of gravelly soil (2/44), extending north–south across the full length of the site in front of the terrace, as well as to its south, and covering the site of Building 4 (Fig. 6.35). This layer was described as a 'metalled surface', although the metalling may simply have been due to its compaction in the area (6.3–6.5 m wide) between the pavement kerb, with the top of which it was almost level, and the western edge of the cobbled road. The same material may have extended further east, forming the make-up layer for the road.

A soak-away (461) formed by a vertically set ceramic drain encased in concrete, with a grated cast iron cover, was cut through the surface 1 m south of the pavement (Fig. 6.35). The surface was also cut by 12 post-holes, arranged in two approximately north–south lines *c.* 1.5–2.5 m apart. The eastern line, lying 1.6–3.7 m west of the cobbled road, consisted of eight post-holes spaced 1.6–4.5 m apart, and of variable shape and size (*c.* 0.3–0.6 m wide). These may have formed a fence line. The western line, lying 0.2–1.3 m out from the pavement kerb, consisted of four circular post-holes spaced 4.2–7.2 m apart, of more regular size (0.2–0.36 m wide).

Figure 6.36: Trench 75: detailed plan and photograph of Phase 5 cobbled road





Some of the demolition rubble from the buildings may have been used to lay an irregular area of a rough brick surface (5), measuring *c.* 5 m by 3 m, south of the terrace, truncated at the south by a wide modern feature. Also partially overlying the metalled surface to the south was a spread of mixed silt gravel and tar (6).

Cobbled road

The cobbled road (Figs 6.35 and 6.36), which passed north–south across the whole site, passed through the former Plot 1–2, changed direction slightly (and its method of construction) opposite Nos 4 and 5 of the terraced cottages, and overlay the south-east corner of the Building 4 annexe. Although it is not depicted on the 1915 map, its course suggests it was built to provide access to a new set of industrial buildings shown on that map which were arranged along the west side of Tumbling Bay Stream to the SSE. The road appears, however, on a 1946 aerial photograph.

The bedding for the road, laid down over Phase 4 ground levelling deposit (260), was a layer of compact sandy silt (259), up to

0.3 m thick, containing frequent pieces of brick and mortar probably derived from the nearby demolitions. This was overlain by a bed of grey mortar (258) in which the cobbles (65) were set.

The pattern and arrangement of the cobbles changed significantly in the middle of the site, at a point were there was also a slight change in direction (by 4° towards the east). The northern half consisted of a central panel, 1.25 m wide, of granite cobbles laid laterally across the road line, edged on either side by single rows of longitudinal cobbles, then two strips of large lateral slabs forming a smoother surface along the wheel lines, and with further lateral cobbles forming irregular edging to the road, giving an overall width of 3.8–4 m. The slabs were 0.25 m wide and up to 1.2 m long, all but three of those on the eastern side spanning the whole strip, while in the western strip pairs of shorter slabs (sometimes three slabs) spanned the strip. The southern part of the road, consistently 3.8 m wide, comprised only cobbles, all laid laterally apart from single rows of longitudinal cobbles at the edges. The road surface featured a consistently slight camber averaging *c.* 0.05 m.

A narrow cut (76), one cobble width, had been made through the road surface for a metal drainage pipe, aligned approximately on the drain (461 above) at the south end of the pavement. Further to south there were two square post-holes (91 and 100), *c.* 0.2 m square and 0.2 m deep, spaced 3.2 m apart, immediately inside the eastern edging cobbles; they are of uncertain function.

Tumbling Bay Stream

Above the fill (280) of the steep-sided slot in the base of Tumbling Bay Stream (Fig. 6.7) there was a sequence of water lain and dumped deposits, indicating its gradual infilling in the early 20th century, with fill 79 (*c.* 0.3 m above the base), for example, containing pottery dated to after 1928. A layer of brick rubble (95) may have been deliberately laid down to consolidate the east bank of the stream, with a sheet of corrugated iron sheet (390) possibly forming an *ad hoc* revetment, or possibly just dumped waste.

Other Infrastructure, Industrial and Commercial Features

The scale of the excavation at Temple Mills was matched at few other locations within the Olympic Park, and most of the other archaeological evidence relating to the industrial development of the site comprises individual and often isolated features. While the industrial premises on which they were located can be determined from the map evidence (discussed more fully above), such as those covering Trench 9, the functions of many of these features (the rest of which are summarised in Table 6.1) are often unknown.

Trench 9

The sequence of late 19th and 20th century industrial activities in the area of Trench 9, between Carpenter's Road and Waterworks River, left many features that cut through earlier archaeological deposits, including drains, pits and building foundations, most of which were only recorded incidentally as areas of truncation, although a number of features were examined more closely, although not fully excavated (Fig. 6.37).

A group of five adjacent features lay on the southern edge of the trench. The most easterly, feature 2183, was a *c.* 1.8 m diameter cut containing an oval wooden lining, possibly a cask whose shape had become distorted. Oval feature (2192), which measured *c.* 1.5 m by 1.9 m, had a small square brick structure in its north-east quadrant. Sub-rectangular feature 2184, which measured 2.5 m by 1.9 m, had a *c.* 1.7 m diameter wooden lining, again possibly a cask; a second, smaller lining or cask had subsequently been inserted into the larger one. Rectangular feature 2185, which measured 0.9 m by 1.1 m, had a 0.9 m diameter wooden lining or cask. With the exception of the inner lining of feature 2184, which

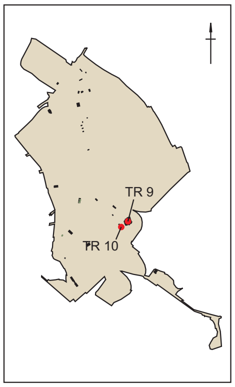


Figure 6.37:
Trench 9: modern features

was filled with clean redeposited clay, all three features had loose dark fills containing fragments of metal, wood and CBM of modern date. To their west was a rectangular concrete tank (2186), measuring 5 m north-east–south-west by 2.1 m, also with a similar fill, from the south end of which was a drain discharging south beyond the edge of the excavation.

A group of three further features lay *c.* 20 m to the north near the centre of the site. Feature 2213 was a 1.4 m diameter brick-lined structure with no visible construction cut, but with a 0.26 m thick layer of concrete adhering to its outer face on the south side. The lining was two brick widths wide. Its loose soil fill contained modern fragments of metal and wood as well as ceramic building material. Feature 2214, which was roughly circular and up to 2.5 m wide, contained a 1.6 m diameter wooden lining/cask, immediately inside of which was a lining of a single row of yellow bricks, presumable a repair to the structure. Sub-rectangular feature 2215, which measure 1.3 m by 1.5 m, also contained a timber lining/cask. The loose fills of these features contain similar materials to that found in the southern group. A further, similar timber-lined feature (2249), lay towards the east of the site.

The 1869 OS map shows the south-west corner of Trench 9 falling within the boundary of Photogenic Gas Works, comprising two groups of buildings and a Gasometer, accessed from the south-east by Warton Road (Fig. 6.12). The gas works occupied one of a number of newly defined plots of

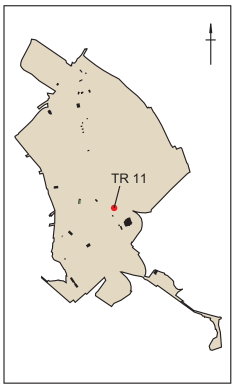
Table 6.1: Other industrial features (continued below)

Trench	Features/contexts	Finds/dating	Description	Map evidence
10 (Fig. 6.37)	Brick-lined well 127	–	1.5 m diameter cut (129); circle of red bricks (230 x 108 x 70 mm) laid on bed; *c.* 1.2 m in internal diam., with 10 mm thick wooden lining of either cask or timber shuttering (128). Only excavated to 0.5 m depth	1869 Photogenic Gas Works 1896 Lea Valley Distillery 1915 Hydrogen Works 1948 Kensington Works (Potted Meat)
	Brick culvert 132	–	Rectangular, *c.* 1.2 x 1.6 m externally with walls 0.25–0.3 m thick. Not excavated	
	Feature 125	–	Circular *c.* 1.8 m diam., 0.14 m deep	
11 (Fig. 6.38)	Pits 42 & 44	–	2 pits at west *c.* 0.6 m & 0.4m in diam. & 0.1 m deep; single fills	1869 undeveloped 1896 Engineering Works 1915 Engineering Works 1948 Engineering Works
	Pits 46, 48 & 50	Pit 46: 19th century glass (+ residual post-medieval pottery)	NW–SE line of three pits *c.* 1.1 m in diameter & up to 0.3 m deep; single fills	
	Layer 34	Oyster shells, brick	Levelling layer sealing pits 42–50; cut by pits 36, 38 and 40	
	Pits 36, 38 & 40	19th century pottery, glass, clay tobacco pipe, button, toothbrush head	NE–SW line of 3 pits, *c.* 0.8–1.4 m diam., <0.2 m deep; sides of pit 40 coated in tar-like substance; sealed by modern deposits	
19	Layer 3010	Pottery, clay tobacco pipe & CBM (none dated)	Alluvium cut by feature 3023	1869 Brick Field 1896 Varnish Works 1915 Goswell Works (Oil, Enamel & Varnish) 1948 Goswell Works (Paint, Enamel & Varnish)
	Feature 3023	Pottery, clay tobacco pipe, CBM & deep, concrete frags	Sub-rectangular, *c.* 4 x 5.5 m, 1.1 m near-vertical sides, flat base; 3 gravelly fills	
	Layers 3009, 3008, 3007, 3006	CBM, glass, oyster shell, wood	Dumped layers, together over 1.1 m thick, overlying feature 3023, capped by concrete	
	Feature 3030	–	Modern feature, *c.* 3.4 x 3.9 m, excavated to depth of *c.* 0.8 m, cut through concrete capping; fill cut by 3032	
	Pipe trench 3032	–	1.2 m wide and 0.44 m deep	
	Wall 3034	–	E–W wall of red & yellow brick in 'variation' English bond, bonded with mortar; up to 0.4 m high	
	Basement walls 3027 & 3028	–	At N end of trench, space between them filled with rubble & overlain with concrete bed for floor 3000	
	Tiled floor 3000	–	Floor of brownish-red ceramic tiles, 150 mm square, 10 mm thick, ornate frog on underside in shape of flower	
44	Ditch 1029	Horse bones	NNW–SSE ditch *c.* 2.3 x <0.55 m deep; 10 bones from 5 small ponies (or donkeys) recovered from basal fill (1030), poss. from adjacent bone works; 1874 trade directory listing for *'Seabourne George, bone boiler, Marsh Gate Lane'*	1869 field drainage ditch 1896 ditch adjacent to Bone Works 1915 undeveloped 1948 NE boundary of Bone Works
71	Pits 4, 6, 8, 10, 39, 51, 63, 77 and 79	Bakelite frag., clinker, iron, pottery, glass, industrial/commercial waste	Series of large, sub-rectangular pits (visible mainly in section) cut, at different levels, into modern made-ground deposits. Bakelite (invented in 1907) from pit 8, early in sequence, indicates 20th century date. Two late pits suggested as dug to recover old stoneware jars or glass bottles for resale as collectable items (Sargent and Corcoran 2008, 21)	1869 field drainage ditch 1896 field drainage ditch 1915 Recreation Ground 1948 Recreation Ground
59 (Fig. 5.14)	Brick-lined well 2002	–	1.9 m diam. construction cut lined with yellow silty clay (2006) then unmortared, randomly coursed, reused, shallow-frogged orange bricks (2000). Well 1.2 m internal diam., excavated to 1.3 m depth. Loose silt fill (2001) contained 19th century pottery, CBM, animal bone, & remains of 2 wooden casks (2003) – poss. randomly discarded or stacked to form timber shaft to protect wooden pump shaft, cf. Holland Street, Southwark (MoL code HLS07)	1869 Nobshill Mill (Corn) 1896 Knobshill Cottage 1915 Knobshill Cottage 1948 undeveloped

cont.

Table 6.1: Other industrial features (continued above)

Trench	Features/contexts	Finds/dating	Description	Map evidence
40	Ditch 404	Brick	NNW–SSE ditch cutting made ground; 2 m wide, at least 1.5 m deep; steep sides, flat base; 2 fills containing brick (lower) & demolition rubble (upper)	1869 parallel to intake channel for Old Ford 'Compensation' (settling) reservoir 1896 undeveloped 1915 undeveloped 1950 Salt Depot
	Fence posts 408–413	–	6 machine-cut posts driven into made ground along W side of ditch, spaced *c.* 1.9–2.3 m apart, with two single posts towards S & 2 pairs towards N	
118	Brick-lined drain 513	Pottery, clay tobacco pipe, pantile and brick	Drain *c.* 8 m long and 0.45 m wide, aligned NNE–SSW, in cut 514 & series of pier bases observed, along with 2 rubbish pits	1746 & all later maps – at rear of buildings on S side of Stratford High Street
	Brick pier bases 527–529	–	NNE–SSW line of 3, at 3.1 m intervals, each *c.* 0.3 x 0.5 m	
	Brick-lined pits 511 & 521	–	Probably soak-aways	
	Rubbish pits 513 & 516	Pottery, clay tobacco pipe		



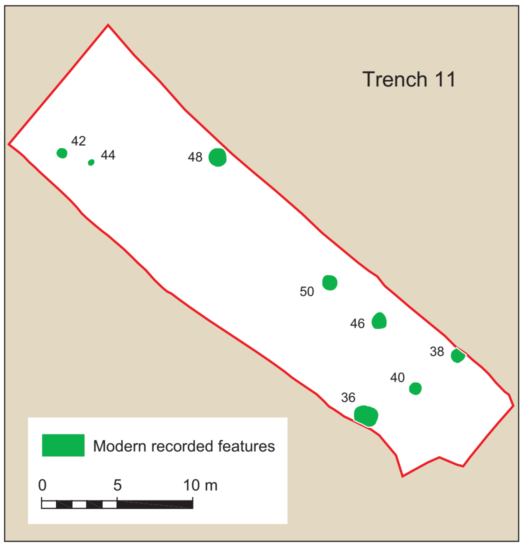


Figure 6.38: Trench 11: modern features

land that cut across some of the earlier drainage ditch, such as sinuous ditch 1007/1011 (see Chapter 4), which was backfilled at this time with black soil containing 19th century pottery and CBM. By 1896, the gas works had been replaced by extensive buildings of the Lea Valley Distillery which covered much of the area of the trench, bounded to the east by Carpenter's Road, and to the south by Warton Road. To the south-west were the Victoria Oil and Candle Works and Varnish Works, while to the north-west were Lea Bank Soap and Candle Works (Fig. 6.13). By 1915 the distillery had been replaced by Kensington Works (Potted Meat) and Hydrogen Works (the latter site occupied by the Goswell Works (Paint Enamel & Varnish) by the middle of the century).

To which phase(s) of industrial activity on the site the features described above belonged cannot be determined, although it is notable that they do not share the north-east–south-west orientation of the areas of modern truncation (Fig. 6.37) which reflect the predominant orientation of the distillery and later buildings. All of the features lie within the apparently undeveloped parcel of land shown on the 1869 OS map to the north and east of the gas works, although they also lie, on the 1896 and later maps, largely within a triangular courtyard, accessed from Warton Road, and surrounded by the industrial buildings (eg, Fig. 6.12). This perhaps accounts for their location, and their survival.

Other trenches

Other industrial features are shown in Table 6.1.

Infrastructure and Industry 1920–1960

Pre-World War II Infrastructure

The rapid infrastructural and industrial development of the late 19th century continued into the early decades of the 20th century. By the 1920s the Back Rivers were showing the strain of over-use and industrialisation. Pollution resulting from the disposal of industrial effluent and sewage was endemic, and flooding, a reminder of the marshland origin, was also becoming increasingly problematic. A dramatic reassessment of the core function

Plate 6.22: 1930 flood relief developments on the Waterworks, City Mill and Three Mills Wall Rivers

and operation of the infrastructure was required to ensure stable industrial growth.

The waterways

Pudding Mill Lock (BHA 31), a tidal gate on the River Lea just upstream of the head of Pudding Mill River (Fig. 6.3) was built between 1922 and 1928, the photographic survey recording a structure built of stone, blue brick and steel. This was contemporary with works to narrow the river bank and the provision of a new towpath.

Following an inundation in 1928, the 1930 *Flood Relief Act* enabled the Lea Conservancy Board to undertake work to improve drainage, and navigation of the river system, and between 1931 and 1935 significant improvements to the waterways were made, including new locks built to manage flooding. Marshgate Lane Lock (BHA 34) was built between the southern ends of City Mill and Waterworks Rivers, and Carpenter's Lock (BHA 27), originally known as Wards Lock, on the River Lea between the heads of Waterworks and City Mill Rivers, was rebuilt; this made the tidal gate at Pudding Mill Lock, just downstream, redundant (Fig. 6.3). Marshgate Lane Lock and Carpenter's Lock both incorporated a pair of double vertical radial gates built for flood defence.

Other notable works following the 1930 Act involved the realignment of the southern ends of City Mill, Waterworks and Pudding Mill Rivers to create a more navigable path around the industrial premises flanking Marshgate Lane (Pl. 6.22). In addition, extensive stretches of the bank of the River Lea south of Old Ford Lock were rebuilt.

The banks of the Hackney Cut Navigation were also opened up by Clarnico (who occupied premises to either side of the waterway) when a wharf was created at the Kings Yard site (BHA 5).

These changes to the waterways and their associated structures took advantage of innovations in technology and building materials and these are reflected in the recorded structures. The design of the footbridge over the north end of City Mill River (BHA 29), for example, has a complex steel structure, comprising riveted steel components forming a gracefully curved central section defined by lattice girders, which can be dated typologically to the early part of the 20th century.

The railways

With the waterways straining under rising demand, pollution and limited finance for expansion, attention continued to shift to road and rail haulage. Under the *Railway Act of 1921*, the GER became part of the London and North Eastern Railway (LNER), resulting in a new phase of railway investment. During the 1920s, the railway bridges over Waterworks River and Warton Road (BHA 24), and Carpenter's Road (BHA 37) were rebuilt, and the full length of the main line across the valley was widened in 1923, and again in 1936.

Plate 6.23: The widening of the GER bridge over City Mill River (BHA 36)

These developments are clearly reflected in the form and fabric of the bridge over the River Lea, the Stratford Viaduct, and the bridges over Pudding Mill Lane and City Mill River. For example, the successive widening southwards of the railway line is shown very clearly in the western abutment of the bridge over City Mill River (BHA 36) (Pl. 6.23). The elliptical brick arch of the original northern part of the bridge (seen on the right) is clearly abutted by two later phases of bridge comprising lateral brick abutments spanned by a grid of robust riveted steel plate girders carrying the bridge deck. The straight joint between the two phases of brick abutment is clear as are riveted plate connections between the two phases of girders.

Trench 50

The only archaeological feature potentially related to the railways was a concrete foundation, 17.5 m wide north-west–south-east recorded in Trench 50, the location of which matches that of a small square building shown on the 1965–8 OS map (but gone by 1970) in an isolated position between the River Lea and the railway lines, and probably associated with Bow Goods Station.

Recreational facilities

As the industrial workforce swelled the local population, so areas of the local landscape were deliberately set aside for recreational and amenity purposes, including extensive allotments and sporting facilities. This was particularly the case in the less developed open areas towards the north of the Olympic Park site, where Hackney Marsh had been acquired by London County Council as an open space in 1893. In 1938 a sports pavilion was built just north-west of Temple Mills, thanks to a £10,000 grant made from the Manor Charitable Trust for the improvement of amenities on Hackney Marsh. The original pavilion was severely damaged during World War II and was entirely rebuilt in 1953 (BHA 21) to the original plans, with the addition of shower and lavatory facilities, an electricity supply, and an additional block of three dressing rooms.

The 1915 OS map shows a football ground on the north side of Temple Mills Lane which belonged to a local public house, probably the *White Hart* immediately opposite. In the early 1930s, the football ground became the site of the running track of the more extensive Eton Manor Sports Ground, which, during its life, also had football, rugby and cricket pitches; tennis, squash and netball courts; and a bowling green.

Nine evaluation trenches were excavated within the area occupied by Eton Manor Sports Ground. Although a number of features and deposits were recorded in these trenches, none can be definitively related to the site's sporting use, although possible buried turf lines, 236 and 167, recorded in Trenches 99 and 100, respectively, both of which lay inside the circuit of the running track, may well date from this period of use. Damage to the track, caused by the huts of a wartime army camp, led to the redundant track surface from the London 1948 Olympic Games track at Wembley being lifted and re-laid here (Lewis 2010).

A number of other features were recorded in the trenches at the Sports Ground, such as a large shallow hollow (198) of uncertain function, *c.* 3.3 m wide and 0.2 m deep with gently sloping side and a concave base, in Trench 97. In Trench 103, two large quarry pits (97 and 98), both *c.* 0.55 m deep with steep sides and flat bases, were recorded cutting the natural gravel. They were sealed by layers of sandy silt and clay up to 0.6 m thick into which was cut a ditch (95), at least 2.5 m wide and almost 1 m deep, aligned approximately ENE–WSW, whose secondary fills contained 19th century pottery, bone, and glass and metal sheets.

In Trench 107, a curved construction cut (67), *c.* 1.1 m wide and 0.55 m deep with vertical sides and a flat base, contained a modern reinforced concrete foundation (39). This filled the base of the cut to a depth of up to *c.* 0.15 m, above which it narrowed to a 'wall' *c.* 0.3 m wide, around which the cut had been backfilled with gravelly clay containing CBM fragments. Although the use of reinforced concrete suggests a 20th century date, the feature is of uncertain function. It was located close to a post-medieval boundary ditch, as well to the Sports Ground's tennis courts and bowling green.

Pre-World War II Industry

Due to the relatively poor coverage of the pre-World War II OS mapping, the third period of industrial development in West Ham (*VCH* 1973), was not included in the land-use analysis. As a result, the spread and mix of industry immediately before the war has not been clearly identified. However, documentary sources relating to a number of premises, and stylistic details of certain buildings provide some information about developments during this period.

While small numbers of new firms continued to be established in West Ham in the pre-war period, evidence from the Olympic Park area points more to the consolidation and enlargement of existing premises, such as at the Marshgate Works of T.H. Harris (BHA 4), the Engineering Works of S.H. Johnson (BHA 22), and Yardley (BHA 23).

Plate 6.24: 1934 photograph of tallow melting building at T.H. Harris (BHA 4)

Industrial shed and adjacent building, Marshgate Works (BHA 4)

In 1873 T.H. Harris & Sons, Soap Manufacturer and Tallow Melter, established their Marshgate Works (later the Marshgate Centre) on a triangular site between Pudding Mill and City Mill Rivers, north of the oblique line of the Northern Outfall Sewer (Fig. 6.13). The surviving buildings of this largely redeveloped site, comprised a conjoined group of three structures – a large monitor-roofed industrial shed with single 'aisle' along the river frontage (Building 1); a three-bay north-light building (Building 2); and a three-bay gable-roofed building to its north (not recorded).

A photograph dating to 1934 (Pl. 6.24), of the river frontage of Building 1, gives a good impression not only of its structure, but also of the likely processes taking place within it, as evidenced by the line of huge ventilation ducts along its ridge and the series of flues beneath the upper roof. The building housed one of the primary functions of the works – tallow melting, which is known to have been carried out by the steam method. The 11-bay interior of the main body of the shed provided a tall single volume, served by a travelling crane on robust rails with braced support.

From the City Mill River frontage it appears that natural light within Building 1 may have been extremely limited, although it is possible that the vertical plane on the west side may have been glazed. Ventilation appears to have been a greater imperative, and it is likely that this works complex contributed more than its fair share to the reputation of the area as 'stinky Stratford'. Soap boiling and tallow melting were two of the processes specifically defined as 'noxious' in the 1844 *Metropolitan Buildings Act*. The 1915 OS map shows the location of a riverside crane (Fig. 6.15), as does the 1934 photograph (Pl. 6.24), providing clear evidence that, as well as having road access via Marshgate Lane, these works also utilised river transport for either raw materials, export of products, or both.

To the west, Building 2 appears to have replaced two lower, monitor-roofed buildings (shown on a pair of 1934 photographs) set perpendicular to Building 1, which together created the footprint shown on the 1896 map. The style of the fenestration of Building 2 suggests that it may have been constructed soon after the photographs were taken, and it appears to have had an office and/or storage function, rather than a manufacturing one.

Plate 6.25: Art Deco detailing of the stairwell in the new Yardley building (BHA 23)

Yardley's 1930s expansion (BHA 23)

The 1930s expansion of the Yardley soap and perfume works was made necessary by a doubling of turnover at the factory resulting from the removal of 'spirit' duty which had been charged on lavender until 1932. Yardley took over the engineering works and tallow works sites to its south-east, and constructed a large new four- and five-storey factory (Building Y3) (Fig. 6.31). Two additional bays were added to the east end of frontage Building Y5 to create a new, more central vehicular entrance to the enlarged premises, and the former carriageway was glazed in.

This building is representative of an entirely new aesthetic in the industrial buildings of the Olympic Park area. It marks a clear move away from the robust, turn-of-the-century industrial aesthetic still being utilised at Clarnico's Kings Yard premises, and in the original soap works buildings of the first decade of the 20th century, to one in which the structural frame is clearly expressed, and the non-load-bearing character of the wall plane is visually demonstrated by the use of large areas of glazing (Fig. 6.32, Pl. 6.19). The architectural detailing of the building demonstrates a range of influences, from the rather curious Edwardian-style 'half-timbering' of the two shallow gables on the north front (Fig. 6.32), to the fashionably Art Deco detailing of the stairwell at the north-east corner (Pl. 6.25).

The plan-form of the building also demonstrated a move away from the concept of detached linear buildings, individually juxtaposed on a factory site, and connects four ranges of building around an internal linear light-well, glazed in at ground floor level. This plan form provides for a range of functions within a single building, with clear circulation zones situated at the four corners, and internal links to the north and south ends of Building Y4 to the west. The structure of the building was essentially a steel-frame with concrete floor slabs and down-stand concrete beams incorporating

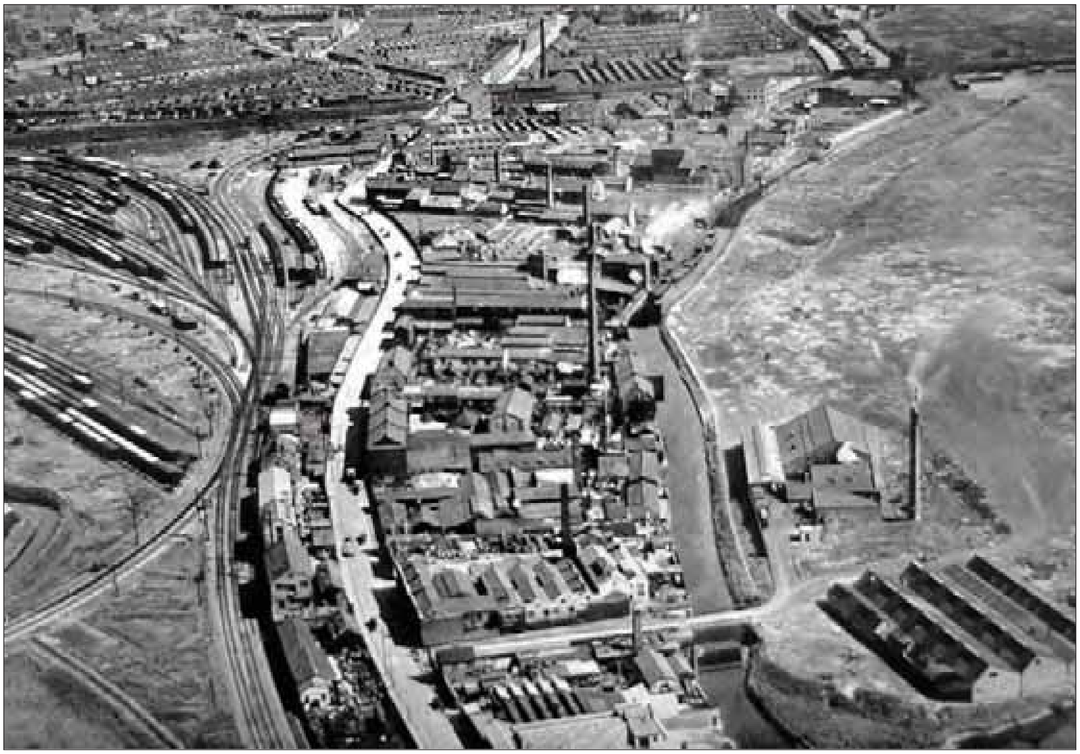


Plate 6.26: 1930s aerial photograph of the Carpenter's Road area, viewed from the north-west

riveted steel girders. This structural system allowed the provision of a high level of natural light to the interiors along both sides of the main east and west ranges. It appears that all three of the central wide bays on the Carpenter's Road frontage originally provided vehicle access to the building, but that they had been blocked in two phases, with the central bay remaining open longest. Pedestrian access to the building would have been via the narrow bay at the north-west corner, or directly to the upper floors via the stairwell entrance at the north-east.

An aerial photograph dating to the 1930s which looks south-eastwards down Carpenter's Road, clearly shows the extent and nature of industrial development of this part of the Olympic Park at this time (Pl. 6.26). The industrial premises are tightly packed, and occupy every bit of land between Waterworks River and Carpenter's Road. Yet the large area of open ground to the west of the river remains largely undeveloped, except at its very northern end where an early 20th century bridge finally provided access across the river. This allowed the construction of a match works, and a fish meal factory, both of which had been earlier defined as anti-social industries.

Gliksten's Timber Yard (BHA 6)

The timber industry was one that relied heavily on water transport to move its high volume and heavy materials. The lower Lea Valley was therefore an obvious place to locate to in the early 20th century, with large vacant plots of land, and numerous navigable waterways. J. Gliksten & Sons Ltd was one of the firms to take advantage of this potential, moving to its Carpenter's Road location sometime between 1905 and 1911 (BHA 6). It occupied the large triangular site between the River Lea and the Hackney Cut, previously occupied by the ELWC compensation reservoir. Their yard was accessed from the south side of Carpenter's Road, not far to the east of Clarnico's recently established Kings Yard works on the north side of the road. These developments marked the eastward expansion of the industrial area of Hackney Wick made possible by the upgrading of White Post Lane Bridge over the Hackney Cut.

Plate 6.27:
Interior view of Brundle's warehouse (BHA 6)

Brundle's Warehouse

At the time of survey, little of the once extensive timber yard survived, and only a single shed, later known as Brundle's Warehouse, was considered worth recording (Pl. 6.27). The former extent of the timber yards and the scale of their activity are clearly visible in the foreground of a 1921 aerial photograph of the area (Pl. 6.12), which appears to show a considerable number of Belfast truss-roofed sheds; these were also used, but to a more limited extent, at Clarnico's Kings Yard to the north (see above). Unfortunately, the recorded shed was not one of the early Belfast truss-roofed sheds shown on the aerial photograph, but a later building of less notable form.

What was notable about the building, however, was the materials used in its construction. Elsewhere in the study area, the 1920s and 1930s saw the increased use of large open sheds of frame construction with lightweight cladding, providing a quick and economical structure with large volume enclosure. However, a number of timber yard fires in London between 1912 and 1921, and a serious fire in a Hartlepool yard in 1922, led to the passing of the 1930 *Building Act*. An Advisory Committee in 1932 stated that no new timber yards should be allowed except under licence from the local authorities, who would have the power to inspect and make regulations with regard to local conditions. The principal regulations imposed were the use of dividing walls to sub-divide the yard into smaller units, the creation of alleys between the stacks of timber to allow access for the fire brigade, and the provision of pumps near water sources.

The first regulation would provide a reason for the robust brick walling of the recorded shed, which, with the use of blue bull-nosed brick quoins, gives the walling a much earlier appearance than its early 1930s date of construction. These masonry walls divided the three-bay shed into a single and a double-bay unit, with intermediary structure provided by a line of lattice braced steel stanchions (Pl. 6.27). The three bays were roofed with lightweight steel Fink trusses, more in keeping with the date of construction. The building was noted on a 1945 site plan as comprising a sawmill in the central bay, with warehousing in the bays to either side. All three bays were served by internal overhead travelling cranes. Where running along the masonry walls, the crane rails were supported on offset brick piers, corbelled out at the top. Along the steel framed boundary between the central and eastern bays, the crane rails affixed the top of the stanchions, which also supported the valley of the trusses on additional vertical members.

Tipping wharves

A more interesting feature of the Gliksten's site, however, was the tipping wharves along the bank of the Hackney Cut. These represent the relatively rare survival within the area of features relating to the once important use of the waterways for the transport of materials and goods. Elsewhere in the area, the later removal of riverside cranes and associated features, once road transport had superseded water transport, left most industrial sites with no visible relationship to their waterside frontage.

Plate 6.28: Tipping Wharf 1 with crane rails and concrete buffers (BHA 6)

Although three raised features were recorded along the Hackney Cut towpath, only two of them were securely identified as tipping wharves, as the third had no evidence of the travelling crane rails which would have been an integral feature. This is certainly supported by the 1950 OS map evidence (Fig. 6.16) which clearly shows two sets of travelling crane rails running from east to west across the site, from north and south of the recorded shed, and the overhead conveyors which connected them to it. Further to the north, overhead conveyors appear to have been used to load barges on the canal direct from the adjacent building.

The two tipping wharves at the western ends of the crane tracks appear to have been constructed in the 1920s–30s, apparently in association with the recorded shed. They comprised a raised section of towpath (presumably to raise the ground level to that of the adjacent timber yard), surfaced with granite setts, to either side of a pair of rails, terminated by small concrete buffers (Pl. 6.28). The shallow ramps up to either side of the wharves were also constructed of setts with raised kickers for traction. Large volume loads of timber could easily be loaded or unloaded to and from moored barges by the large travelling cranes.

Discussion

The pre-WWII industrial buildings recorded within the Olympic Park site fall largely into three main types: the multi-storey brick building, lit by regularly placed windows, and served by multi-storey loading bays with external hoists; the large, top-lit, single volume shed, often steel-framed, and nearly always served by an internal overhead travelling crane; and the 20th century framed multi-storey factory. Despite having functions as dissimilar as the production of printing ink, soap and candied fruit, the turn-of-the-century buildings of the Clarnico works (BHA 5), Yardley (BHA 23), Unit 1 of the Vanguard Estate (BHA 14, Marshgate Mills) and the complex on Marshgate Lane (BHA 4, Marshgate Works) are very similar both in terms of form, scale and massing, and also stylistically.

This demonstrates that the buildings required by these completely different industries were determined much more by the scale of their manufacturing function than on what was actually being produced. Even the multi-storey brick buildings with relatively modest floor to ceiling heights served many different manufacturing processes; what was crucial was that the internal spaces were uninterrupted in plan (apart from an essential line of structural columns or two). At a time when many of the industrial and manufacturing processes were labour-intensive, the buildings within which they were undertaken were appropriately humanly-scaled. Where larger-scale manufacturing or assembly processes needed to be accommodated, the single volume shed provided a suitable alternative.

World War II

World War Two had a devastating effect on the area. German air raids targeted both the docks to the south, and the industrial heartland of east London, with drastic lateral impact on the intervening residential areas. Bomb damage records list a number of incidents within the Olympic Park, some of which had a direct impact on recorded BH Assets including the Old Ford Lock (BHA 30) and Lock Houses (BHA 33), Clarnico's

Plate 6.29:
World War II Defences showing gun emplacement, Building 4, nissen huts, Buildings 15 and 16 and part demolished service road looking south (BHA 19)

(BHA 5), Gliksten's timber yard (BHA 6) and various premises on Marshgate Lane, including BHAs 9-15.

Defence structures

However, the area was also able to play a significant role in the defence of this part of east London. The still vacant areas of Hackney Marsh to the north provided an ideal location for the siting of an anti-aircraft installation (BHA 19) on a strip of land between the River Lea and the Waterworks River (later part of Manor Garden Allotments), immediately to the south-west of Temple Mills (Figs 6.3, 6.39). In addition, a pillbox and associated tank blocks (BHA 20) were recorded to the south, on the Greenway where it crosses the River Lea near Old Ford Locks.

The defence structures near Temple Mills (BHA 19) included a Heavy Anti-Aircraft (HAA) battery (assigned the code ZE21 by AA Command), a radar station and associated buildings and structures (Buildings 1–10 and 13–18) (Fig. 6.39; Pls 6.29–30). The recorded structures at the HAA battery, built shortly before the outbreak of the war, comprised three gun emplacements (Buildings 1, 4 and 14), a magazine (Building 2), a cordite store with blast walls (Building 3), a possible Bofor gun emplacement and a command post (Building 17). To the south, on the allotment site, buildings were added during the war, including a radar station (Building 10); associated pillboxes (Buildings 6–8); and a storage compound (Building 9). All the features and principal buildings were of uniform construction, made of reinforced poured concrete.

The site was accessed from the north by a concrete track, running from Temple Mills Lane just west of the *White Hart* public house, and meandering between a small complex of structures which probably included sleeping huts, cook house, ablutions block and latrines etc. The map indicates that the site was enclosed by a security fence.

The layout of the HAA battery (visible on an aerial photograph of 1946, although overlain by later storage buildings, Pl. 6.30) was of a typical four-gun emplacement, conforming to a standard pattern estab-lished before the war. It consisted of four octagonal gun emplacements placed around an oval concrete road loop – one to the south, two to the east and one to the north – with a branch of the road leading to

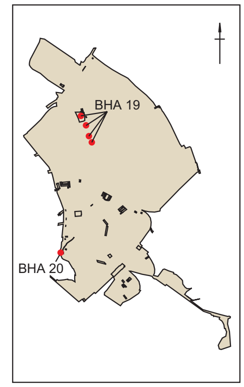


Figure 6.39: Anti-aircraft battery, Manor Garden Allotments (BHA 19) with inset showing location of associated structures

Plate 6.30:
Aerial view of the gun emplacement taken by the RAF on 2nd April 1946 showing the development of the area (BHA 19)

the command post within the loop. The command post was set at an angle due to the narrow confines of the site between the two rivers. The main magazines were located between the two east-facing guns and, although not unusual, their position can be considered risky in the event either of an accident or direct hit.

Each octagonal gun pit had six magazine lockers, three either side of the gun's main access point which ran out directly from the loop road. This enabled gun carriages or lorries to enter the centre area of each gun pit so that the gun could be lifted into position and the vehicle carrying the gun could exit the gun pit by driving straight through. Protection for each gun pit was provided by earthen embankments to the exterior. There are no other features relating to the main gun emplacement shown on the map outside the perimeter fence. As with other early gun emplacements there do not appear to have been any gun crew shelters built near the guns, and the on-duty crew would have had to brave the elements.

Buildings 2 and 3 have been identified as the magazine and cordite store but a more accurate description would be shell store. The 3.7 inch anti-aircraft gun used a fixed one-piece projectile which produced a spent cartridge shell after firing so a cordite or propellant store was not necessary. Therefore Building 3 may have been used as a spent cartridge store or other use.

In 1946 the gun emplacement site became a depot for the Ministry of Supply, which had been created in August 1939 (Pl. 6.30). In 1954, the site became a Civil Defence training ground, and it ran as such until its closure in 1968. The Civil Defence was set up to assist in emergencies relating to future wars, specifically nuclear attack. The site was used for practical training and exercises in connection with rescue, field cable, first aid, ambulance service and N.H. Service Reserve, emergency feeding, Industrial Civil Defence Service units and control and communications (London Boroughs Association General Purpose Committee HO 322/546).

War memorials

Two World War II memorials (BHA 8) were subsequently set within the sandstone boundary wall at Eton Manor Sports Ground, on the north side of Temple Mills Lane, in which military huts had been built during the war. Given the local significance of the war memorials, they were put in storage to keep them safe during construction of the Olympic Park, and are due to be reinstalled at Eton Manor after the Games.

The impact of the war

During the war, the area faced the challenge of continuing production against a background of constant threat. Because both industry and large-scale infrastructural features were common targets, Stratford was an enticing lure for bombers *en route* or returning from the air raids on the City. The County Borough of West Ham Civil Defence World War II Bomb Damage Map shows a high density of impacts across the borough. A more detailed record of the level of damage suffered by buildings on the extreme west side of the Olympic Park is provided by the London County Council Bomb Damage Maps, which show the damage suffered by the two Clarnico factory sites on the east side of the Hackney Cut, and by Gliksten's timber yard to the south.

Among the recorded infrastructure features affected by the bombing raids was the radial lock gate at Carpenter's Lock (BHA 27) which was damaged by a V1 bomb; repairs had to be undertaken to the footbridge piers. The Northern Outfall Sewer (BHA 38) was hit by High Explosive (HE) bombs near Upper Road, Emma Road, Corporation Street, Marshgate Lane (17th September 1940) and Abbey Lane (BHA 42). Old Ford Lock was hit early in the war, following which a new Lock House was built (BHA 33) on the east side of the lock.

Perhaps more important than the damage to factories and infrastructure, large swathes of the surrounding residential areas were also affected. As a result, much of the population had to be re-housed elsewhere, thus reducing the potential workforce for the surviving industries. Those that remained had to adapt to wartime hardship, and Stratford, with its multiple refuse dumps and processing facilities, pioneered food recycling for animal feed.

In the aftermath of the war, the undeveloped areas of the east London marshes were again utilised for the benefit of the metropolis, as vast quantities of demolition rubble deriving from bomb damage in the capital were dumped across the northern half of the Olympic Park area. The extent and depth of this imported material, which in places was up to 10 metres thick, is indicated on Figure 6.14. It was in part the depth of this material which made the archaeological investigation of the Park extremely challenging, even of features as recent as the World War II anti-aircraft installation (BHA 19).

Post-war Industrial Development

The few recorded BH Assets that date to the post-war period largely reflect the stylistic changes taking place in architecture at the time. While some of the firms had to rebuild damaged or demolished buildings out of necessity, others appear to have invested in new buildings as a mark of optimism in the stabilising economy.

Robinson, King and Co. (BHA 13), 7 Pudding Mill Lane

A good example of this optimism is the Robinson, King and Co's new offices and showroom building, constructed in 1952 adjacent to Bow Back River at the southern end of Pudding Mill Lane (BHA 13) (Pl. 6.31). The building presented an overtly modernist elevation, with bold Art Deco detailing to the river frontage and bridge, with a more utilitarian works building to

Plate 6.31: Exterior of Robinson, King and Co's Offices (BHA 13)

Plate 6.32:
Interior of Robinson, King and Co's 1952 works building (BHA 13)

the rear with brick wall planes and continuous concrete lintels giving the long horizontal elevation the emphasis favoured by the modernists. This was further accentuated by the long runs of fenestration also given a horizontal emphasis by the glazing bars. The interiors of the main body of the building, in which the concrete framing was clearly expressed, were extremely plain and functional (Pl. 6.32), although a fireplace was recorded in what was assumed to be a manager's office or boardroom (Dwyer 2008, 16). Concrete had begun to be used in the framing of buildings as early as the 1880s, but its more common period of use in Britain really only began in the 1930s. Although it became the ubiquitous structural system for modest multi-storey commercial buildings in the post-war period, this is the only recorded example of its type in the Olympic Park.

Yardley's further expansion (BHA 23)

Elsewhere, some of the firms which had located to the area in the late 19th or early 20th century continued to extend their premises, most usually through the acquisition of adjacent premises which had become less viable or totally redundant. The 1950s saw the beginning of the trend for successful firms with high volume production to look to move out of the area, to the suburbs of the metropolis and beyond where development land was cheap and freely available, and road transport links were good. One important firm which chose to remain, however, was Yardley which further extended its Carpenter's Road premises (Fig. 6.31).

Although presenting a relatively uniform and coherent frontage to Carpenter's Road, the factory's two easternmost buildings (Buildings Y1 and Y2) are of two different phases of construction (Fig. 6.32). Although both structures were already partially demolished at the time of survey, sufficient fabric survived to illustrate their form, if not their original layout. Building Y2 was the earlier, being shown on the OS map of 1950 as a fully glass-roofed linear shed (Fig. 6.16). The surviving fabric showed it to comprise a number of brick-walled volumes roofed over by a series of tall, lightweight Fink trusses. Building Y1 had been constructed against the east wall of Y2 and displayed a more unusual structural form, with the exception of its traditional brick panel-and-pier curtain walls. The trusses providing both the vertical components and roof structure were of an unusual splayed design with a flat top chord and curved bottom chord connected by a flat plate along the middle section, but with wider lattice sections at either end. Together the two vertical sections, and two roof sections essentially created an early form of portal frame providing a large volume, open to ridge height.

Industrial sheds (BHA 3), City Mill River

The post-war period is also represented by two large warehouse buildings fronting the west bank of City Mill River (BHA 3). The original section of the southern warehouse dated to the early 1950s, and was of standard steel frame construction set into a concrete slab, with Fink roof trusses strengthened with additional king ties. The walls were clad in corrugated metal sheet, as were the roof slopes, though each of these also contained two rows of uniformly-spaced skylights. The warehouse to the north was constructed at some time during the 1960s. Its structure was even simpler than its predecessor, with rolled steel I-sections forming both the verticals and sloping principal rafters of the truss. The angles between members were strengthened with steel plates at eaves and ridge, creating a simple portal frame structure, again clad in corrugated metal sheet, with panels of clear corrugated plastic providing a degree of natural lighting.

Jerome Engineering, 98–100 Carpenter's Road (BHA 22)

Some firms were keen to demonstrate their commercial optimism by the upgrading or re-fronting of their most prominent buildings. This appears to have been the case at Jerome engineering works on Carpenter's Road (BHA 22), where there is evidence that the rather plain pre-existing works buildings were re-fronted to provide a more prominent public frontage, advertising the success of the firm.

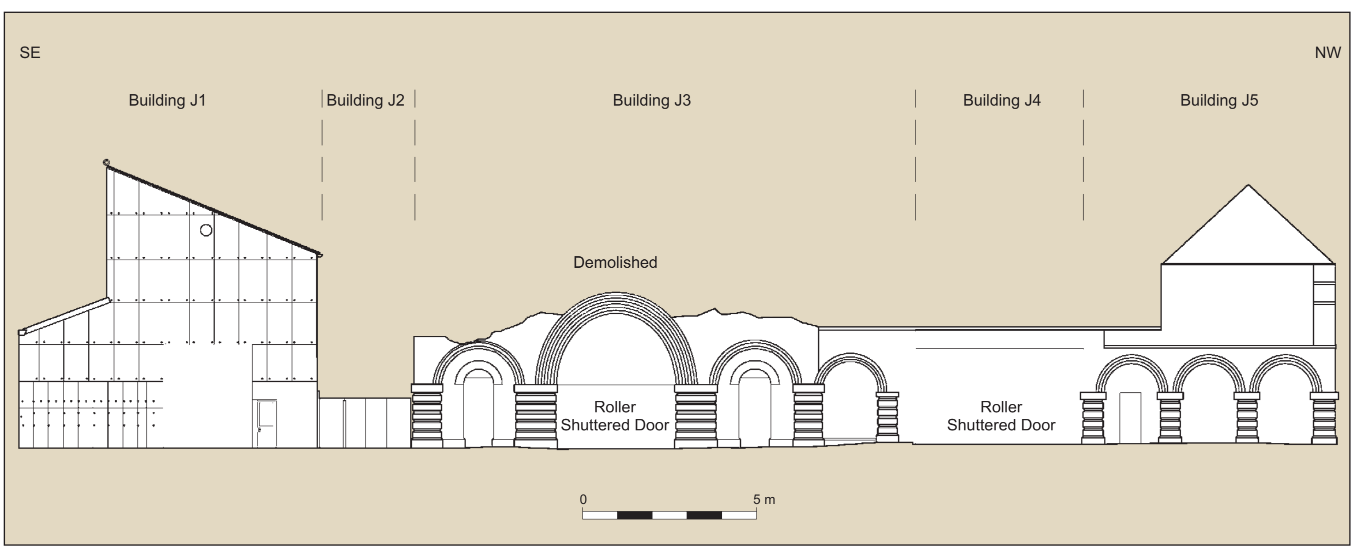
Following the loss of all internal plant and other evidence of individual functions, the most notable feature of the works premises was the relatively elaborate and unusually-styled street elevation to Buildings J3-J5. Quite unlike any other façade in the area, this highly articulated frontage was obviously added to mask and visually connect a disparate group of plain and unexceptional industrial and administrative buildings. This elevation comprised two sequences of blue-brick-framed round-headed arches, springing from rusticated blue brick piers (Fig. 6.40), surmounted by a rendered and painted plane capped by a deeply corbelled blue brick cornice to either side of a segmental arched raised section. It gives more of an impression of a post-war cinema than an engineering premises. Still bearing the name of Johnson-Progress Ltd in raised letters above the southernmost arch, the large roller-shuttered entrance in the centre of Building J3 is surmounted by the name Jerome Engineering Ltd. This is one of the few premises in the study area where the frontage has been given such a highly distinctive, rather than purely pragmatic, treatment.

The later 20th century

An understanding of the later post-war industrial townscape of the study area is provided by a 1969 PhD thesis (Addington 1969) which undertook a detailed analysis of the mix of industry at that date. This point marks the end of the 3rd and final era of industrial development as identified by *VCH*, and provides a convenient snapshot of the study area at the end of a century of industrial development.

Despite the apparent decline in the numbers of chemical firms in the Olympic Park area during the first half of the 20th century, the

Figure 6.40: Carpenter's Road elevation of Jerome Engineering (BHA 22)



1969 statistics demonstrate a considerable resurgence of these works to once again dominate the local industrial scene, representing close to half of all industry in the study area at this date (as opposed to only 30% across the borough as a whole). Timber works were also represented at above the borough average, though to a lesser extent, whereas there had been moderate declines in the engineering, food and textile industries in the previous two decades.

Although the majority of recorded buildings had continued in use until at least this date, there was only one site at which the recorded structures were built here after this date. Demonstrating a more pragmatic approach to the provision of cheap and instant workshop accommodation, three Romney huts (BHA 1) were re-located on adjacent sites on either side of Carpenter's Road, close to the junction of the former GER and the Victoria Park Branch lines between 1989 and 1993. Although this took place some considerable time after the dismantling of the Ministry of Supply depot near Temple Mills, it is tempting to suggest that these three structures may have originally been brought to the study area as storage sheds at the supply depot, and later found to provide useful workshop spaces.

The pattern of ownership and usage of the buildings during the later 20th century demonstrates a trend of sub-division of the larger works complexes into smaller units and therefore a greater range of business types. This was true of the former Brush and Mat works at Marshgate Lane (BHA 9–12) and the former Marshgate Mills site, which became the Vanguard Trading Estate (BHA 14–15). Elsewhere, the premises were converted to non-industrial uses such as at Yardley (BHA 23) where the buildings were acquired by ACME Studios and sub-divided and let out as artists' studios.

The increasing use of containerised shipping to continental ports like Rotterdam, with transfer to road trailers bringing in goods by ferry, led to the rapid collapse of the London docks from the late 1960s. It also led to a reduction in rail freight traffic, despite substantial investment in the Temple Mills marshalling yard in the 1950s. Further investment in the yards in the 1970s, to enable the transfer of containers from the London docks, came too late as the docks were already closing, and the marshalling yard became increasingly redundant. The Stratford railway works closed in 1963 and the Temple Mills wagon works in 1983. All these developments resulted in a sharp fall in local employment.

Conclusion

The century between 1860 and 1960 encompasses the transformation of what at the start of the period was still essentially an agricultural landscape into one that witnessed the growth and then decline of Stratford's industrial heritage. Within this overall process, however, there was in fact wide variation dependent on a range of both local and more general factors. Although the fragmentation of the valley floor by late 18th and early 19th century infrastructure, and additionally at the start of this period by the construction of the Northern Outfall Sewer, had made much of the valley floor increasingly unsuited for agricultural use, a substantial part of the Olympic Park area was still open and undeveloped land as late as 1950.

The medieval crossing of the valley at Stratford remained the decisive factor in determining how and where industry developed. As new forms of fuel replaced water power, access to industry via this major road artery was far more influential in determining its location than the presence of the waterways. Certainly, the river channels provided water needed in some industrial processes, as well as an easy means of waste disposal, causing pollution; moreover, riverside cranes and wharves attest to the potential of the waterways for transporting materials and goods, particularly for high-volume industries such as timber where bulk and weight were an issue. However, for most industry, proximity to the waterways appears to have been a secondary consideration compared to the need for road access.

The industrial infilling of the landscape, quite tentative at first, largely followed the extension of the roads, such as Marshgate Lane, Warton Road and Carpenter's Road, which ran off Stratford High Street. Even the railways, whose junctions, depots, goods yards and sidings, rapidly expanded across large areas of the valley, appear to have had little influence of the disposition of industry – with the obvious exception of the extensive Stratford locomotive works on the east side of the valley.

The character of the industry which developed was also very varied. Stratford has long been burdened with its 'stinky' label, which gives a narrow and inaccurate impression of the types of industries which established themselves there. Certainly, some premises were involved in those smelly and noxious processes no longer permitted in the more built-up areas of London. However, the label ignores the diversity, creativity and innovation that characterised the wider industrial landscape. Moreover, there was a degree of interdependence between many of these 'antisocial' industries and their more acceptable neighbours. It is notable, for example, that Yardley of London, one the world's oldest established perfumery and cosmetics companies, established a new factory next to the Channel Sea Tallow Works – tallow being rendered for many uses, including the manufacture of soap and cosmetics. Food manufacturers, chemical works, engineering companies and many other forms of industry, therefore, invested in the area, drawing in with them workers from all over the country.

The range of recorded industrial structures dating to this period provide an important, albeit partial, insight into the scale and character of the industrial landscape as it had developed during this period, although their selection for recording was more a function of their survival than their particular significance. They have only limited potential, therefore, to clearly illustrate how industrial buildings developed – such as by identifying phases of development; or illustrating the range of buildings required by different industrial processes; or the scale and frequency of alteration and refurbishment required to accommodate either new processes, or completely new industries. Nonetheless, contextual information derived from historic mapping, trade and Post Office directories, and other documentary evidence, has provided significant extra information about the layout, fabric and detail of the selected premises, and their interrelationships with local infrastructure at different times over the 100 year period.

World War II marked another turning point. The area never fully recovered from the heavy damage inflicted on its industry and infrastructure, as well as on the local population and their housing, and after the war large areas of still vacant land were used as rubbish dumps and landfill sites. Although there was a brief period of rebuilding and expansion by a number of companies, the nature of industry in the area, and its building requirements, were changing. The multi-storey brick factories of the late 19th and early 20th centuries were no longer appropriate for modern manufacturing processes, and these only survived where they could be successfully converted into smaller premises. Elsewhere they were demolished and their sites redeveloped with modern industrial units, or they were left to slowly deteriorate, giving the area a run-down and neglected character. It was from this low point that the area has now been again transformed and regenerated, with the construction of the Olympic Park.

Chapter 7

Human Residues: the Finds, Human Bone and Environmental Remains

Introduction

Given the size of the Olympic Park, and the scale of the archaeological fieldwork undertaken within it over a number of years, the actual quantity of artefacts and ecofacts recovered from the project might be considered small. Table 7.1 summarises the overall quantities recovered, broken down by material type (comments on the data from which this table was constructed are given below). The majority of this material derived from just two trenches, one prehistoric (Trench 9) and one post-medieval/modern (Trench 75 at Temple Mills). Across the whole site, remains pre-dating the post-medieval period, in particular those of Romano-British date, were scarce, and the discussion in this section therefore focuses on the later history of the sites in the Park. In this respect the aim is to add to the growing discussion of the material culture of London's recent past (eg, Hicks and Jeffries 2004; Jeffries *et al.* 2008; Owens *et al.* 2010). Many of the artefacts recovered from the Park could be viewed as commonplace,

Table 7.1: Finds totals by trench, by number except where stated (the groups of trenches are based on the Phase 3 evaluation reports)

Trench	Pottery				CBM	CTP	Flint	BF (g)	Glass	Slag (g)	Metal	Leather	Animal bone	Human bone	Wood	Other
	Preh	RB	Med	PM												
26–35	1	–	–	–	–	1	–	–	–	–	–	–	1	–	*	–
20–4	–	–	–	11	–	3	–	1283	–	–	–	–	–	–	*	–
1–3, 5, 6	4	–	–	7	–	–	–	–	–	–	–	–	–	–	*	–
7–19, 25	2612	6	–	30	3	13	154	23442	7	131	2	1	1941	4 in; 1 cr	*	12 fired clay; 1 PM coin; 1 shale bracelet
4, 36–8	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–
39, 46, 47	–	–	–	16	–	–	–	–	2	10	2	1	–	–	*	1 worked bone; 1 PM coin
52–7, 60	23	3	–	113	4	7	–	1	38	–	2	–	9	–	*	1 RB coin
58, 59	116	27	–	74	*	7	–	93	39	551	25	10	10	1 cr	*	1 RB coin; 789 lead shot from boat
43–5	252	–	–	–	6	2	15	2510	–	39	–	–	13	1 cr	–	3 fired clay
40–2, 48–51	–	–	–	–	–	–	–	–	–	–	–	–	–	–	*	–
63–5, 69	–	–	–	6	–	1	–	–	–	–	–	–	–	–	–	–
61, 66, 67, 70	–	–	–	10	–	–	–	–	–	–	–	1	–	–	–	–
71	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
72–4; 92–5	–	–	–	–	*	–	–	–	–	–	–	–	13	–	–	2 fired clay
75	–	–	9	1532	282	935	–	–	495	18094	336	3	209	–	*	14 PM coins; 4 jet beads; 1500+ glass beads; 7 bone objs; 5 stone objs; textile
78, 79	–	7	–	–	–	4	–	–	–	–	–	–	–	–	–	–
80–3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	*	–
76, 77, 116–7	–	–	–	33	–	3	–	–	34	–	–	–	–	–	–	–
96–108	–	–	1	168	–	29	–	–	128	–	11	–	–	–	*	1 PM coin
109–13	–	–	–	–	17	4	–	84	–	–	–	–	–	–	–	–
118, 119	10	–	3	61	20	9	1	308	5	–	2	1	247	–	*	1 PM coin
120, 121	–	–	–	2	–	–	–	–	1	–	–	–	–	–	–	–
114	–	4	–	–	–	–	–	–	–	–	–	–	–	–	*	–
Totals	**3018**	**47**	**13**	**2063**	**333**	**1018**	**170**	**27721**	**749**	**18825**	**380**	**17**	**2443**	**4 in; 3 cr**	**–**	**–**

Key: CTP = clay tobacco pipes; BF = burnt flint; RB = Romano-British; PM = post-medieval; in = inhumation; cr = cremation; * indicates unquantified presence examples of mass-produced commodities found across Britain (and indeed the British Empire and beyond) from the 18th century onwards, but this should not preclude their use in our attempt to explore the lives of the inhabitants of Stratford, at a period which spans the transition from small town to a part of the metropolis.

In terms of the range of material encountered, the most commonly occurring material types were pottery, clay tobacco pipes, animal bone and burnt (unworked) flint. Waterlogged conditions in several of the trenches also resulted in the preservation of a significant quantity of worked timber, mostly of a structural nature. There were smaller quantities of ceramic building material (brick and tile), worked flint, glass, metalwork (including coins), metalworking debris, ceramic objects and daub, and leather.

Finds Recording

All of the finds were quantified, and then scanned, within their original trench assemblages; details of each assemblage were included in the evaluation and/or mitigation report for each trench. At this stage the finds were recorded to a basic level appropriate for initial assessment, ie, pottery ware types, clay pipe bowl types, animal bone species, initial identifications of metalwork and other small finds. Broadly speaking, this was carried out to a consistent level across Park.

This dataset thus formed the basis for the analytical phase; recorded details have been enhanced and/or amended, and quantifications updated, during this phase. It is important to document this process as, although most finds were re-examined during the analytical stage, not all were available for study; those that were not comprise some of the smaller evaluation assemblages (some elements of which were discarded following initial quantification), and the worked timbers, most of which were recorded to an appropriate level on site or immediately afterwards, and then discarded.

Prehistoric Pottery

by Matt Leivers

A total of 3018 sherds of Early Neolithic, Middle and Late Bronze Age and Middle Iron Age pottery weighing 30,446 g was analysed. This pottery was recovered from cut features contemporary with its manufacture, use and discard, and as residual pieces in later prehistoric and historic contexts. The majority of the assemblage came from Trench 9, with only very small quantities of material from other trenches.

Methods of Analysis

The material was analysed in accordance with Wessex Archaeology's recording system (Morris 1994), which follows the nationally recommended guidelines of the Prehistoric Ceramics Research Group (PCRG 2010). Sherds were examined using a x20 binocular microscope to identify clay matrices and added tempers. The dominant inclusion observed provided the letter code for each fabric group and variation amongst sherds of that code determined numerical fabric types. All data have been entered into an Access database.

Condition of sherds was assessed on the basis of the degree to which edges and surfaces were abraded. The condition of the pottery varies: some is in relatively good condition, although sherds frequently display rounded edges as a result of post-deposition abrasion and many surfaces and broken edges are covered with a heavy cream/beige calcareous deposit 'Thames Race', again from post-depositional conditions. A relatively large proportion of the assemblage is in poor condition, characterised by small sherd size and a high degree of abrasion. A small number of sherds have been burnt.

A total of 17 fabric groups was defined, which have not been grouped into chronological periods, since most appear to have been of local manufacture and to cross period boundaries. The breakdown of ceramics by

Table 7.2: Prehistoric pottery fabric totals

Fabric	No. sherds	Weight (g)	ASW (g)
C1	4	59	14.75
F1	781	6944	8.89
F2	77	504	6.55
F3	677	4872	7.20
F4	702	8741	12.45
F5	212	4108	19.38
F6	9	50	5.56
F7	12	64	5.33
F99	59	69	1.17
G1	2	26	13.00
I1	7	38	5.43
QU1	114	1080	9.47
QU2	279	2877	10.31
SH1	13	122	9.38
SH2	14	83	5.93
SH3	43	588	13.67
V1	13	221	17.00
Total	**3,018**	**30,446**	**10.09**

ASW = Average Sherd Weight

fabric group is given in Table 7.2. Fabric descriptions are given in Appendix 4.

Early Neolithic

A sherd from the rim of an Early Neolithic plain open bowl, with a distinctive rolled rim and a poorly-sorted burnt flint temper, was recovered from a gravel horizon (55) on Trench 118. Two other sherds from the same layer derive from two further bowls, both with heavy rolled rims, one tempered with poorly sorted flint, the other with shell (Fig. 7.1, 1–2). This trench also produced a flint axe and *in situ* worked timbers, also of Neolithic date, as well as undated flint debitage, and animal bone.

The rim forms are typical of the Decorated Bowl tradition (what used to be referred to as Mildenhall Ware). Parallels from large assemblages of similar ceramics elsewhere in the Thames valley suggest a currency between the 38th and 35th centuries cal BC (Gibson and Leivers 2008, 245).

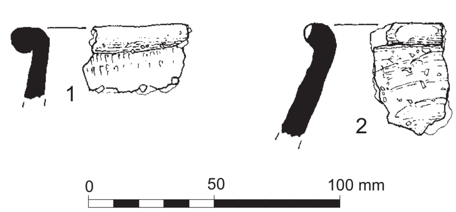


Figure 7.1: Neolithic pottery (nos 1–2)

Middle Bronze Age

Flint-tempered sherds of Middle Bronze Age date derive from two basic vessel types, corresponding to the standard division of Deverel-Rimbury ceramics into coarser Bucket or Barrel-shaped and finer Globular jars. There is no evidence of Deverel-Rimbury ceramics in funerary contexts, and as such these vessels cannot be considered urns.

Fabrics and forms

Thick, coarse vessels are represented, the identifiable sherds of which all come from Bucket-shaped jars. Ellison (1980) distinguishes between large, thick-walled, heavily gritted vessels (heavy duty wares) and smaller, bipartite or oval vessels (everyday wares). Such a division is visible in the assemblage but no attempt has been made to categorise vessels on this basis, given the difficulty of assigning plain body sherds to individual vessels, and the tendency of the two types to merge into each other.

Surfaces can be slipped or smoothed but are most often left rough. Rims are simple or slightly flattened and expanded, and tend to be upright or slightly inturned, although there are rare examples which turn outwards. One vessel has a pre-firing perforation below the rim (Fig. 7.2, 3), another has diagonal impressions on the outer edge of the rim (Fig. 7.2, 4).

Thinner, finer Globular vessels were also identified. These are an uncommon element of Ellison's lower Thames Valley/Kent regional Deverel-Rimbury group, although more numerous examples are now known from excavations on settlement sites in the London region (Brown and Cotton 2000, 87).

Surfaces are generally well-finished, smoothed, slipped or even burnished. Rims tend to be simple and upright, either pointed or flat, although a small number are everted or in-turned. None is decorated.

The third element of the standard Deverel-Rimbury repertoire – the Barrel-shaped jars (as defined by Calkin 1962, 19–24) – do not appear to be represented here, which fits the general pattern in the lower Thames Valley.

All of the fabrics can be considered locally-manufactured. The standard tempering agents neither prove nor preclude this, but the absence of non-local materials indicates a possibly local clay source.

Distribution

Middle Bronze Age pottery was recovered from Trench 9, primarily from two feature types: either field boundary ditches or pits.

The Deverel-Rimbury material appears to derive from domestic contexts, mostly as waste disposal, characterised by small numbers of sherds. Only one feature (ditch terminal 1436 in field system 2354) contained a more substantial deposit, consisting of fragments of five vessels: two Globular jars, one represented by its rim, the other by its base; two Bucket-shaped jars (one with pre-firing perforations below the rim – Fig. 7.2, 3); and 14 sherds weighing 83 g from a fifth vessel in a shelly fabric which is very uncommon in Deverel-Rimbury ceramics and which may be intrusive. The condition of these vessels varied quite markedly, indicating their pre-depositional histories had been markedly different.

The only other notable group (from ditch segment 1920/1921 in field system 2354) included 92 sherds (approximately 1 kg) from a coarse jar (Fig. 7.2, 4). This group also contained a single rim sherd from what appears to have been a small cup.

Discussion

Although Deverel-Rimbury material is not common in the immediate area, the range of fabrics and forms is typical of such assemblages from the middle and lower Thames, and there are numerous parallels in the west London area and in central and southern Essex (Brown 1995). Many of these assemblages are largely funerary, relating to cremation cemeteries (Gardner 1924; Barrett 1973). There is nothing to suggest that the Olympic Park assemblage had anything other than a domestic origin. Domestic assemblages in the area are less well known, but have been identified at Innova Park, Enfield (Ritchie *et al.* 2008), at Prince Regent Lane, Canning Town (Stafford in press) and in west London at Isleworth (Hull 1998), and further west around Heathrow (for instance Barrett 1984, Cotton *et al.* 1986, Jefferson 2003, Leivers 2010, O'Connell 1990, Leivers forthcoming a) and in Essex at Stansted Airport (Leivers 2008).

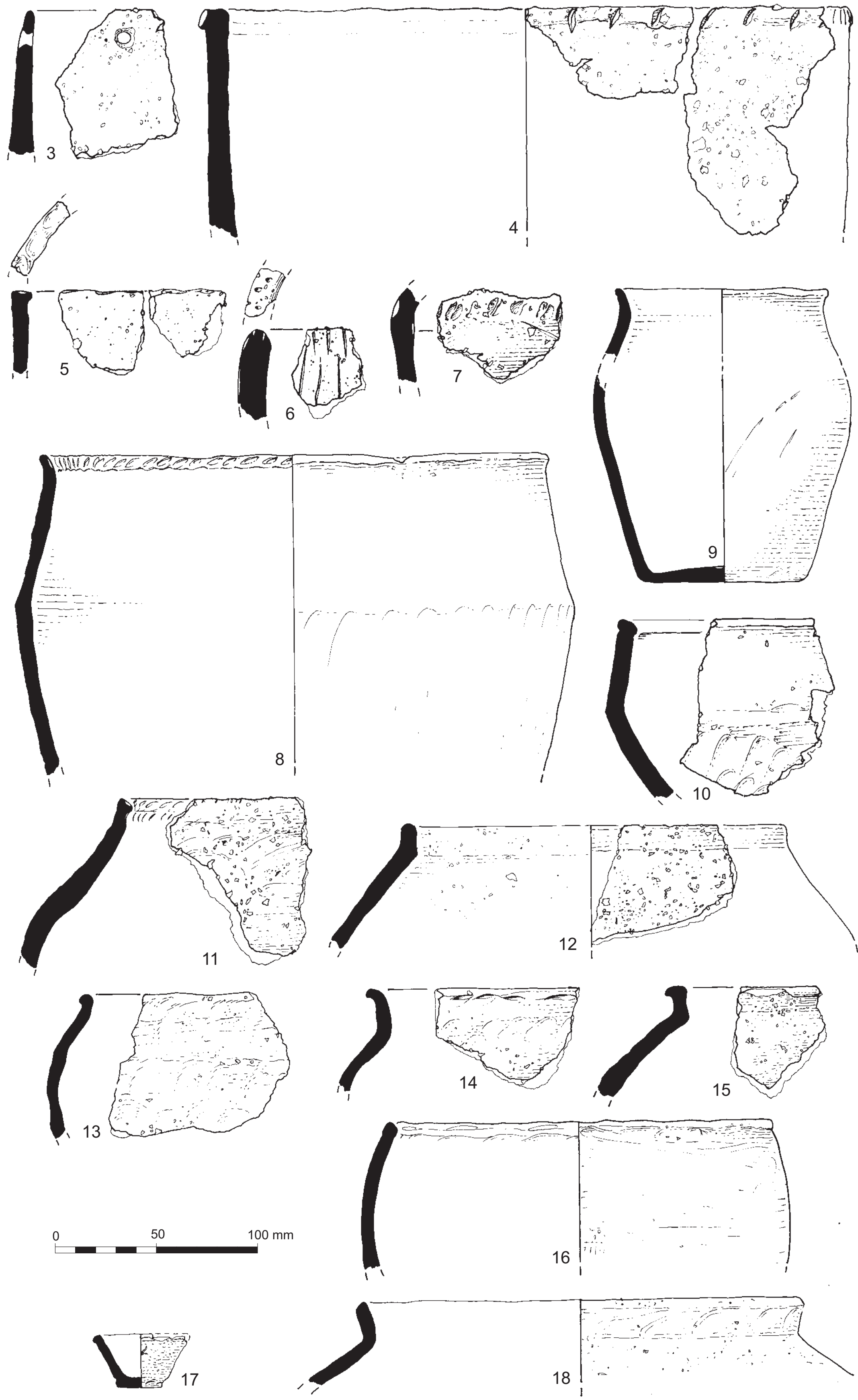
Late Bronze Age

Post-Deverel-Rimbury (PDR) ceramic traditions mark a continuation of those of the Middle Bronze Age, developing further into the Early Iron Age. This broad period is characterised in the middle and lower Thames Valley by a ceramic sequence of plainware assemblages (dating to *c.* 1200–750 BC) gradually superseded by decorated wares. The assemblage from Olympic Park appears to have an emphasis within the Late Bronze Age (perhaps the mid-10th century BC), with a notable lack of deposits with large numbers of decorated vessels which might be interpreted as falling later in the sequence.

Fabric and form

For the most part, fabrics are flint-tempered, with a very small proportion of sandy fabrics (many of which occur in features dated to the latter part of the PDR sequence, perhaps in the 8th century BC). Within the flint-tempered fabrics there is a wide range of coarseness, and a very broad distinction between coarsewares and finewares – defined here on the basis of a combination of fabric type, surface treatment (eg, smoothing, burnishing, coating with surface slip or slurry to disguise inclusions) and the presence of decoration (which is rare).

Figure 7.2: Bronze Age pottery (nos 3–18)



Coarse fabrics of this period from the Park are principally typified by jars with distinct shoulders and concave necks, with flat-topped or flattened rims and slightly convex or curved wall profiles sloping inwards toward the base (eg, Fig. 7.2, 9, 11); large jars with straight sides (eg, Fig. 7.2, 8); and smaller vessels, perhaps bowls (eg, Fig. 7.2, 10, 13).

The fine fabrics are characterised by the presence of bowls and round-bodied and shouldered jars. Both are mainly unoxidised, dark grey-black fabrics with some variable firing including full oxidisation, and both have smoothing or burnishing on both surfaces, although the bowls tend to be markedly better finished than the jars.

Decoration occurs on very few vessels and is limited to a small number of basic motifs: four examples with finger-tip impression on rim tops (Fig. 7.2, 5, 8 and 11); one with deep narrow 'pin pricks' on top of the rim (Fig. 7.2, 6); two with finger-tip and nail impression on the shoulder (Fig. 7.2, 7); one with light horizontal tooling below the shoulder (Fig. 7.2, 10); two with vertical finger fluting below the shoulder (Fig. 7.2, 8, 10); one with an applied horizontal cordon.

Distribution

Trench 9

In Trench 9, PDR ceramics were primarily recovered from pits and occupation layers, with smaller quantities in post-holes and redeposited material in later ditches.

Very few features contained sizeable groups. Of the 132 features or layers containing prehistoric ceramics, only eight contained more than 30 sherds, while 85 produced fewer than five sherds. As might be expected from these figures, the dating of contexts on the basis of pottery is not always secure, and identifying patterns and documenting change is difficult. Of the remaining features containing ceramics, six had between 20 and 29 sherds, eight had 10–19 sherds, and 25 had 5–9 sherds.

Pit group A consisted of a distinct group of irregular (sometimes intercutting) pits covering an area *c.* 8 m by 10 m towards the centre of the site (see Fig. 3.6, Table 3.2, above). Only four of these features contained over 20 sherds, but eight had average sherd weights higher than the overall assemblage. Some contained quite sizeable assemblages (1163, for instance, with 45 sherds weighing 1.43 kg), or small numbers of substantial sherds (1235: 19 sherds weighing 278 g; 1370: five sherds weighing 291 g; 1426: 11 sherds weighing 212 g). While not especially noteworthy, these figures suggest that freshly broken ceramics were being deliberately discarded into some of these pits, rather than becoming accidentally incorporated into their fills. It is apparent, however, that at least some of the material in the pit fills was not freshly broken: pit 1163 for instance contained a large rim, shoulder and body sherd from a shouldered jar with a finger-tip impressed rim and fluted lower body (Fig. 7.2, 8) which showed considerable wear and rounding of the broken edges, suggesting that it may have spent some time in surface (perhaps midden) deposits before being buried. Other sherds from this same feature belong to a small, rather fine jar (Fig. 7.2, 9): these are in better condition, indicating various sources for the material in the pit.

All of the features in pit group B, to the north of pit group A (see Fig. 3.6,Table 3.2, above) contained ceramics: pits 1009 and 1015 contained 84 and 90 sherds respectively, although while in the former the average sherd weight was 19.46 g, in the latter it was only 4.44 g. Amongst the material in pit 1009 was a bipartite shouldered bowl with light horizontal tooling in zones below the shoulder, above and interrupted by diagonal finger fluting (Fig. 7.2, 10) and at least two jars. The 24 sherds in pit 1017 included pieces from a round-shouldered, closed, narrow-mouthed jar (Fig. 7.2, 11) and a small shouldered jar. Pit 1019 contained fragments of a similar round-shouldered vessel (Fig. 7.2, 12). The forms present in this group of features appear to be somewhat different to those in the larger pit group, perhaps because they are later (8th century BC rather than 10th century, possibly).

A number of isolated pits contained PDR ceramics (1253, 1728/1730, 1827, 1896, 1981, 2004 and 2115). Some of these at least appear to be 8th century BC: diagnostic forms included a shouldered bowl from pit 2115 with a flattened shoulder and a rusticated lower body (Fig. 7.2, 13) and a small shouldered jar in pit 2004. The pottery in pit 1981 comprised a number of large sherds from a similarly dated vessel apparently deliberately placed on the base of the feature (Pl. 3.3, above).

Many of the features in pit group A were sealed by layer 1027, which contained a substantial quantity of PDR ceramics (365 sherds weighing 4.5 kg) alongside smaller quantities of Middle Iron Age material (51 sherds, 722 g). PDR forms include jars with finger-tip impressed rims, finger-tip impressed shoulders, gritted bases, and round-shouldered, closed, narrow-mouthed jars (Fig. 7.2, 14 and 15). The identifiable forms suggest that the material is a mixture of earlier and later PDR vessels, suggesting that the layer is better dated by its Middle Iron Age component. A quantity of later PDR sherds was recovered from the ring gully of round-house 2357 where it intersected with this layer, including a globular jar (Fig. 7.2, 18).

Other occupation layers were present around pit group A. To the south-east, irregular hollow 1583/1645 contained 136 sherds weighing 1645 g. Included in this material was a small globular bowl in a fine flint fabric, the outer surface of which had been slip-coated and wiped, probably with a pad of vegetable matter (Fig. 7.2, 16). Also present were a large thick-walled jar and a second bowl with an omphalos base. Parallels elsewhere in the lower Thames suggest a date of anywhere between the 10th and 8th centuries BC for these forms (Leivers forthcoming b).

Several spreads of gravelly soil west of the main pit group appear to be similar deposits (1086, 1089, 1114, 1154 and 1333), possibly forming a single layer. Together, they contained nine sherds of PDR ceramic, including a very small conical bowl or cup (Fig. 7.2, 17; Pl. 3.2, above).

Other trenches

Late prehistoric ceramics were also recovered from Trenches 43 (245 sherds), 45 (7 sherds), 56 (23 sherds), 59 (115 sherds) and 118 (5 sherds). There are very few diagnostic sherds, and dating of the smaller groups in particular is difficult. The group from Trench 43 consisted almost exclusively of flint-tempered fabrics with sandy rather than silty matrices. Given this, it is likely that the material belongs to the end of the PDR phase, although the condition and quantity of material makes certainty impossible. The same is probably true of the group from Trench 59. A Late Bronze Age date is suggested for the 23 sherds from Trench 56, while the very small groups from Trenches 45 and 118 can only be broadly dated as Late Bronze Age to Middle Iron Age.

Discussion

Within Barrett's (1980) sequence for the PDR tradition, simple, largely undecorated jars and bowls, developing directly from Deverel-Rimbury forms at the end of the 2nd millennium BC, are succeeded by 'plainware' assemblages with a greater variety of forms and finally, around the 8th or 7th century BC, by 'decorated' assemblages. Needham's (1996) reappraisal of Bronze Age chronology places the emergence of PDR forms around 1200 BC, with the decorated phase beginning at perhaps 750 BC, making it an Early Iron Age innovation. Recently dated assemblages in the lower Thames Valley suggest that the sequence is not so clear cut, with most of the forms thought to be diagnostic of the Decorated phase present by the 10th century BC (Leivers forthcoming b), with later forms typified by bowls with more angular shoulders and jars with less rounded (and higher) shoulders. The morphology of the Olympic Park material suggests that the assemblage falls somewhere in the first half of the PDR sequence, with a limited range of vessel forms (round-shouldered closed-mouthed jars primarily) distinctive of later PDR types. These seem to be associated with (but not made from) sandy fabrics (very scarce in the assemblage as a whole).

The particular forms present in the assemblage can all be paralleled at other Late Bronze Age sites around the lower Thames Valley, such as Innova Park (Ritchie *et al.* 2008), Cliffs End Farm, Ramsgate (Leivers forthcoming b), Queen Mary's Hospital, Carshalton (Adkins and Needham 1985) and Coombe Warren, Kingston Hill (Field and Needham 1986). On the west London gravels parallels can be found at Runnymede Bridge (Longley 1980; Needham 1991; Needham and Spence 1996), Petters Sports Field, Egham (O'Connell 1986), Caesar's Camp (Grimes and Close-Brooks 1993) and Terminal 5 Heathrow (Leivers 2010).

At the Olympic Park there is nothing about the assemblage to suggest anything other than the discard of refuse. Although the Olympic Park assemblage is too fragmentary for forms and types to be reconstructed with any certainty, there are some indications (the very small cup; the prevalence of round-shouldered, closed-mouthed jars in later contexts) of the inter-site assemblage variation seen elsewhere. These are to some degree chronological, but each appears to have a different character (more decoration and wider range of forms at Runnymede Bridge; specific jar and bowl forms at Caesar's Camp; an unusual proportion of handled jars at Queen Mary's Hospital, Carshalton; a range of noticeably small vessels from Coombe Warren, Kingston Hill). Explanations for such variation should be sought not only in a consideration of vessel (and therefore site) function but also in the way in which social patterning might be embodied in, and reinforced by, the use and deposition of specific vessel forms. The condition and distribution of the Olympic Park material suggests that it results from the disposal of domestic rubbish. The varying condition of the assemblage recovered from the field boundary ditches especially is indicative of the dispersal of waste material from the associated settlement, and perhaps of the manuring of fields.

Middle Iron Age

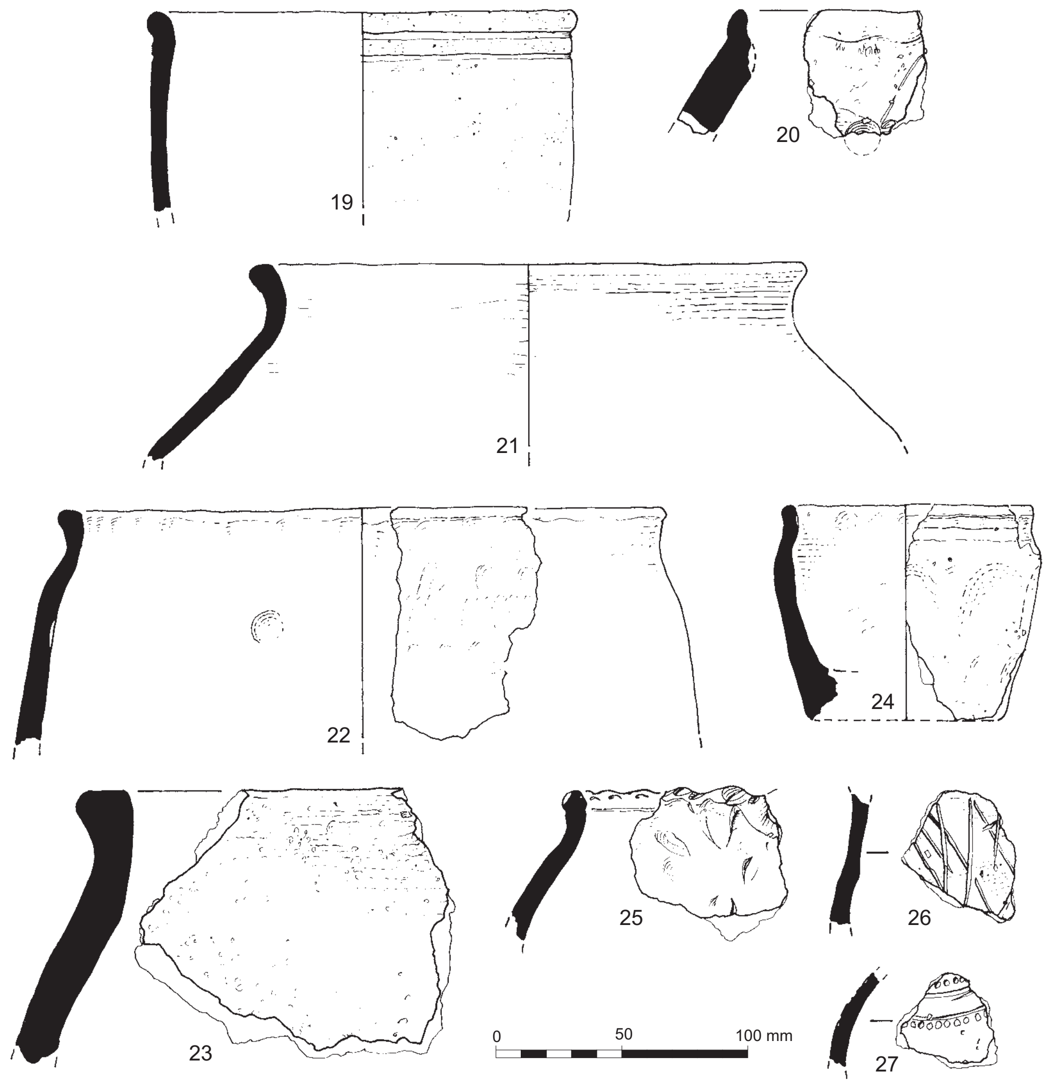
Middle Iron Age ceramics were recovered only from Trench 9, from layers, ditches, pits, post-holes and round-house gullies, usually in small quantities. Of the 44 features and five layers from which Middle Iron Age ceramics were recovered, four contained over 30 sherds while 19 contained fewer than five (four contained 20–29; 10, 10–19; 12, 5–9).

Fabric and form

A very much wider range of tempering agents are present in Middle Iron Age ceramics than in earlier periods. Flint-tempered fabrics continue to be used, and are for the most part indistinguishable from Late Bronze Age fabrics. Sandy fabrics increase in frequency very markedly, and new tempering agents appear: shell, grog, calcareous rock. Particularly notable is a sandy matrix containing a very high proportion of black (probably glauconitic) grains which occurs in very limited quantities, probably from a single vessel, and which is 'identical' to a glauconitic fabric present among the material from assemblages from Hascombe, Holmbury and Anstiebury, Surrey (Seager Thomas 2010, 6, who also notes 'analogous fabrics across the south-central and south-east regions').

Given the very fragmentary nature of much of the assemblage, forms are difficult to reconstruct with certainty, but include Saucepan Pots (7.3, 19); a variety of jars

Figure 7.3:
Middle Iron Age pottery
(nos 19–27)



(round-shouldered (Fig. 7.3, 20); S-profiled (Fig. 7.3, 21); proto bead-rimmed; weakly-shouldered (Fig. 7.3, 22)) in a range of sizes from very large (Fig. 7.3, 23; likely to be over 400 mm in diameter) to very small (Fig. 7.3, 24); and burnished and plain bowls.

Decoration for the most part is limited to light finger fluting. Other instances include a round-shouldered jar with a cabled rim (Fig. 7.3, 25), irregular scoring (Fig. 7.3, 26), and a globular bowl with ring-and-line motifs (Fig. 7.3, 27). Two horizontal lines of very faint tooling are present immediately below the rim of one of the saucepan pots (Fig. 7.3, 19).

Distribution

In Trench 9, Middle Iron Age ceramics were recovered primarily from features belonging to all phases of the development of the settlement and its enclosure.

Enclosure ditches

The Phase 1 enclosure ditch (2358) contained 11 sherds in segment 2222 (a coarse bowl, a very large saucepan-type pot), two in 1222, and six in terminal 2196. A radiocarbon determination from the lowest fill of segment 2222 produced a date of 380–110 cal BC (Beta-254067, 2180±40 BP); broadly contemporary with two determinations from the upper half of the fill sequence in ditch cut 1705 of 400–200 cal BC

(Beta-254061, 2250±40 BP) and 390–170 cal BC (Beta-254062, 2200±40 BP).

The Phase 2 ditches contained two sherds in ditch 1013, six in 2297 including a small jar (Fig. 7.3, 24), one in 2299, eight in 1923 (including an S-profiled jar; Fig. 7.3, 21) and 27 in 1385 (including Saucepan Pot, convex-sided jars and a proto bead-rimmed jar).

Round-houses and associated features

The gullies of the earliest two round-houses (2355 and 2356) contained 13 and 10 sherds of Middle Iron Age pottery respectively. Little of this material is identifiable to form, although gully 2356 did contain a cabled rim from a round-shouldered jar (Fig. 7.3, 25). Within round-house 2356, pit 1609 contained nine sherds from the base and shoulder of a vessel in a sandy fabric. Round-house gully 2356 cut an earlier gully (1886) which contained 26 sherds including a weakly-shouldered jar (Fig. 7.3, 22). Other round-house gullies (208; 1146; 1655; 1935) contained small quantities of Middle Iron Age or probably Middle Iron Age pottery. Notable among this material are the calcareous Saucepan Pot sherds from 1146, which is among the latest of the identified structures belonging to the Middle Iron Age settlement.

The most substantial assemblage from any of the round-house gullies was the 63 sherds from 1940 which include fragments of a convex-sided jar and a burnished bowl, as well as a very large jar with an expanded flat-topped rim (Fig. 7.3, 23), this latter from the gully terminal. Within the arc of this structure, pit 2012 contained 38 sherds from at least seven vessels including one with a very distinctive glauconitic fabric.

Discussion

The range of fabrics and forms from Olympic Park is entirely typical of the Thames Valley (eg, Drury 1978), except for the presence of Saucepan Pots which are more often found in Surrey and Sussex (Seager Thomas 2005; 2010). Elsewhere in the Thames Valley, broad parallels can be found at Terminal 5 and Caesar's Camp, Heathrow (Leivers 2010; Grimes and Close-Brooks 1993), although there are details of the Olympic Park assemblage which set it apart from these west of London sites. Many of the general forms find parallels in Surrey assemblages (for instance Hascombe: Seager Thomas 2010).

The lack of distinctive features in the Olympic Park assemblage means that it is not possible to place it more closely within the regional ceramic sequence. It lies beyond the eastern limits of Cunliffe's 'saucepan pot continuum' (1991, fig. 4.6); a few examples were recorded from Imperial College Sports Ground, Harlington (Leivers forthcoming a), from Brooklands, Weybridge (Close-Brooks 1977, 41), and from Hascombe (Seager Thomas 2010). At Caesar's Camp one such vessel is suggested as a possible import to the site (Grimes and Close-Brooks 1993, 356); at T5 Heathrow examples are all in the sandy fabrics, presumably locally produced. The near absence of decorated wares, noted above, could also have some chronological significance: the only example of a fineware decorated bowl falls within Cunliffe's Mucking-Crayford style (see for instance Cunliffe 1991, fig. A:26.2, 579). Dates in the 4th to 1st centuries BC would accommodate the entire assemblage, as the radiocarbon determinations from the settlement enclosure indicate (see Chapter 3).

List of illustrated vessels (Figures 7.1–7.3)

Early Neolithic

1. Rim sherd, rolled over, fabric SH3. PRN [Pottery Record Number] 1874, Trench 118, layer 55-complex.

2. Rim sherd, rolled over, fabric FL7. PRN 1875, Trench 118, layer 55-complex.

Middle Bronze Age

3. Rim sherd, perforated, fabric FL4. PRN 186, Trench 9, context 1435, terminal 1436, ditch 1922, field system 2354.

4. Joining sherds from large bucket-shaped jar rim, slashes on outer edge, fabric FL5. PRN 261, Trench 9, context 1737, ditch terminal 1738, ditch 1920, field system 2354.

Late Bronze Age

5. Rim sherd, fingertip impressions on top of rim, fabric FL4. PRN 34, Trench 9, layer 1027.

6. Rim sherd, pin pricks on top of rim, fabric FL4. PRN 45, Trench 9, layer 1027.

7. Shoulder, fingertip impressions, external linear scoring, fabric FL4. PRN 58, Trench 9, layer 1027.

8. Jar rim and shoulder, fingertip impressions on internal bevel of rim, vertical fluting below shoulder, fabric FL1. PRN 90, Trench 9, context 1162, pit 1163.

9. Rim, body and base of small, fine ?jar, fabric FL3. PRNs 87-89, Trench 9, context 1162, pit 1163.

10. Rim and shoulder; vertical fluting below shoulder, fabric FL3. PRN 14, Trench 9, context 1008, pit 1009.

11. Jar rim and rounded shoulder, fingertip impressions on top of rim, fabric FL1. PRN 21, Trench 9, context 1016, pit 1017.

12. Jar rim and rounded shoulder, fabric FL1. PRN 25, Trench 9, context 1018, pit 1019.

13. Rim, shouldered bowl, rusticated lower body, fabric FL2. PRN 388, Trench 9, context 2114, pit 2115.

14. Rim and rounded shoulder, from narrow-mouthed jar, fabric FL3. PRN 29, Trench 9, layer 1027.

15. Rim and rounded shoulder, from narrow-mouthed jar, fabric FL4. PRN 35, Trench 9, layer 1027.

16. Globular bowl, fabric QU2. PRN 211, Trench 9, context 1583, hollow 1584.

17. Small conical bowl or cup, fabric FL3. PRN 71, <100>, Trench 9, layer 1114.

18. Rim, globular jar, fabric FL3. PRN 117, Trench 9, context 1259, ring gully 1260, round-house 2357 (Middle Iron Age).

Middle Iron Age

19. Saucepan Pot, tooling below rim, fabric V1. PRN 61, Trench 9, layer 1027.

20. Rim with internal groove, fabric FL4. PRN 59, Trench 9, layer 1027.

21. Rim, globular jar, burnished, fabric QU2. PRN 308, Trench 9, context 1909, ditch 1923.

22. Rim, shouldered jar, burnished, fabric QU2. PRN 292, Trench 9, context 1885, gully 1886.

23. Large jar rim, fabric SH3. PRN 390, Trench 9, context 2126, ring gully 2127, round-house 1940.

24. Small bowl rim, fabric QU1. PRN 415, Trench 9, context 2229, ditch 2297.

25. Rim, globular jar, 'cabling' effect on top of rim, fabric QU2. PRN 360, Trench 9, context 2013, round-house gully 2356.

26. Decorated body sherd, fabric QU2. PRN 361, Trench 9, context 2013, round-house gully 2356.

27. Decorated body sherd, fabric V1. PRN 239, Trench 9, context 1693, ditch 1212 (Romano-British).

Romano-British Pottery

by Lorraine Mepham

Very small quantities of Romano-British pottery were recovered from six trenches, totalling 47 sherds. The sherds are tabulated by trench in Table 7.3, which gives details of fabrics and (where known) vessel forms. Identifications are taken from the original assessment reports.

The date range of the sherds spans the Romano-British period, but some chronological distinction can be seen between the trench groups (albeit based on very small quantities) – Trench 9, for example, shows an emphasis on the early Romano-British period, while sherds from Trench 58 are predominantly late Romano-British.

Most of these sherds were found redeposited in later contexts, but some groups were found *in situ*. These include three sherds from ditch 213 in Trench 56, which were found together with Romano-British brick/tile and a Roman coin; both pottery and coin date this deposit to the early Romano-British period. In Trench 58, two sherds, including a late Romano-British form 7M22 Oxfordshire whiteware mortarium, came from alluvial clays sealing the prehistoric topography. Three sherds, including the rim from an early Romano-British Verulamium region necked jar, came from the primary fill of ditch 2005 in Trench 59.

Table 7.3: Romano-British pottery by trench

Tr.	Fabric	No. sherds	Weight (g)	Date (AD)	Vessel form/ comments
9	SAMCG	1	41	120–200	illegible stamp
	FINE	2	5	43–200	
	GROG	1	13	43–200	
	SAND	1	4	43–200	
	VRW?	1	13	70–200	Flagon 1B
56	LOMI	1	–	70–120	
	SAND	2	–	120–400	
58	BAET	4	449	43–400	
	BB2	1	38	120–350/400	
	CALC	1	10	300–400	
	FINE	2	6	43–400	
	OXRC	2	13	240–400	rouletted
	OXWW	2	103	240–400	1 x 7M22
	PORD	1	4	350–400	
	SAND	8	135	43–400	
	SAND (Essex?)	1	8	120–350/400	
	TSK?	1	40	120–400	
59	VRW	1	16	43–200	necked jar
	SAND	2	12	43–400	
78	MHAD	7	63	200–400	
118	SAMCG	1	1	120–250	
H08	GAUL	3	235	50–250/ 300	
	SAMLG	1	32	50–100	Dr 18

Medieval and Post-Medieval Pottery

by Lorraine Mepham

All the post-Romano-British pottery is of medieval or post-medieval date; no sherds of Saxon pottery were recovered. The total assemblage reported on consists of 2076 sherds, approximately three-quarters of which (1541 sherds) came from Trench 75 (Temple Mills). Thirty-four other trenches produced pottery, in quantities ranging from one to 99 sherds (see Table 7.1).

Methods of Analysis

All the sherds were examined and reported on at the assessment stage, the reports prepared variously by several individuals, but in every case, standard Museum of London (MoL) codes (for fabric type and vessel form) were used to classify the pottery. Records were compiled as sherd counts within each context. Some context-by-context records, mainly for the larger trench assemblages, were available during the analysis. In most cases, however, only summary quantifications were available.

During the process of analysis, all pottery was checked against the assessment records and reports as a first step. Each sherd, or group of sherds, was quantified (sherd count and weight) by fabric type and by vessel form (where known); details of decoration and any other modification (such as stamped proprietary names) were also noted. MoL fabric and vessel form codes continued to be used throughout; vessel codes accord with nationally recommended nomenclature (MPRG 1998). All data are held in an Access database (and also in an

Excel spreadsheet) which form part of the project archive. The assemblage includes a significant proportion of complete or near complete vessels (128, although these largely derived from unstratified or poorly stratified contexts).

A summary of the results of the analysis is given here; full details of the assemblage can be found in the specialist archive report (Mepham 2012a).

Medieval Pottery

Very small quantities of medieval pottery were recovered (13 sherds; 136 g), deriving from Trench 75 (nine sherds), Trench 101 (one sherd) and Trench 118 (three sherds). Nine fabrics were identified (see Table 7.4), and the pattern is one of local coarsewares appearing from the early medieval period, later (from at least the 13th century) augmented by regional types, products of the London-type, Surrey whiteware and

Table 7.4: Medieval and post-medieval/modern pottery fabric totals

Fabric code	Date	Description of fabric	No. sherds	Weight (g)
Medieval wares				
CHEA	1350–1500	Cheam-type ware	1	10
EMSHX	1000–1225	Essex early medieval shelly ware (Essex fabric 12a)	1	3
EMSSX	1000–1225	Essex early medieval sandy shelly ware (Essex fabric 12c)	1	8
EMSX	1000–1225	Essex early medieval sandy ware (Essex fabric 13)	1	17
KING	1230–1400	Kingston-type ware	3	3
LOND	1080–1350	London-type ware	3	38
RCWX	1175–1400	Essex reduced coarse ware (Essex fabric 20)	1	48
SHER	1140–1300	S Herts/Limpsfield type greyware	1	1
SOWX	1200–1500	Essex sandy orange ware (Essex fabric 21)	1	8
Sub-total medieval			**13**	**136**
Post-medieval/modern wares				
BBAS	1770–1900	Basalt ware	5	47
BBASG	1770–1900	Basalt ware with glaze	6	39
BLUE	1800–1900	Blue dry-bodied stoneware	1	36
BONE	1794–1900+	Bone china, refined	6	119
BORDB	1620–1700	Border Ware, brown glaze	4	27
BORDG	1550–1700	Border ware, green glaze	9	81
BORDO	1550–1700	Border ware, olive glaze	3	17
BORDY	1550–1700	Border ware, yellow glaze	4	38
CHPO	1580–1900+	Chinese porcelain	8	27
CHPO BATV	1700–1750	Chinese porcelain (Batavian style)	1	13
CHPO BW	1580–1900+	Chinese porcelain, blue and white	23	149
CHPO IMARI	1680–1900+	Chinese porcelain (Imari style)	8	15
CONP	1710–1900+	Continental porcelain	16	89
CREA	1740–1880	Creamware	1	3
CREA DEV	1775–1880	Creamware, developed pale glaze	106	465
CREA GRN	1760–1880	Creamware, green-glazed	1	1
CREA MARB	1770–1840	Creamware, marbled slip	3	60
CREA OTR	1760–1830	Creamware with overglaze transfer printed dec	1	6
CREA SLIP	1800–1880	Creamware, slip decorated	6	30
DERBS	1700–1900+	Derby stoneware	5	62
ENGS	1700–1900+	English stoneware	92	14,026
ENGS BRST	1830–1900+	English stoneware (Bristol glaze)	138	28,723
ENPO HP	1780–1900+	English hard paste porcelain	73	617
ENPO LITH	1850+	English porcelain, lithographic decoration	2	66
ENPO OTR	1755–1800	English porcelain, overglaze transfer-printed	5	93
ENPO PNTD	1745–1900+	English porcelain, polychrome painted decoration	6	142
ENPO UTR	1760–1900+	English porcelain underglaze transfer-printed	9	61
FREC	1550–1700	Frechen stoneware	4	19
FTGW	1600–1800	French tin-glazed ware	3	312
JAPO	1660–1900+	Japanese porcelain	1	42
LONS	1670–1926	London stoneware	25	894
LUST	1800–1900+	Lustreware	5	91
MAJO	1850–1900+	Majolica	8	48 cont.

Table 7.4 continued: Medieval and post-medieval/modern pottery fabric totals

Fabric code	Date	Description of fabric	No. sherds	Weight (g)
Post-medieval/modern wares cont.				
METS	1630–1700	Metropolitan slipware	1	102
NOTS	1700–1800	Nottingham stoneware	4	64
PEAR	1770–1840	Pearlware	20	239
PEAR BW	1770–1840	Pearlware, blue and white painted decoration	23	41
PEAR ERTH	1770–1840	Pearlware, earth colours	3	5
PEAR SLIP	1770–1840	Pearlware, slip decoration	15	312
PEAR TR	1770–1850	Pearlware, transfer-printed dec	85	757
PEAR TR3	1810–1850	Pearlware, brown/black transfer-printed	2	2
PMBL	1580–1700	Post-medieval redware, black glazed	8	367
PMFR	1580–1700	Post-medieval fine redware	3	22
PMFRG	1580–1700	Post-medieval fine redware, green glazed	24	791
PMR	1580–1900+	Post-medieval redware	188	5663
PMR SLIP	1800–1900+	Post-medieval redware, slip decorated	1	86
PMRE	1480–1600	early post-medieval redware	5	113
PMSL	1480–1600	Post-med slip-painted redware	1	8
PMSR	1480–1650	Post-medieval slip-coated redware	2	55
RAER	1480–1610	Raeren stoneware	1	99
RBOR	1580–1800	Red Border ware	20	410
REFR	1740–1800	Refined redware	2	372
REFW	1805–1900+	Refined whiteware	273	6264
REFW CHROM	1830–1900+	Refined whiteware, chromatic decoration	41	803
REFW LUST	1805–1900+	Refined whiteware with lustre decoration	16	132
REFW PNTD	1805–1900+	Refined whiteware, hand painted decoration	1	23
REFW SLIP	1825–1900+	Refined whiteware, slip decorated	6	13
REFW SPON	1830–1900+	Refined whiteware, sponged decoration	14	136
RESTG	1760–1780	Red stoneware, glazed	1	4
ROCK	1800–1900+	Rockingham ware	15	664
SPEC	1680–1740	Red earthenware with speckled glaze	3	32
STBRS	1690–1730	Staffordshire brown salt-glazed stoneware	4	45
STCO	1650–1800	Staffordshire coarseware	1	1
STSL	1650–1800	Staffordshire slipware	9	115
SUND	1800–1900+	Sunderland ware	17	271
SUND MOT	1775–1850	Sunderland ware, mottled glaze	1	17
SWSG	1720–1780	Staffordshire white salt glaze	50	200
SWSG COB	1740–1780	Staffordshire white salt glaze, cobalt & incised decoration	1	4
SWSG SCRB	1740–1780	Staffordshire white salt glaze, scatch blue decoration	15	18
TGW	1570–1800	Tinglazed ware	14	85
TGW A	1612–1650	Tinglazed ware, Orton type A	6	94
TGW BLUE	1630–1800	Tinglazed ware, plain pale blue glaze	14	60
TGW C	1630–1800	Tinglazed ware, Orton type C (plain white glaze)	19	88
TGW D	1630–1680	Tinglazed ware, Orton type D (blue & white or polychrome)	3	16
TGW E	1680–1710	Tinglazed ware, Orton type E (Persian blue)	1	1
TGW H	1690–1800	Tinglazed ware, Orton type H (pale blue glaze, dark blue dec)	22	77
TPW	1780–1900+	Transfer-printed whiteware	244	4767
TPW FLOW	1840–1900+	Transfer printed ware, watery flow blue transfer-printed	6	476
TPW3	1810–1900+	Transfer printed whiteware, brown/black transfers	112	5707
TPW4	1825–1900+	Transfer printed whiteware, colour transfers	54	984
TPW5	1848–1900+	Transfer printed whiteware, colour transfers	1	1
TPW6	1840–1900	Transfer-printed ware, overglaze printed & underglaze painted	30	382
TUDG	1380–1500	Tudor Green	1	11
WEST	1590–1800+	Westerwald stoneware	8	1959
XX	unknown	Unknown ware type	13	89
XX SLIP	unknown	Unknown slipware type	1	12
YELL	1800–1900+	Yellow ware	30	378
YELL SLIP	1820–1900+	Yellow ware, slip decorated	20	71
Sub-total post-medieval			**2063**	**79,286**
Overall total			***2076***	***79,422***

Plate 7.1: Possible tool made from medieval sherd

Hertfordshire/Surrey greyware industries. All the regional types occur commonly in the capital and the surrounding area. Kilns producing London-type ware have been found in Woolwich (Cotter 2008), several production centres are known for the whitewares along the Surrey/Hampshire border and elsewhere in Surrey (Pearce and Vince 1988), while the greyware industry apparently spanned several counties around London and included a number of kilns in Buckinghamshire and Hertfordshire, amongst others (Blackmore and Pearce 2010).

Of interest amongst this small assemblage is a single sherd of EMSX, which appears to have been modified by deliberately shaping into a form with rounded corners, presumably for use as a tool of some kind (Pl. 7.1). It is possible that such an implement could have been used in pottery production, for the secondary shaping and finishing of vessels. Similar examples have been found within the Late Medieval Reduced Ware industry of the south-east Midlands, where it is surmised that they may have functioned in the same way as a modern potter's purpose-made 'rib', to help form the neck and shoulder of a vessel, or to shave the base angle (Slowikowski 2011, 63, fig. 34, nos 133–4; fig. 42, nos 219–20).

Some of the medieval sherds recovered were clearly residual finds, occurring alongside post-medieval wares; in other instances they provided the only dating evidence, but are unlikely to represent primary refuse.

Post-Medieval and Modern Pottery

The post-medieval/modern assemblage comprises 2063 sherds, and in date range covers the late 15th century to the present day, with an emphasis on the 19th and early 20th centuries. Most of the assemblage (1532 sherds) was recovered from Trench 75; all other trench assemblages were small, none exceeding 100 sherds (see Table 7.1).

Totals by ware type are given in Table 7.4. The chronological sequence is best illustrated by the assemblage from Trench 75 which, in an echo of the medieval sequence, shows local coarsewares in use from the late 15th to 16th century, later augmented by regional coarsewares and finewares, and finally by national factory-produced types.

Coarse earthenwares

Of interest amongst the coarsewares is a rim sherd in PMR from Trench 75, possibly from an oversized beaker-shaped vessel. This sherd was not available for analysis, but it may have been comparable to forms termed 'industrial pedestal beakers', made at Deptford *c.* 1680–1750, of which examples have also been found in 18th century contexts associated with industrial activity at Point Pleasant, Wandsworth (Jarrett with Sabel 2004, fig. 77.1–3; Jarrett *et al.* 2010, fig. 13). The function of these vessels remains uncertain; there is a definite association with industrial activity, although their function was probably as containers for some substance(s) rather than actual use in industrial processes. They may have contained a solid or semi-solid substance, of which one possibility is dye for printing calico (Jarrett *et al.* 2010, 157), in which context the presence of a calico-printing works at Temple Mills may be noted.

Also present, and also indicative of industry, are parts of two sugar-loaf moulds, one from Trench 104 and one from Trench 118. These cone-shaped vessels with holes in their pointed bases would have been used in sugar refining to hold the prepared sugar syrup; once the sugar had set, the bungs inserted in their basal holes were removed so that excess syrup or molasses could drain through, collecting in syrup-collecting jars (Brooks 1983, fig. 4). In London examples of both moulds and jars are known from the 17th century redware kiln site at Woolwich (Pryor and Blockley 1978, fig. 13, 64, fig. 14, 70–1). The fragment from Trench 104 came from a dump of building rubble, part of the latest stratigraphic phase on the site, of dumping, levelling and landscaping, and is presumably residual here. The deliberate dumping of refuse from elsewhere is apparent in this site phase, and the sugar mould could have originated elsewhere in east London. The example from Trench 118, however, came from the fill of a pit associated with late 18th and 19th century buildings, probably related to the terraced housing recorded on the site by Milne's map of 1800. This mould fragment, therefore, is more likely to represent sugar refining in the relatively near vicinity of the site. The nearest known sugar refinery was located on the south side of the High Street between Bow and Stratford (the present day Sugar House Lane is assumed to have taken its name from this establishment), and is documented from 1843 (*VCH* 1973); this would have been only about 300 m from the location of Trench 104.

Tinglazed earthenwares

Most tinglazed sherds derive from London delftware (TGW), which was recovered in a variety of decorative styles. Plain whitewares (TGW C) and blue wares (TGW BLUE) were purely utilitarian, and provided ointment pots and chamberpots. The decorated wares span the period from early 17th century to late 18th century, and include drug jars, bowls and dishes. The only imported sherds identified were of French tinglazed ware (FTGW). This includes two complete mustard jars (Trenches 105 and 117 respectively), of late 19th or early 20th century date.

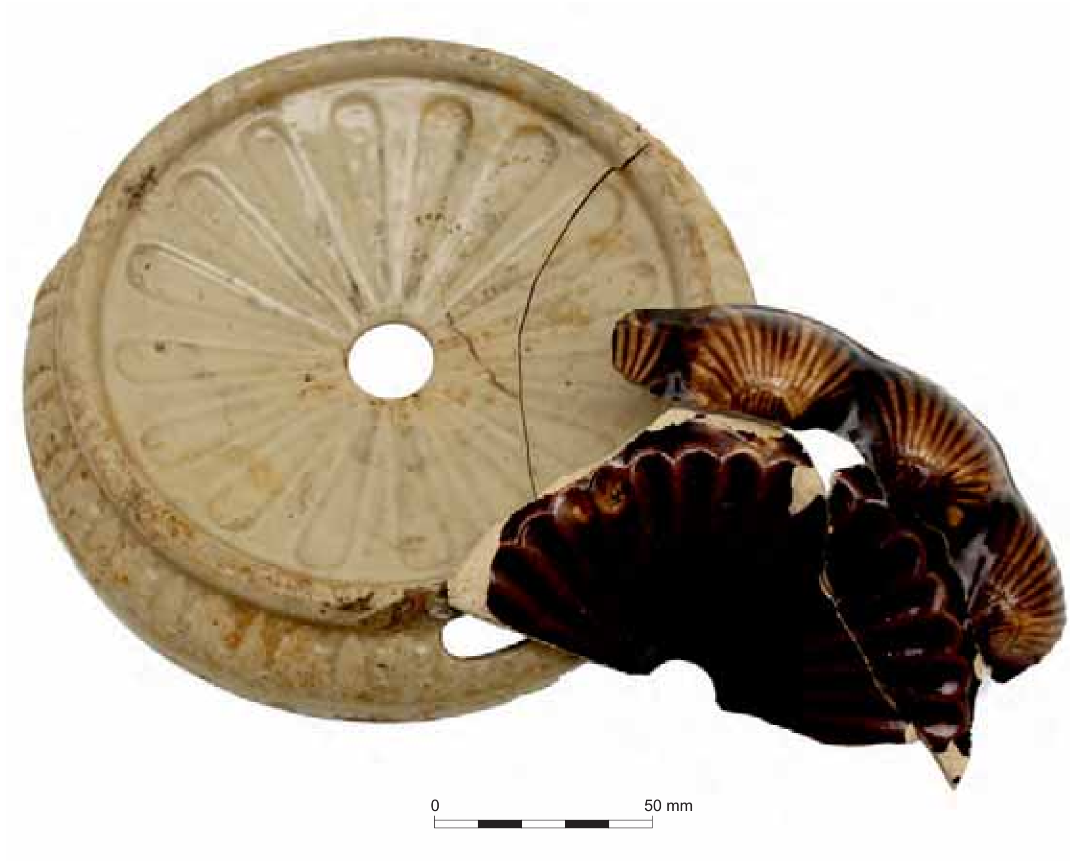
Stonewares

These include both German and English wares. Early German stonewares (late 15th–17th century) appear in the form of Frechen (FREC) and Raeren (RAER) products, the latter represented by a single frilled base sherd from a mug or jug. Westerwald stonewares (WEST) appear both in 17th/18th century forms, including a chamberpot dated 1740–60, and in later forms, comprising three, possibly four, Seltzer bottles, containers for mineral water. The three more complete bottles are all of the tall, cylindrical form introduced in the 19th century, and imported until the beginning of World War I; all three are stamped (one from the Emser Kränchen spring at Bad Ems, one from the Elisabeth spring at Bad Homburg, and one from the Nassau Selter Company).

British stonewares are far more common. Most of these wares are generic English stonewares (ENGS), dated from 1700; from *c.* 1830 these appear with feldspathic 'Bristol' glazes rather than salt glazes (ENGS BRST), although salt glazes continued to be used into the 20th century. More specifically-attributed English stonewares include products of Staffordshire (STBRS; straight-sided mugs or tankards), Nottinghamshire (NOTS; lid) and Derbyshire (DERBS; jar and flared bowl). There are also examples of glazed red stoneware (RESTG; lid), and white salt-glazed stoneware, including sherds with cobalt-based and 'scratch blue' decoration (SWSG, SWSG COB, SWSG SCRB). Straight-sided mugs or tankards are the most common vessel forms in these wares, alongside bowls (one tea bowl), lids, a plate and a small dish or saucer. Two small 'toy' vessels, a lid and a tea bowl, are of interest here.

More specialised English stonewares, used here mainly for tea wares (teapots or

Plate 7.2: Spittoons from Trenches 52 and 107



coffeepots, and their lids), comprise Black Basalt wares, introduced by Josiah Wedgwood *c.* 1770 (BBAS, BBASG), and 19th century blue stoneware (BLUE).

London stoneware (LONS), pioneered by John Dwight at the Fulham pottery (Green 1999), is the most common of the sourced stonewares and, together with the generic English stonewares, consists largely of utilitarian containers dating from the 19th and early 20th centuries, and including a number of complete vessels. One earlier exception is a straight-sided tankard in LONS, stamped 'WR'. Excise stamps of 'WR', 'AR' or (much more rarely) 'GR', for the reigning monarchs, are commonly found on stoneware vessels of the late 17th and early 18th century, used in compliance with the 1700 Act governing ale and beer measures. 'WR' marks, however, were also used during the reign of Queen Anne, after King William III's death in 1702 (Green 1999, 171–3).

Many of the later containers bear stamped proprietary names, of the manufacturer of the vessel itself and/or the contents; full details of these can be found in the archive (see also Mepham 2012a). The vessels themselves include bottles, flasks and jars in various shapes and sizes. These can be paralleled within the known range of 19th century (mainly after *c.* 1865) and later products from the Fulham pottery (Green 1999), the Doulton pottery in Lambeth (*ibid.*, appendix 18; Tyler *et al.* 2005), and the Stiff pottery, Doulton's main rival in Lambeth (Green 1999, appendix 17). According to the late 19th century price lists, they include 'upright bottles', 'bung jars', 'butter jars', 'extract pots' (or 'wide mouthed jars'), 'jam jars' (or 'mustard jars', depending on size), 'ink bottles' (in a variety of sizes, some with pourers), 'ginger beer bottles' (which could also be used for other beverages), 'Brunswick black bottles', 'blacking and polish bottles', 'wide-mouth bottles' (for furniture cream and disinfectants), and 'anatto bottles'. There are also small jars and jugs for milk or cream. These vessels would have contained a wide range of foodstuffs and other household products, most of which are apparent from the named forms, although some of these are less familiar today – annatto is a reddish-yellow dyestuff used to dye fabric and as a food colouring, while 'Brunswick black' is a black varnish used for metal, particularly stoves and fenders, drying to a durable, protective finish. Where identified from the proprietary stamp, the contents include the products of a number of drinks manufacturers from east London (both soft drinks and alcohol, eg, Biddle & Gingell of Leyton, R. White of Camberwell, Batey of Shoreditch), as well as nationally distributed products, eg, Hartley's preserves, and Virol, the '*Ideal Fat Food for Children and Invalids*' (a preparation of bone-marrow).

Amongst the manufacturers of the vessels themselves, Doulton is, as might be expected for a London-based company, well represented (15 backstamps, dating from 1858 onwards); the next most common manufacturer seen here is Bourne of Denby (10 backstamps, the earliest of which dates between 1812 and 1841, and the latest to 1934). Skey of Tamworth provided three of the vessels; the company traded between 1860 and 1935, when Doulton acquired it. Powell of Bristol also supplied three jars, all dating before the take-over of the company in 1906 by Price and Sons, also of Bristol. The Fulham pottery, founded by John Dwight in *c.* 1672, appears in two guises, as Bailey & Co. (backstamp dated *c.* 1870–91), and as the Fulham Pottery Co. (backstamp dated *c.* 1890s–1914) (Green 1999, 160, fig. 130, k, q). Other manufacturers represented by single vessels comprise Lovatt & Lovatt, of the Langley Mill pottery in Nottinghamshire (1895–1930) and Gray of Portobello, Scotland (from 1856).

One small, spouted ink bottle with a liquid brown 'treacle' glaze can be identified as an import, from the proprietary stamp of N. Antoine & Fils of Paris. Antoine also had a London branch at Prior Street in Greenwich by the 1870s.

Less common forms amongst the London and English stonewares include a spittoon (ENGS BRST), with a fluted, concave top with a central vent (Trench 52; Pl. 7.2). The spittoon, which can be found in Doulton & Watts' 1873 catalogue (Green 1999, 367), is not a domestic vessel, but would have been used, for example, in a public house. This can be added to part of a tap (often referred to in the literature as a 'stone cock'), possibly from a beer barrel, another public house item (cf Green 1999, 176, fig. 142, no. 437) (Trench 70). Similar forms are illustrated in the catalogue of Stiff and Sons, 1873 (*ibid.*, 368).

Of particular interest is a spirit flask (LONS) in the form of a female figurine, the head missing, holding a scroll reading 'My hope is in my people' (Trench 117, PRN 1587; Pl. 7.3). At the figure's feet is the proprietary stamp of Edmonds, Wine &

Plate 7.3: Figurine flask

Spirit Merchant, of 45 Strutton Ground, Westminster. A backstamp underneath the base is only partly legible, but appears to be that of Doulton & Watts, at the High Street, Lambeth. The identification of the figure is debatable. At least some are assumed to depict Queen Caroline, married to George, the Prince Regent (later George IV), in 1796. An attempt by George to divorce her in 1820 turned public opinion in her favour, and flasks depicting Caroline seem to date from 1820 to the time of her death in 1821 (Eyles and Irvine 2002, 21–2; Askey 1981, 54, 56, 58). However, Askey also notes at least one such flask carrying the mark of Doulton and Watts at 15 High Street, Lambeth, as this example does. This cannot date earlier than 1826, when the firm, known as Watts and Doulton from 1820, became Doulton and Watts, and moved to new premises in Lambeth High Street (Tyler *et al.* 2005, 12). The possibility remains, then, that at least some of these flasks commemorate the young Princess Victoria rather than Caroline (Askey 1981, 58).

The newly developing telegraph and electrical industries stimulated the production of new ceramic forms in stoneware, such as telegraph insulators and other electrical fittings, which were recovered mainly from Temple Mills. Telegraph insulators initially carried wires for Morse code; after 1876 they carried telephone wires. They appear on a price list of 1860 for Bourne of Denby, while Doulton manufactured insulators from the 1850s (internet source: Bourne, Denby; Tyler *et al.* 2005, 12).

Industrial finewares

The dominant ware in the post-medieval/modern assemblage comprises industrial finewares, and these include a wide variety of types, although most fall within the generic groups of creamware (CREA), pearlware (PEAR) and refined whiteware, including the transfer-printed examples (REFW, TPW). Vessel forms are largely tablewares – cups, plates, bowls – but there are also other domestic forms, such as chamberpots and candlesticks, a bedpan, and decorative items (figurines).

Amongst the transfer-printed wares there are six vessels with 'nursery' mottos or designs. A small tea plate carries a design of Robinson Crusoe, while the other vessels fall into the category of 'moralising china', carrying maxims, religious inscriptions and children's rhymes, which were popular during the Victorian period (Jeffries *et al.* 2008, 336–9).

A funnel in plain white earthenware (REFW) is of interest. This carries the transfer-printed mark of the 'Poplar and Stepney Sick Asylum' (Trench 92). The Poplar and Stepney Sick Asylum was founded in 1868, under the Metropolitan Poor Act of 1867, built at Bromley-by-Bow, and opened in 1873. It was renamed St Andrew's Hospital in 1921 (internet source: St Andrew's Hospital). No direct parallel for the funnel has as yet been located, but it could have been used for either feeding or sanitary purposes (Barber 2009). Three other vessels (all from Trench 52) feature the same mark – a straight-sided cup, a jug and a tea plate.

Containers for foodstuffs and other household goods are also represented amongst the industrial finewares, and several of these carry transfer-printed proprietary marks. The most common forms are cylindrical jars with an external groove for a lid attachment below the rim, used for preserves, and potted meat and fish products (eg, Keiller marmalade, J. Sainsbury's bloater paste and potted meat). One of these, containing Harris's Clotted Cream from Devonshire, makes the rather improbable claim that the product '*has been successfully employed in cases of debility and consumption*'.

Non-local wares

Other non-local wares, apart from the stonewares, discussed above, are present in small quantities. The earliest are the combed slipwares, of Staffordshire or

Bristol origin (STSL), in both closed (cups, mugs) and flatware forms, and one small sherd of Staffordshire coarseware (STCO). Three sherds in a red earthenware with a speckled glaze (SPEC), found in Trench 75, are of uncertain source, but the ware has been identified previously in north-eastern boroughs of London and in East Anglia (Jarrett 2009).

Other non-local wares largely date to the 19th century or later. These include Sunderland coarseware (SUND, SUND MOT), occurring exclusively in (kitchen) bowl forms, some handled, all internally white-slipped. Kitchen wares were also supplied by yellow ware, including slip-decorated variants (YELL, YELL SLIP), in the form of bowls, dishes and a jug. Rockingham ware (ROCK) occurs as teapots, (and a teapot lid), a small cream jug, and a larger jug, but of particular interest in this ware are parts of a spittoon (Trench 107), with scallop shell decoration around the 'shoulder', and a design around the sides, depicting uniformed figures above the motto …] BRAVE VOLUN[TEERS… (Pls 7.2, 7.4). This seems likely, from the uniforms, and the reference to volunteers, to date from the period of the second Boer War (1899–1902).

Porcelains

These include both English and imported wares. English porcelains are most common, and include the hard paste type (ENPO HP), as well as over- or under-glazed transfer-printed types (ENPO OTR, ENPO UTR), and those painted in enamels (ENPO PNTD). Forms largely comprise tea wares (saucers, tea cups, jugs, small bowls), but also egg cups and candlesticks. There are also toys (a teapot, a lid, and a jug, from dolls' tea sets; two doll fragments), decorative items (two figurines), and an electrical fitting. The continental porcelains (CONP), although seen in smaller quantities, demonstrate the same range of forms – tea wares, toys (doll and doll's head, miniature tea cup and jug) and a figurine.

Plate 7.4:
Spittoon 'Brave Volunteers'

From the Far East come Chinese porcelain, decorated in blue and white (CHPO BW), in Batavian style (CHPO BATV) and in Imari style (CHPO IMARI); and a single sherd of Japanese porcelain (JAPO). These porcelains were used for tablewares (plate, saucers, cups or small bowls), with one lid, probably from a ginger jar.

Pottery Provenance

Only one of the trenches (Trench 75, Temple Mills) produced pottery in any quantity (see Table 7.1). Combined with the clay pipe data, this has been used to provide the chronological framework for the trench. The quantity of sherds recovered from contexts pre-dating the early 19th century, however, was extremely low (135 sherds altogether). Stratigraphically these contexts ranged from layers pre-dating the construction of any of the buildings on the trench, through the Phase 1 construction and use of Building 1, and the associated timber waterfront structures, to the Phase 2 construction of Building 2. The range of wares consisted primarily of coarsewares, tinglazed wares and early English stonewares. Also present were early post-medieval finewares, German stoneware and Chinese porcelain. Vessel forms also showed a limited range, largely utilitarian – bowls, drinking vessels, possible chamber-pots and ointment pots – but with some tablewares. The range suggests occupation here rather than merely a working environment, and one where, at least later on, the inhabitants had some pretensions to gentility.

Pottery from Phases 3 (construction and use of Buildings 3 and 4, associated features, and revetment of Tumbling Bay Stream) and 4 (demolition of Building 4, new revetment of Tumbling Bay Stream), spanning the 19th century, was more common (840 sherds). By this time the emphasis of the ceramic assemblage had changed markedly, and now consisted largely of tablewares and tea wares (plates, saucers, cups and small bowls) in industrial finewares; by this time these wares were cheaply available to all sections of society. They include here an example of 'moralising china', in the form of a mug bearing two of Benjamin Franklin's maxims (these maxims, first published together in *Poor Richard's Almanac* (1737), are commonly found on other 'moralising china' from London and elsewhere: see Jeffries *et al.* 2008, 336). Two other examples of 'moralising china' were found redeposited in later contexts.

Phases 3 and 4 also saw the first appearance, in small quantities, of ceramics specifically made for use as containers for foodstuffs or other domestic goods, and an interest in horticulture is suggested by flowerpots. Very little pottery (or, indeed, any domestic refuse) was recovered from within the terraced cottages of Building 3 – most refuse would have been discarded externally, and probably to the rear of the cottages (beyond the western limit of the excavated area), although at least some appears to have been incorporated in the post-holes, drains and external surfaces associated with Building 4, thought to be an outbuilding (298 sherds).

Interestingly, a marked increase in the mean sherd weight between Phases 3 and 4 (7.4 g to 19.4 g), suggests that the pottery incorporated in the demolition and decommissioning layers of Phase 4, and in the backfilling behind the new timber revetment, did not originate as domestic refuse from the trench itself, but may have been introduced from elsewhere. The pottery from this phase includes several ceramic containers (jars and bottles for food and drink), and proprietary stamps on these place the date range later in the 19th century, from the 1870s or 1880s (eg, Keiller marmalade with a post-1862 mark; and Batey, soft drinks manufacturers of Shoreditch, listed in the trade directories from 1877). There are insufficient of these, however, to gain any overall picture of sources of supply for the foodstuffs and other products used on the site at this time. Phase 4 activity, dated *c.* 1890, just precedes the establishment of Messrs G.W. Abbott's dust shoot in 1896, where street sweepings and other refuse from Hackney were dumped.

This pattern is more obvious in Phase 5, when the pottery assemblage included a number of complete or near complete vessels, most of which came from the final infilling of Tumbling Bay Stream. This is recorded as having taken place from 1929, as part of a process of 'controlled tipping' in West Ham, whereby certain low-lying sites in the borough were designated as waste tips. Proprietary names on the bottles and jars from this infill date them broadly from the 1880s to the inter-war period, with identifiable suppliers in Stratford, Leyton and Maldon, Essex; in other words, these dumps include much residual refuse. Similar dumping appears to have taken place in the area immediately to the north (Eton Manor Sports Ground), although perhaps slightly earlier, as none of the wares or marks from the latter site definitely dates later than the beginning of the 20th century.

Ceramic and Stone Building Material

by Kevin Hayward and Matt Leivers

Samples of ceramic building material (CBM – brick, tile, drainpipe) from 17 trenches were examined (Table 7.5); the stone building material examined was confined to nine pieces, all from Temple Mills (Trench 75).

Romano-British

Romano-British CBM was very uncommon, and no stone building material of this date was recovered. Trench 56 produced two abraded pieces, both of early Romano-British (AD 50–120) type. Trench 58 produced a small cluster of abraded brick, tile and *opus signinum*, redeposited in the gravel fills of late medieval/early post-medieval ditch 126 (Phase 2), and a single abraded tile of the Hertfordshire Radlett fabric (3023) from an alluvial layer within a channel, found associated with Romano-British pottery. Trench 95 produced a brick bearing the imprint of a hob-nailed shoe or sandal from a sandy silt layer which had an attached layer of thick, coarse *opus signinum*, suggesting that it may have come from a substantial structure.

Medieval

Medieval ceramic construction materials are limited to some abraded peg tiles from the alluvial silty and sandy clays at Trench 75 (pre-Phase 1), and a single piece from alluvium in Trench 118.

Two stone mouldings, both from Trench 75, were probably parts of medieval column bases. One (reused in Phase 3 drain 507 from Building 3) was made of Reigate stone from the Surrey Upper Greensand; the other (reused in the Phase 3 cobbled surface outside Building 4) was made of Jurassic Taynton stone from Oxfordshire. Both stone types were used in quantity in medieval ecclesiastical buildings through-out London from which they probably originated. The same source is likely for the Kentish ragstone rubble from the final infill of Tumbling Bay Stream (Phase 5) and the Hassock stone from drain 204 from Building 3 (Phase 3).

Table 7.5: Quantification of CBM by trench

Trench	Brick	Tile R	Tile F	Tile ?	Indet.	Drain
9	–	–	–	–	3	–
38	–	1	–	–	–	–
43	2	–	–	2	2	–
52	–	1	1	–	–	–
56	–	–	–	1	1	–
58	Unspecified quantities of brick and tile	–	–	–	–	–
59	5	6	–	–	–	–
75	282 total CBM	–	–	–	–	–
92–95	Unspecified quantities of brick and roof tile	–	–	–	–	–
109	–	6	–	–	–	1
111	–	–	–	–	2	–
112	1	1	–	–	–	–
113	3	3	–	–	–	–
118	20 total CBM	–	–	–	–	–

Post-Medieval and Modern

The CBM assemblage is dominated by post-medieval forms and fabrics, comprising predominantly unfrogged, stock moulded bricks of early post-medieval (1450–1700) and late post-medieval (1700–1800) date from Trench 75. Smaller quantities were recovered from other trenches.

At Trench 75, the walls of Building 2 in the south of the trench were built almost entirely of thin but wide Tudor-type stock moulded red (fabric 3033) and mottled (fabric 3039) bricks (dated 1450–1700) and transitional (fabric 3032nr3033) post-Great Fire maroon bricks (dated 1666–1725). This would indicate that the structures were built between the late 17th and early 18th century, corroborating the evidence from the stratigraphy.

The brick used in the later walls of the terrace of six cottages (Building 3) consisted of a mixture of fabrics and forms. These include the widespread reuse (in 19th century gravel cement) of the same thin red and transitional fabrics from the underlying industrial structures, which may indicate that early post-medieval activity would have been much greater than previously thought. In addition to this, unfrogged and frogged purple post-Great Fire clinker bricks (fabrics 3032, 3034) were used for the first time in these walls. As frogged bricks were only manufactured after 1750, these structures can only date from the second half of the 18th century at the earliest. However, the presence of 'Roman cement', a mixture of chalk and clay (patented after 1790), and moulded London stock bricks (fabric 3035, manufactured after 1780) suggests a date in the early 19th century as more likely.

As well as the walls of the terraced cottages, the drains and edging all underwent a series of repairs or replacements from the middle of the 19th century onwards. This is shown by the use of machined kiln bricks, the re-introduction of red bricks and machined London stock bricks – all of which could only have been manufactured after 1850. Finally, the inclusion of yellow stock moulded bricks (fabric 3035) would indicate that the brick cobbled surfaces were constructed after 1780. The widespread reuse of poor quality old bricks would also indicate that this was the case.

Tiles were less frequent, but were recovered from Trench 38 (including one pantile, probably redeposited); Trench 52 (an overfired Flemish floor tile fragment); Trench 59 (pantile); Trench 92 (peg tile); Trench 94 (peg and pantile); Trench 109 (three fragments of roof tile and three of pantile); Trench 112 (a single roof tile fragment); Trench 113 (two fragments of roof tile and a third of pantile) and Trench 118 (seven peg tile, one pantile and one ridge tile fragment.

Apart from the two medieval column bases, other worked building stone, all from Trench 75, was limited to paving in York stone (redeposited in the Phase 4 revetment of Tumbling Bay Stream) and Carrara marble (from a Phase 3 post-hole), both common post-medieval stone types.

Fired Clay

by Matt Leivers

A small assemblage of fired clay was recovered from two trenches: 16 pieces from Trench 9 and two pieces from Trench 92. The pieces consist of fragments of loomweights, fragments of perforated slabs, and shapeless pieces of indeterminate origin.

Loomweights

Fragments of two loomweights were recovered from Trench 9. Two pieces of a cylindrical weight with a single vertical perforation through the approximate centre came from pit 1896, associated with over half a kilogram of Late Bronze Age pottery. A piece with a perforation running diagonally between two edges is probably a fragment of a triangular loomweight. This piece came from Middle Iron Age ditch 1213.

Perforated Clay Slabs

Fragments of thin slabs with the remains of one or more perforation were recovered, mostly from Trench 9, from pits 1019 (one piece), 1322 (one piece), 1896 (two pieces), and 2004 (one piece), and from a layer (1027) sealing the pits (five pieces). A similar piece, without perforations, came from pit 1430 in the same trench. All of the contexts containing perforated fragments in Trench 9 were Late Bronze Age on the basis of ceramic association.

In addition, two further pieces were recovered from a post-medieval layer in Trench 92.

All reconstructable forms are straight-sided, and all of the examples are in flint-tempered fabrics that would not be out of place in the Late Bronze Age pottery repertoire. These and other less common traits (general indications of thickness, expanded and grooved edges) identify the fragments as perforated clay slabs of Late Bronze Age or Earliest Iron Age date (Champion 1980; 2011).

The function of these perforated tablets is uncertain, although various suggestions have been made, including use as oven furniture, or an association with pottery production or salt-making. Both Cynthia Poole and Timothy Champion consider them to be associated with food preparation (Champion pers. comm.), perhaps as part of a wider class of fired-clay oven and hearth furniture (Poole 2011).

Slabs of this type are a recurrent if scarce occurrence on Late Bronze Age and Earliest Iron Age sites in the Thames Valley. Most often they are found in areas of field systems, in association with defended enclosures or ringworks (Champion 2011, 220), of which South Hornchurch is the closest example. To date, no other examples have been published from the Lea Valley, although the concentration of Late Bronze Age sites and metalwork finds in the area suggests that this would be a typical location for them to occur (Champion, pers. comm.).

Fragments

Two miscellaneous fragments were recovered from Trench 9. A perforated fragment came from a post-hole (1169) associated with Middle Iron Age ceramics, and another from a pit (1506) associated with Late Bronze Age ceramics. Neither can be identified to a specific type.

Clay Tobacco Pipes

by Lorraine Mepham

The complete clay tobacco pipe assemblage reported on amounts to 1018 pieces, of which about 92% (935 pieces) came from a single trench (Trench 75, Temple Mills). Quantities recovered from other trenches were minimal; 29 trenches produced clay pipe, in quantities ranging from one to 11 (see Table 7.1, note that some trenches are grouped).

The assemblage includes a large proportion of plain stem fragments (some with mouthpieces), as well as bowls in varying degrees of completeness. Only three pipes survived complete, two of them short, 'cutty' pipes (Pl. 7.5). Some bowls are decorated. The bowls cover a date range from the early 17th century onwards, although there are few examples pre-dating the 18th century. Both bowls and stems include examples carrying makers' marks, in the form of symbols, initials, or full names. The range of identifiable makers indicates a supply drawn largely from east London (Limehouse, Whitechapel, Stepney, Bethnal Green).

Methods of Analysis

All clay pipe was examined and reported on at the assessment stage, the reports prepared variously by several individuals (13 separate reports). All clay pipe was subsequently checked against the assessment records and reports. Bowls were classified using the typologies of Atkinson and Oswald (1969) and Oswald (1975); these are pre-fixed AO and O respectively. Some bowls are too fragmentary to be classified by type. The extent of milling on the 17th century bowls has been recorded in quarters. Decorative motifs have been recorded, as have makers' marks and their position.

Plate 7.5: Complete short ('cutty') pipe

Table 7.6: Clay tobacco pipe bowl types by trench

		Trench													
Bowl type	Date range	22	26	53/54	58/59	60	65	75	76/77	78/79	97–108	111	117	118	**Total**
AO5	1610–1640	–	–	–	–	–	–	–	–	–	–	–	–	1	**1**
AO9	1640–1660	–	–	–	–	–	–	2	–	–	–	–	–	–	**2**
AO13	1660–1680	–	–	–	–	–	–	2	–	–	–	–	–	–	**2**
AO15	1660–1680	–	–	–	–	–	–	1	–	–	–	–	–	–	**1**
AO18	1660–1680	–	–	–	–	–	–	2	–	–	–	–	–	–	**2**
AO20	1680–1710	–	–	–	–	–	–	1	–	–	–	–	–	–	**1**
AO21	1680–1710	–	–	–	–	–	–	6	–	–	–	–	–	–	**6**
AO22	1680–1710	–	–	–	–	–	–	8	–	–	–	1	–	–	**9**
AO24	1700–1740	–	–	–	–	–	–	1	–	–	–	–	–	–	**1**
AO25	1700–1770	–	–	–	–	–	–	3	–	–	–	–	–	–	**3**
AO26	1740–1800	–	–	–	–	–	–	2	–	–	–	–	–	–	**2**
AO27	1780–1830	–	–	–	1	–	–	5	–	–	–	–	–	2	**8**
AO28	1820–1860	1	–	–	1	1	–	15	–	–	1	–	–	–	**19**
AO29	1840–1880	–	1	1	–	–	1	7	–	1	4	–	–	–	**15**
AO30	1850+	1	–	–	1	1	–	8	–	2	3	–	–	–	**16**
AO33	1840+	–	–	2		–	–	1	1	1	1	–	1	–	**7**
OS10	1700–1740	–	–	–	–	–	–	15	–	–	–	–	–	1	**16**
OS12	1730–1780	–	–	–	–	–	–	5	–	–	–	–	–	–	**5**
square bowl		–	–	–	1	–	–	–	–	–	–	–	–	–	**1**
Totals		**2**	**1**	**3**	**4**	**2**	**1**	**84**	**1**	**4**	**9**	**1**	**1**	**4**	**117**

Results of Analysis

A full descriptive breakdown of the clay pipe assemblage can be found in the specialist archive report (Mepham 2012b), and only a very brief summary is presented here, mainly in tabulated form. Table 7.6 gives the quantification of the bowl types (and their date ranges) by Trench, while Table 7.7 presents the makers' marks.

Most of the datable pipes belong to the 19th century; these included 64 bowls (types AO27, AO28, AO29, AO30 and AO33). One example of AO28 is an oversized bowl, thick walled and with a flat internal base containing four holes surrounding a larger central hole. This may be a patented registered pipe design, but no information survives to confirm this. It probably dates to after 1880. Two of the AO30 pipes are complete, plain cutty types (short bowl) (Pl. 7.5), and a number of the other AO30 bowls are highly decorated. One bowl has fluting around the rim containing a flower, and around the base there are scallops that continue to the rim; this resembles a type called the *Tulip* in Pollocks' 1879 catalogue. At least five other bowls have a band of beaded moulding below the rim, and triangular stems. Another bowl has scale decoration in relief. Of the Irish-type AO33 bowls, one has a harp stamped on the back, and a second has the heads of Victoria on one side and Edward VII on the other. A third has a rope cordon positioned part way down the bowl, and random dots in relief below this.

In addition, one unusual square bowl belongs to this period, identified by its mark. This bowl, from Trench 59 (from layer 1000 overlying the clinker-built boat), is a rare example of a pipe stamped with the name not of the maker, but of the consumer - in this case a pub and its landlord. It has a horse in relief on two opposed faces, each face also bearing lettering as follows: WHITE HORSE / F. BRIEN, and CORNER OF CHURCH ST / SHOREDITCH (Fig. 7.4). F. Brien is listed as the landlord of the White Horse at 64 Shoreditch High Street in 1872; by 1881 he had been replaced by Henry Balls (internet source: historical pubs). Church Street is now Redchurch Street.

Table 7.7: Clay pipe makers' mark by bowl type

Bowl type	No.	Marks	Identification and comments
AO5	1	EB under heel (incuse)	Unidentified
AO21	2	E/?E on sides of heel (relief)	Family name illegible; unidentified
AO22	3	W/M on sides of heel (relief)	William Manby I, 1681–96, Aldgate
AO25	2	P/B on sides of heel, crowns above each letter (relief)	?Peter Branbury, recorded 1696
AO26	1	I/F on spur (relief); FORD/STEPNEY in circle on back of bowl (incuse)	John Ford (2), 1805–65, Stepney
AO26	1	?/K on spur (relief)	Forename damaged; unidentified
AO27	1	I/R on spur (relief)	Probably James Roscoe, 1809–11, Stratford
AO27	1	I/F on spur (relief)	John Ford (2), 1805–65, Stepney
AO27	1	C/W on spur (relief)	Charles Walford, 1828. Possibly remoulded bowl
AO27	2	I/S on spur (relief)	No pipe makers known locally (see Oswald 1975, 145)
AO27	1	I/R on spur (relief)	Unidentified
AO27	1	E/H on spur (relief)	Unidentified
AO28	1	?/W on spur (relief)	Forename illegible; unidentified
AO28	1	?/I on spur (relief)	Forename illegible; unidentified
AO28	1	I/F on spur (relief)	?John Ford (2), 1805–65, Stepney, or Jesse Ford, 1836–77, Mile End Rd
AO28	4	stars on sides of spur (relief)	Unidentified
AO28	1	S/? on spur (relief)	Family name illegible; unidentified
AO28	1	?/?G on spur (relief)	Almost totally illegible; unidentified
AO28	1	J/D on spur (relief)	James Davis (2), 1826–32, Cromer Street, or John Dearden, 1805–40, Edgware Road; both are unlikely here
AO28	1	J/B on spur (relief)	James Bourne, 1799–1832, Bethnal Green, or John Birch, 1823, Whitechapel; many contemporary makers with the same initials (see Oswald 1975, 131)
AO28	1	P/B on spur (relief)	Poorly moulded *Fox & Grapes* public house (Atkinson & Oswald 1969, 183, fig. 7.44); Paul Balme, 1832, Mile End Road
AO28	1	E/R on spur (relief); ROACH / LONDON in wreath on back of bowl (incuse)	Edmund Roach, Featherstone Street, Shoreditch (1859–99), probably producing pipes after this date
AO29	1	4-petalled rosette on each side of spur (relief)	Unidentified
AO29	1	I/? on spur (relief)	Acorn & oak leaf borders; family name missing; unidentified
AO29	1	?/F on spur (relief)	Forename illegible; unidentified
AO29	1	M/L on spur (relief)	probably Mrs M. Leach, 1848–69, Whitechapel
AO29	1	K/G on spur (relief); KIPPS & GLIDE in shield on back of bowl (incuse)	Kipps & Glide, *c.* 1860
AO29	1	G/B on spur (relief); BALME / MILE / END above star, in shield, on back of bowl (incuse)	George Balme, 1867–76, Mile End Road
AO29	1	pellets on sides of spur (relief)	Unidentified
AO29	1	I/J on spur (relief)	Moulded dec: RAOB; maker unidentified
frag	1	I/C on sides of heel (relief)	Unidentified
frag	1	BALM[E] / MIL[E] / END (in shield) on back of bowl (incuse)	George Balme, 1867–76, Mile End Road
OS10	18	D/?I on sides of heel (relief)	Family name uncertain; unidentified
OS10	1	R/B on sides of heel (relief)	Possibly Robert Bowes (1719), R. Barrett (1719), or Richard Bryant (1733–40)
OS10	1	E/C on sides of heel (relief)	?Elizabeth Collett, 1762, Gaol Yard, Drury Lane
OS10	9	W/M on sides of heel (relief)	William Manby II, 1719–63, Limehouse & other workshops in SE London
OS10	1	I/W on sides of heel (relief)	Several makers for this period (Oswald 1975, 148); John Watts, 1731, Whitechapel most locally known mater pipemaker
OS12	1	Raised dots on either side of heel (relief)	Unidentified
OS12	1	illegible initials on sides of heel (relief)	Unidentified
OS12	3	R/B on sides of heel (relief)	?Robert Baldwin, 1749, Chymister Alley, St Martin's Westminster, but more likely unidentified
OS12	1	?W/H on spur (relief)	?William Huggins, 1739–42, Green Dragon Alley, St Annes, Limehouse
square	1	WHITE HORSE / horse / F BRIEN on L face; CORNER OF CHURCH ST / horse / SHORE/DITCH on R face (all relief)	F. Brien listed as landlord of White Horse, 64 Shoreditch High Street, 1872
stem	1	CORNWELL / LONDON, in cartouches, on sides of stem (relief)	John Cornwell, Stepney, working 1854–92, but recorded 1854–68, St George in the East; 1880–92, Ratcliffe
frag	1	W/M on sides of heel (relief)	William Manby II, 1719–63, Limehouse & other workshops in SE London

Figure 7.4: Unusual square bowl clay tobacco pipe

Worked Flint

by Matt Leivers and Erica Gittins

A small assemblage of 257 pieces of flint was recovered, of which 170 pieces were available for analysis (Table 7.8). Most of the material is undiagnostic flake debitage which could date to any part of the later prehistoric period (Late Neolithic or later). Very few pieces are chronologically distinctive.

Palaeolithic/Early Mesolithic

One broken flake from a large blade core could possibly be of Palaeolithic date, although an Early Mesolithic date is perhaps more likely. The piece came from Trench 118 and is clearly redeposited. Definite Mesolithic pieces consist of a flake struck from a bladelet core and a bladelet core fragment; a notched blade; a tranchet axe sharpening flake; and a burin from Trench 9. An unabraded microlith (Barrowman and Corcoran 2008) was recovered from the base of Trench 101 during the evaluation (not seen during analysis, this may in fact be a bladelet rather than a microlith).

Mesolithic/earlier Neolithic

Pieces of more general Mesolithic or earlier Neolithic date consist of two blade-like flakes; a blade with edge-damage; two pieces with miscellaneous retouch; a core trimming flake; a broken flake and a broken blade, from Trench 9; a core fragment, the blade of an end or side scraper, a blade and a broken blade from Trench 43; and a flint axe from Trench 118 (context 580, Fig. 7.5; Pl. 2.1 above).

Type	No.
Flakes	117
Blades	3
Core rejuvenation/preparation	1
Cores	23
Irregular debitage	10
Axe debitage	1
Scrapers	2
Burin	1
Notch	1
Axe	1
Miscellaneous retouch	10
Total	**170**

Table 7.8: Worked flint totals by type

The axe is thin-butted, fully flaked bifacially but not ground or polished. It has a notably rounded butt and blade, and is 220 mm in length by 80 mm breadth at the widest point. A date of Early or Middle Neolithic (ie, the 4th millennium BC) is probable given its form and context. The flint is mid- to dark greenish-grey with cherty inclusions. Although undamaged the axe is rather worn, with the edges of the flake scars being dulled. The piece was recovered from deposits on the eastern side of a north-west/south-east aligned Neolithic stream channel, and was probably *in situ*.

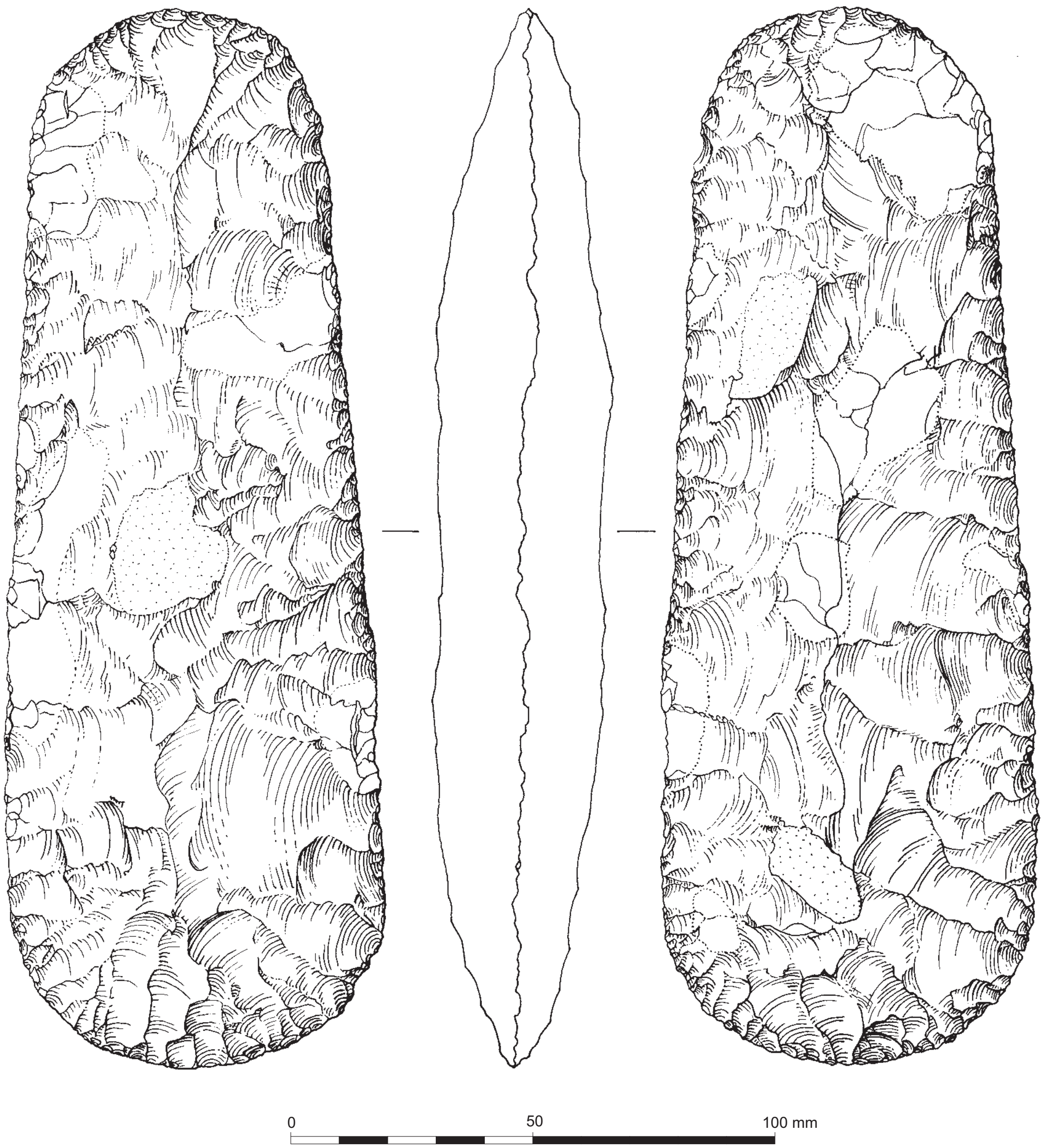


Figure 7.5:
Flint axe

Later Neolithic to Early Iron Age

Two core trimming flakes from Trench 9 are likely to be of later Neolithic/Early Bronze Age date. Ten flakes, one piece of irregular debitage, one piece with miscellaneous retouch and one core from Trench 9 are likely to date to the Middle to Late Bronze Age, while 13 flakes, three pieces of irregular debitage, three broken cores and a core from Trench 9 have the characteristics of the very expedient technology typical of the Late Bronze Age to Early Iron Age.

Discussion

Only the Neolithic flint axe is worthy of further note (Fig. 7.5). Finds of individual axes from the Thames and its tributaries are not uncommon (eg, Adkins and Jackson 1978), but most are unstratified, giving the Olympic Park example added significance. Whether the axe was lost by chance or was deliberately placed into the river is uncertain, although the condition of the piece may suggest the latter. Other accounts of flint axes from this period in the Lea Valley suggest that the placing of the Olympic

Park example (if that was the case) was not an isolated instance: Smith (1894, 309–11) records three polished axes in perfect condition lying 'side by side, and touching each other' from Temple Mills at Stratford, while a single flaked axe was found buried on its edge close to the confluence of the eastern (Croydon) and western (Carshalton) headwaters of the river Wandle at Wallington (Cotton 2003).

The Olympic Park example has very straight sides and curved ends with no marked angle between. A small number of broadly similar forms (although none identical) are known elsewhere in the London area: an example from the Thames off The Reservoir, Putney Reach is of similar size (204 x 86 mm) although rather thicker and slightly more convex-sided; another Thames example from Barn Elms Reach is again of a similar size (200 x 75 mm) and shares the slenderness and straight sides of the Olympic Park axe, although the butt is considerably more angular (inf. J. Cotton).

With the exception of the axe the assemblage is of limited significance, demonstrating only a low level of human activity around the channels of the Lea throughout prehistory.

Burnt Flint

by Matt Leivers

Burnt flint was recovered from a number of trenches although only Trench 9 contained any significant quantity (Table 7.1). Here burnt flint was recovered from a variety of features of mainly Late Bronze Age and Middle Iron Age date. The burnt flint was relatively evenly distributed among numerous features across the trench. The largest quantity from any single context was 1726 g and only four other contexts produced more than 1 kg, all of these being from Late Bronze Age pits.

Although some of the material from individual contexts was variably burnt, as would be consistent with incidental burning in hearths, the bulk of the material was more heavily and uniformly burnt, consistent with it having been deliberately and systematically fired. The generally worn, rounded and chatter-marked state of the identifiable pieces indicates a local source in alluvial deposits.

The uses of burnt flint are not well understood, although large quantities of it are sometimes recovered from prehistoric sites. Quantities of burnt stone have sometimes been associated with parching corn, cooking, feasting or ceremonial practices, and with a variety of industrial processes. In isolation from other forms of evidence it is neither chronologically sensitive nor particularly indicative of any specific practice.

Vessel Glass

by Lorraine Mepham

The complete glass assemblage, all of post-medieval date, amounts to 749 pieces (including complete vessels), of which about two-thirds (495 pieces) came from Trench 75. Twenty-two other trenches produced glass, in quantities ranging from two to 32 pieces (see Table 7.1, note that some trenches are grouped).

A small amount of the recorded glass was recovered as unstratified finds. A significant proportion, however, came from levelling and dumped layers, in particular from Trench 75, and in general little of the glass can be regarded as forming part of primary deposits. Rather, it has been redeposited from elsewhere, probably in some cases as part of large-scale dumping exercises, possibly of municipal instigation.

The assemblage consists primarily of vessel glass, of which a large part comprises containers for foodstuffs, beverages and household products. Window glass is also represented, as well as a few objects, including some household items (eg, lampshades).

Methods of Analysis

All glass was examined and reported on at the assessment stage, the reports prepared variously by several individuals. During the process of analysis, all glass was checked against the assessment records and reports as a first step. Each fragment (or vessel) was quantified (sherd count and weight) by type (bottle, jar, drinking vessel, misc vessel, window, object). Further details of the form, decoration, and any other modification (such as embossed proprietary names) were also noted. The archive specialist report (Mepham 2012c) gives a detailed description of the complete glass assemblage, of which a summary is presented here.

Plate 7.6: Bottle seal 1732

Utilitarian Wares

Bottles and jars

Bottle and jar glass makes up the majority of the glass assemblage, and ranges in date from early 17th to 20th century. The earliest vessel identified is a case bottle dating to the 17th century, found in Trench 75 (probably intrusive in an alluvial layer [845] that returned a radiocarbon date in the Romano-British period: see Douglas and Spurr 2009, 31). Other early forms, dating between the mid-17th and mid-18th century, are also restricted to Trench 75; these include the base from one shaft-and-globe bottle (*c.* 1650–80; Biddle and Webster 2005, *pace* Dumbrell 1992), and fragments from at least three onion (*c.* 1680–1730; Biddle and Webster 2005) and one possible mallet form (*ibid.*, *c.* 1730–60). A bottle seal, stamped with the name 'Jams. Barrow', and the date '1732' (Pl. 7.6), may originate from a family living in Suffolk and Cambridge in the 16th century (Dumbrell 1992, 235).

Most of the identifiable bottle and jar forms, however, belong to the 19th and early 20th centuries, and these include a range of containers for wine and other alcohol, soft drinks (mainly carbonated), sauces and other foodstuffs, cosmetics and pharmaceutical products, and household goods. The majority are for foodstuffs or beverages, with health and hygiene products, cosmetics and household products forming much smaller proportions.

A number of these containers (98) carry some form of embossed proprietary mark of the contents manufacturers and, occasionally, of the vessel manufacturer (details in archive; see also Mepham 2012c). Amongst the soft drinks, there are some examples of manufacturers also represented amongst the ceramic (stoneware) containers (eg, R. White of Camberwell, Batey of Shoreditch). In general, although glass bottles were used for carbonated drinks alongside stoneware containers from around 1840, stoneware bottles had largely disappeared by the 1930s, following hygiene concerns. Companies whose products are seen here only in glass bottles might therefore be expected to have been trading in the early/mid-20th century, eg, J. Mills of Bermondsey (in trade directories from 1938).

There are many well-known names amongst the bottles and jars containing foodstuffs, many still in production today, including Bovril (first developed as Johnston's Fluid Beef and renamed as Bovril in 1886, first factory in Shoreditch), The Co-operative Wholesale Society (meat or fish paste, factory in Silvertown by 1902), Daddies Sauce (launched in 1904), Goodall Backhouse's Yorkshire Relish (firm established in Leeds in 1837), Mason's OK Sauce (introduced in 1911), Horlicks Malted Milk (company founded in Chicago in 1873), Pan Yan pickle (first made by Scottish firm Maconochies in 1907 in the

Isle of Dogs), and Paterson's Camp Coffee (in production from 1876).

Other products and manufacturers are not now so familiar, although an internet search suggests that their containers are still circulating in some numbers: Armour Beef Juice from Chicago (presumably a rival to Bovril); Holbrook & Co. (sauces, sued by Goodall Backhouse in the 1890s for using the name of 'Yorkshire Relish'); the Maltine Manufacturing Company (maltine was a malt extract; the US-based firm was operating from Bloomsbury by 1909); Peck's (meat paste); and Symington & Co. (based in Edinburgh, producing a coffee essence rivalling Paterson's Camp Coffee). Some of the small, London-based food manufacturers can be glimpsed in the trade directories. These include E. Manwaring of Peckham (recorded in 1878 and 1908), and Samuel Dodman of Bermondsey (recorded in 1884), both supplying sauces.

Several products are related to health and hygiene, including Vaseline Petroleum Jelly (patented by Robert Chesebrough in the USA in 1872), Elliman's Universal Embrocation (introduced in 1847 and marketed as suitable for both humans and animals), Mrs Winslow's Soothing Syrup by Curtis and Perkins (first marketed in Maine, USA in 1879, for teething infants), and Owbridge's Lung Tonic (invented in 1874).

Phials

Sixteen phials were recorded, 13 of them complete – six of these were found in the final infilling (early 20th century) of Tumbling Bay Stream in Trench 75. Most are cylindrical with short necks and rims cracked-off or of laid-on ring type, although one is conical, and two have been slightly flattened on one side, giving a D-shaped section. Two bases, both from Trench 75, are from phials of mid–late 17th or 18th century date, while the remainder date to the 19th or early 20th centuries.

Tablewares

Only ten fragments of drinking vessels were recorded. The earliest of these is a wine glass baluster stem from Trench 75, dated *c.* 1700–40 (Tumbling Bay Stream early 20th century infill). Other footring bases come from wineglasses dating to the late 18th/19th century or the 19th/20th century. There are also two fragments from beakers or tumblers, one of late 18th/19th century, and one 19th/20th century beer glass has the acid-etched mark 'Half Pint'.

Other Vessels

The remainder of the vessel glass comprises mainly small fragments, some of which could belong to further utilitarian wares, although some are clearly from more decorative vessels, identifiable either from form or from their colour – several fragments are in strong coloured glass (blue, green, orange, pink, white), sometimes opaque. These include several possible bowls or vases with fluted, moulded or embossed decoration, and a possible lid.

Other decorative wares comprise a possible lamp base in opaque green glass, in the form of three standing female figures, in Art Deco style; a curved rod of 'barley twist' form, possibly a decorative handle; and a fragment of a vase or other object, apparently in the form of a 'thorny branch', in blue glass. There are also fragments of three lamp shades, in either colourless or opaque white glass.

Site Provenance

Trench 75

This trench produced the largest assemblage of glass (495 pieces, including 70 complete or almost complete bottles and jars). The glass derived from contexts dating from stratigraphic Phase 2 onwards (a possible 17th century case bottle base from a pre-Phase 1 context, which produced a radiocarbon date in the Romano-British period, is clearly intrusive here).

Glass from Phase 2 (74 fragments) derived largely from contexts within the fill of the timber-lined water channel. These include parts of at least three green wine bottles in 'onion' forms; a fourth bottle, of 'shaft-and-globe' form came from a compacted clay layer outside Building 2. There is also the base of a single phial of mid 17th to late 18th century type, also from the channel.

Phase 3 glass (133 fragments) derived from contexts associated with Building 4 (particularly the associated external surfaces and other features); none came from Building 3 (the terraced cottages). Fragments of mid-17th to mid-18th century bottle glass (including the bottle seal of 'Jams. Barrow 1732'), and a phial base of similar date, are residual in this phase; alongside these more recent bottles and jars, including two with embossed proprietary marks (illegible), make their first appearance, but there are few diagnostic forms.

From Phase 4, 56 fragments, recovered from contexts relating to the disuse of the Building 3 drains and the new revetment of Tumbling Bay Stream, include wine bottles and wineglasses of 18th/19th century type, and there is one early 20th century milk bottle from a dairy in Ruckholt Road, Leyton (which runs to the north-west of Temple Mills), as well as some small pieces of decorative glass, perhaps from a bowl or vase.

The largest group of glass, however, derived from Phase 5 contexts (217 fragments). It is this group that includes all of the complete or nearly complete vessels found in Trench 75. Nearly all of these came from the infill of Tumbling Bay Stream. Only small groups were encountered in other contexts, including contexts relating to the demolition of Buildings 4 and 5, the construction of a new gas pipe trench, and a pavement constructed to the east of Building 3. Clearly there are some residual fragments here, including 17th/18th century bottle glass, but other fragments appear to be contemporaneous with the late 19th to mid-20th century activity represented by Phase 5. These include bottle, other vessel, wine glass and window glass, as well as some waste fragments. In general the range is suggestive of standard small-scale domestic refuse, and includes some 'fancy' items (decorative bowls or vases, and a jug) as well as utilitarian containers.

Large deposits of glass (as well as pottery and other materials) were recovered from the final infill of Tumbling Bay Stream, which is dated to the early 20th century. A high proportion of the glass within this stratigraphic group comprises a group of 59 complete or almost complete bottles and jars (a further nine complete bottles and jars found unstratified could also be related to these deposits). Many of these carry proprietary names identifying the contents and/or manufacturers; the group as a whole includes examples ranging in date from late 19th to 20th century. The group appears to represent part of a large-scale dump of refuse, either accumulating in the stream channel or, more probably, accumulated elsewhere and then dumped into the stream in bulk, for example during dredging of the Lea as part of a flood relief scheme in 1934. A later Pepsi-Cola bottle from the 1950s (the trade mark dates it as 1951 or later) may represent opportunistic disposal into the top of the infilled stream.

Trenches 96-108

These trenches, located immediately to the north of Temple Mills in Eton Manor Sports Ground, produced a similar range of material. All the glass came from Victorian phases of activity, largely from deposits of made ground or landfill, with very little from earlier phases. This glass represents material which has been dumped wholesale on the site from elsewhere. The group includes a number (at least 27) complete or almost complete bottles, jars and phials, of which several bear proprietary marks, signifying a range of beverages, foodstuffs, household and health-related products, ranging in

Table 7.9: Metalworking debris totals by trench

Trench	Weight (g)
9	131
39	10
43	39
58	215
59	336
75	18,094
Total	**18,825**

date from the 1870s or 1880s into the early 20th century, perhaps up to the 1930s.

Some clues as to where the glass could have been dumped from may be provided by the proprietary names. Some of these are clearly from manufacturers whose products, either London-made or transported to London from other parts of the UK, were widely available across the capital and its suburbs in the late 19th and early 20th centuries – for example, Horlicks Malted Milk, Elliman's Universal Embrocation, and Goodall Backhouse's Yorkshire Relish. There are, however, also represented here some small-scale manufacturers of carbonated drinks and pharmaceutical products, whose products might be expected to have had a relatively restricted distribution within their immediate locality. These manufacturers were located in east London, in the districts of Shoreditch, Bethnal Green and Stepney.

Trenches 76 and 77

A similar pattern of dumping within made ground deposits was encountered in Trenches 76 and 77, to the south-east of Temple Mills. The recorded assemblage from this trench was not large (30 pieces), but included 26 complete bottles and jars, including four Bovril jars, one jar of Armour beef juice (Chicago), one Vaseline jar, two Jeyes Fluid bottles, two Owbridge's Lung Tonic bottles, a beer bottle from Batey's brewery (Shoreditch), a complete case bottle from Liptons, a small sauce bottle from Holbrooks, and two rectangular bottles (perhaps also for sauce), one from J. Davis of London SE (probably Bermondsey), and one from A.J. White (unlocated).

Metalworking Debris

by Phil Andrews

Debris certainly or possibly deriving from metalworking was recovered from six trenches, although, with one exception, in very small quantities (Table 7.9).

The material, predominantly slag, has been classified on the basis of morphology alone. It includes some which may derive from iron or copper smelting, some which is a by-product of iron smithing, and other, undiagnostic material which may come from either iron smelting or smithing (but probably the latter here). The most characteristic iron smithing debris comprises smithing hearth bottoms (SHBs), which are the hemispherical, bowl-shaped accumulations of slag which formed in the base of smithing hearths. There is also some cindery material/fuel ash slag which may have derived from a high temperature process, though not necessarily metalworking. Sample residues have been examined where appropriate for hammerscale, which formed as a result of hammering or welding iron, but virtually none was present.

The debris from Trenches 39, 43, 58 and 59 includes one fragment of smithing hearth bottom (weighing 85 g) and a larger, undiagnostic piece (251 g) of iron slag, both from 19th century contexts and probably redeposited. This material is not further discussed here (details in archive).

Prehistoric

A tiny quantity (131 g) of debris was recovered from three prehistoric contexts in Trench 9. The assessment questioned the dating of the contexts and these have been re-examined in the light of subsequent site analysis.

Part of a SHB (97 g) with coal inclusions came from the fill of Middle Bronze Age ditch 1922 (field system 2354). The presence of coal indicates a Romano-British date at the earliest for this piece of slag and it must, therefore, be considered intrusive. In addition, a small piece (14 g) of undiagnostic slag came from a trampled layer (1583) of Late Bronze Age/Iron Age date and a relatively dense undiagnostic fragment (20 g) from the fill of Middle Iron Age enclosure ditch 1213. Both pieces could be of Iron Age date, but they cannot be regarded as securely stratified and cannot, therefore, be used as an indicator of ironworking on the site at this time.

Post-medieval

The largest quantity (18,094 g) of debris came from Trench 75. Temple Mills is known, from documentary evidence (see below), to have been a likely site of non-ferrous metalworking from the end of the 17th century until at least 1720. Full details are tabulated in the assessment report and are summarised in Table 7.10.

Of particular relevance here is the material in contexts assigned to Phases 2 (mid-/late 18th to early 19th century) and 3 (early 19th century to *c.* 1890) respectively.

Of the two SHBs from the fill of the construction cut (1091) for the Phase 2 timber water channel, one is particularly substantial (3.7 kg) and comprises an agglomeration of SHBs, though formed in a single iron smithing hearth. All, however, were redeposited in the construction cut and may, therefore, pre-date the documented metalworking activity. By contrast, the SHB from rubble fill 488 is from a demolition layer within the Phase 2 furnace in Building 2.

The other noteworthy assemblage is the 2.95 kg of 'copper-rich' slag from a variety of contexts, including the base of the Phase 2 furnace. The largest quantity, however, came from the fill of the construction cut (1091) for the Phase 2 timber water channel. This 'copper-rich' slag was relatively dense, plate-like in form but broken up, and had small patches of pale green copper efflorescence on the surface; in two cases (from a demolition layer associated with Building 2, and from a post-hole possibly forming part of Building 4) minute traces of metallic copper were apparent close to the upper surface. This slag probably derives from copper smelting, rather than iron smelting or any other, non-ferrous process (eg, casting) and, as such, is likely to represent material imported to the site.

Also from the fill of the construction cut for the Phase 2 timber water channel came a

Table 7.10: Trench 75: metalworking debris by context and type

Context	Phase	Identification	Weight (g)
79	5	Cinder/coal/charcoal	5
333	2	Iron (casting)	4874
333	2	Undiagnostic slag	640
392	2	Copper-rich slag	91
488	3	Smithing hearth bottom: 110 x 95 x 65 mm	297
488	3	Undiagnostic slag	180
489	2	Copper-rich slag	461
505	4	Cinder/fuel ash slag	122
534	5	Cinder/fuel ash slag	3658
614	2	Cinder/fuel ash slag	55
614	2	Concretion	229
614	2	Undiagnostic slag	53
614	2	Copper-rich slag	2172
627	2	Concretion	393
627	2	Hearth lining	165
627	2	Smithing hearth bottoms (x2): 100 x 100 x 40 mm (499 g: incomplete) 110 x 95 x 65 mm (3207 g)	3706
641	3	Cinder/fuel ash slag	67
641	3	Undiagnostic slag	199
686	2	Hearth lining	7
686	2	Iron	11
847	3	Copper-rich slag	11
847	3	Undiagnostic slag	53
763	3	Copper-rich slag	54
919	5	Iron	19
921	2	Copper-rich slag	5
930	2	Hearth lining	96
930	2	Iron (casting)	38
941	3	Copper-rich slag	108
955	3	Copper-rich slag	69
957	3	Copper-rich slag	51
957	3	Copper alloy slag /'run'	114
960	3	Iron	17
964	5	Iron (x2)	38
984	2	Copper-rich slag	4
984	2	Cinder/fuel ash slag	32
Total			**18,094**

small fragment of brick with a thin, bright blue but opaque glassy deposit on part of one face. Under the microscope this deposit appears to be cobalt glass, vesicular as a result of melting, and perhaps a residue from enamelling.

A relatively large deposit of cinder (3658 g) was collected from a layer associated with the demolition of Building 4, though all came from a sample (17) and represents only a small fraction of the total present. It is very likely that this debris derives from the metalworking activity undertaken in Building 2, and most probably from the operation of the furnace (see below). A very small quantity of what appears to be flake hammerscale and several pieces of spheroidal hammerscale were also present in the sample which, if not residual, may indicate that occasional forging or welding of iron took place in the vicinity.

In addition to the metallurgical debris, there are several fragments of metal that may have been associated with metalworking on the site. These comprise individual small pieces of copper alloy sheet and lead sheet and a relatively large (116 g) 'run' of copper alloy, all from Phase 2 contexts, and small quantities of lead waste and copper alloy offcuts from Phase 3 contexts.

Discussion

There is no secure evidence for metalworking at Temple Mills prior to the post-medieval period, at a time when the lower Lea Valley was being increasingly exploited for industry. Documentary evidence records that one or more of the mills at Temple Mills was used by a company established in the 1690s to manufacture brass kettles and tin and latten plates, and that this company was still active in 1720 (Lysons 1796, 182). It is reasonable to assume on the basis of this and the archaeological evidence that Building 2 in Trench 75 was one of the mills used for this purpose. The function of Building 1 which lay to the north-west and preceded it is unknown, but there was no surviving evidence to indicate a connection with metalworking, unless some of the residual metalworking debris (eg, the smithing hearth bottoms) derived from it (see below).

The alignment of Building 2 adjacent to the timber-lined water channel indicates that the two were associated, and the channel is likely to have been used to drive a small waterwheel of which no evidence survived. The arrangement of the timbers forming the channel revetment do, however, indicate that such a wheel probably lay adjacent to the south side of Building 2, with the revetment preventing scouring around the base of an undershot wheel. The wheel could have provided power for equipment in the mill, including possibly a lathe and a small battery- or drop-hammer, as well as driving a fan which would have supplied air via a pipe and tuyère to the furnace or hearth.

The metals being worked are recorded as brass, tin and latten in the documentary evidence. 'Brasse' in the late medieval was a term used indiscriminately to cover various copper alloys including leaded bronze and even copper itself (Brownsword 1988), and whether brass (copper with a significant amount of zinc) was actually being worked on the site is uncertain. Similarly, it is possible that pewter (tin with a small amount of copper and, sometimes, lead) rather than tin was being used for plates as pure tin would be too soft for this purpose. Latten, another late medieval term, referred to a variety of copper alloys which contained zinc, a small amount of tin and, sometimes, lead, which when combined produced a metal with a pronounced golden colour (Brownsword 1988). Later, latten came to generally refer to an alloy comprising mainly copper and zinc, in other words brass. Brass was only manufactured on a small scale prior to the 18th century, using zinc probably imported from India, after which the development of European zinc production lead to the widespread adoption of this hard, corrosion-resistant alloy.

Table 7.11: Roman coins

Trench	Object	Context	Denomination	Description	Issue date	References
56	1	201	Cu Alloy *As/Dupondius*	Heavily corroded *as/dupondius* of C1–C2 AD. Illegible	C1–C2	–
58	1	125	AE 3 *nummus*	Constantine II Obv. Bust r, laureate, cuirassed. C- - NTINVSISNNOBC Rev. 2 soldiers, 2 standards. (GLOR) IAEXERC ITVS Mint Mark: TRS. (Trier)	AD 331	LRBC I, 56

The working of these metals to produce such domestic items as kettles and plates would have involved hot or cold working by hammering, small-scale casting (for plates using moulds of bell metal or bronze), turning (ie, lathe work), soldering, brazing and perhaps tinning. The furnace in Building 2 could have been used for melting metal in crucibles for small-scale casting and tinning, providing heat for soldering and brazing, and for annealing (heat-treating/tempering) items during fabrication, as cold-working alone causes stress and fracturing of the metal. The arrangement of this structure includes the possibility of a raised, open hearth comprising a trough filled with charcoal or coal at the front, within Building 2, and a flue/chimney projecting to the rear.

A timber-lined pit in the central, southern part of Building 2 is most likely to have held water, but for what exact purpose is unclear. Perhaps it was used for quenching/cooling or cleaning objects during manufacture.

The presence of the three smithing hearth bottoms, indicating iron smithing, suggests that some ironworking may also have been undertaken on the site, possibly at an earlier date as some debris was found in the backfill of the construction trench for the timber-lined channel. Perhaps Building 1 may have been a smithy, but there was no evidence to support this. Alternatively, though it seems a little unlikely, this debris may have been brought to the site along with other material to use as hardcore/make-up. However, it seems that this may provide an explanation for the presence of the small amount of dense, 'copper-rich' slag which almost certainly derives from smelting (rather than melting or casting), and not from the lower temperature, fabrication processes that are known to have been undertaken on the site, almost certainly within Building 2.

Coins and Tokens

by Nicholas Cooke

Nineteen coins and a single token were recovered from the excavations. The bulk of the assemblage was recovered from Trench 75 (13 coins and a token), with single coins recovered from Trenches 9, 46, 56, 58, 105 and 118. Two of the coins are Roman (from Trench 56 and Trench 58), and these are described below (see also Table 7.11). The remaining elements of the assemblage can all be dated to the post-medieval and modern periods, and are not reported on here; details can be found in the project archive.

A single *as* or *dupondius* of the 1st or 2nd century AD was recovered from Trench 56. This is too corroded to be dated closely, but the size and shape of the flan provide a broad date.

The coin from Trench 58 is a small AE3 'Gloria Exercitus' issue of Constantine II, struck in Trier in AD 331.

Metal Objects

by Grace Perpetua Jones

Almost all the metal objects recovered date to the 19th and 20th centuries. The exception is a small fragment of sheet copper alloy, recovered from the final fills of Middle Iron Age ditch 2297 in Trench 9. It measures 10 x 6.5 x 0.3 mm, and has no distinguishing features. The vast majority of finds came from Trench 75, with a smaller assemblage from Trench 59. Within these two trenches, objects were concentrated in the later levels, in particular those relating to the recent (late 19th/early 20th century) infilling of water channels. Very few finds came from the other trenches.

Ph.	Description	Personal	Household	Tools	Transport	Leisure	Fixtures & fittings	Other
0	Unstratified	safety pin	curtain ring, knife, spoon, cutlery handle	–	iron–shod wooden hame	lead figurine, lead ?fishing weight	lead ?counterbalance weight, 33 nails	–
2	Building 2: use	–	–	–	–	–	10 nails, L–shaped fitting	–
	Timber-lined channel	–	–	–	–	–	staple/joiner's dog, 10 nails	–
3	Building 2: demolition	–	–	–	–	–	5 nails	–
	Building 3: drains	wire dress hook	–	–	–	–	–	19 copper alloy pins
	Building 4	–	tin can	–	–	–	8 nails, iron ?door fitting	–
	Building 4: external surface	–	?curtain weight	chisel	–	–	2 strap fittings, 91 nails	2 copper alloy pins, possible iron bobbin
	Building 5	–	–	–	horseshoe	–	lock plate	lead type or stamp
	Misc. cut features	–	–	–	–	–	nail	2 copper alloy pins
	Fence-line	–	–	–	–	–	nail	–
	Metalled surfaces	button	–	–	–	–	3 nails	–
	Sunken barrels: use	–	–	–	–	–	7 iron barrel hoops	–
	Tumbling Bay stream	–	curtain ring	–	lead sounding weight	–	4 nails	–
4	Sunken barrels: infill	–	curtain ring, bird cage door, S-shaped hook	trowel	horseshoe	lead ?fishing weight	2 window came	–
	Building 3: drain disuse	wire dress hook, locket	tin can	–	–	–	hooked fastener	49 copper alloy pins
	Tumbling Bay Stream: revetment	–	–	–	–	–	looped fitting, L–shaped fitting, 2 nails	–
5	Building 3: pavement	–	–	–	–	–	2 nails	–
	Metalled surfaces	–	–	–	–	–	drain cover, nail	–
	Tumbling Bay Stream: final infill	–	pan/kettle lid, enamel container, 3 enamel mugs, enamel lamp base, dessert spoon	sickle/ scythe	–	–	small cap fitting, 3 nails, iron suspension weight	copper alloy stud, 2 enamel signs
	Levelling & made ground	–	cutlery handle	–	–	–	–	–

Table 7.12: Metalwork from Trench 75

The number of identifiable objects from all trenches, apart from nails, is relatively low, but these fall within a number of different functional groups. Table 7.12 presents a summary by functional group of the objects from Trench 75. Commentary is offered here on selected items of interest; the assemblage is fully discussed in the specialist archive report (Jones 2012).

Personal Items

Amongst the personal items is a watch key, found in quarry pit 97 in Trench 103. This is probably of 18th century date, and rarer than the more commonly found plain and more robust examples from the 19th and 20th centuries (Bailey 1995, 26).

Household

Several items of cookware were recovered from Trench 75 and Trench 59, although mainly from unstratified contexts or recent channel infill deposits. These include a long-handled, oval iron frying pan (Trench 59, fill of the revetted Pudding Mill River; Pl. 7.7). The length of the handle suggests it was used over a stove rather than an open fire, and the style of the pan suggests a date within the Victorian period, with a similar example from a trade catalogue of the 1880s (Bosomworth 1992, 220, no. 9883) in an enamelled iron ware. However, most frying pans were made in wrought iron and were relatively cheap, both in terms of their purchase cost and the amount of fuel required to use them (Eveleigh 2001, 20). Their shape was particularly suited to cooking fish.

Plate 7.7: Oval-shaped iron frying pan

Plate 7.8: Cutlery recovered from the site

A range of cutlery was also recovered, including a tablespoon, two dessert spoons, a teaspoon, a knife and bone handles (Pl. 7.8). Of particular interest is a spoon from a modern made-ground deposit in Trench 53 (Pl. 7.9). It is a fiddle pattern dessert spoon, made from a copper alloy, possibly silver plated, but an X-radiograph shows that the handle has a square-ended iron shaft that runs through it, and the spoon appears to have been cast around it (the more typical method of spoon manufacture during the 19th and 20th centuries was by stamping and pressing). On the underside of the handle there is a manufacturer's stamp of NOELLE'S / ALBALOID / MADE IN GERMANY (Pl. 7.9 inset). The Noelle manufacturers were based in Lüdenscheid,

Plate 7.9:
Fiddle pattern dessert spoon, copper alloy with iron core to handle with detail of stamp on underside of handle

Germany, and produced pewter and Britannia metal (tin alloy) goods from 1892 until the 1930s.

Two scale-tang bone handles were recorded from Trench 75, of which one has a pistol-shaped handle (Phase 5, levelling deposit in front of Building 3; Pl. 7.10). Two crudely carved initials (TN, or possibly IN), are

Plate 7.10 (left):
Scale-tang bone pistol-grip handle, probably from a knife, carved with the initials 'T N'

Plate 7.11:
Iron tools recovered from Trench 75

visible on the well-polished surface. Handles of this style were a reflection of a 'change in flatware pattern to Hanoverian with the accession of George I in 1714' (Moore 1999, 207). The pistol handle declined in use during the 1760s and 1770s, and although still in use today it is likely that this handle is of 18th century date.

Other household objects included the door of a birdcage from Trench 75 (Phase 4, sunken barrel infill), comprising a wooden frame with iron wires forming the bars, and iron tools, including a chisel, a sickle or scythe, and a trowel (Pl. 7.11).

Toys

A nearly complete hollow-cast lead figurine of a smiling lady with was recovered from Trench 75, but was unstratified (Pl. 7.12). She is wearing a long dress, a bonnet and an apron, tied at the back. She carries a basket in her left arm, but her right arm is missing, as are her feet. A pivot joint at the top of her missing arm indicates that this arm was movable. She would originally have been painted, although little evidence survives of this. She is probably a villager designed for the Model Home Farm series, introduced 1921 by W. Britains Ltd, as the appetite for toy soldiers waned after World War I. Part of a farm set, now housed in the Powerhouse Museum in Sydney, Australia, contains an almost identical lady, holding a basket and an umbrella (in the movable arm). The set in the Powerhouse Museum are part of a collection of Britain's farm figures and Australian buildings, amassed by two sisters between the late 1930s and early 1940s. As was the case for collectors in Britain, many were bought as individual pieces.

Another toy came from Trench 59, comprising the fragmentary remains of a crude toy sword (from the fill of the revetted Pudding Mill River; Pl. 7.13). The sword blade was made from a slightly curved strip of metal, broken at the handle end. The handle was formed from a strip of the same width, bent into a C-shape, with slots cut at either end through which the 'blade' was slotted. A similar example in the V&A Museum of Childhood was made from steel and dates to the 1950s–1960s, but iron swords may be earlier in date (Ieuan Hopkins, pers comm.); the condition of this example renders identification of the metalwork impossible without scientific analysis. Whilst many swords were mass-produced, the rough nature of the handle from the Olympic Park sword suggests it may have been made for a specific child to play with, or was a mass-produced toy that was repaired.

Plate 7.12:
Lead figure of a farmer's wife, part of the home farm series, dating to the 1930s

Plate 7.13:
Iron toy sword, early to mid-20th century date

Plate 7.14: Victorian coffin fitting, gilded lead

Funerary Practices

A disc-shaped escutcheon, which would have decorated a Victorian coffin, was recovered from Trench 59 (from fill of revetted Pudding Mill River; Pl. 7.14). It was made from thin lead cut into an open-work design (*ajouré*), and appears to have been gilded. Similar examples are recorded from a coffin in the crypt of Rycote Chapel in southern Oxfordshire (Boston 2008, pl. 19, coffin 72), a coffin in the Sackville Vault at Withyham, Sussex (Litten 1988, pl. 61), and at St Augustine the Less, Bristol (Boore 1998, fig. 6.8c).

Transport

A nearly complete wooden hame, edged with iron, was found unstratified at Trench 75 (Pl. 7.15). This would have formed part of a harness of a draught horse, used when pulling a carriage, with a pair of hames fitted on either side of the collar, attached with leather straps. The collar would allow the weight to be distributed around the neck and shoulders, with the hames taking the strain. It is noted that bones from a draught horse were also found at in Trench 75 (Higbee, below).

Plate 7.15: Wooden hame from horse harness

War

World War II helmets

by Andy Brockman

Four helmets dating to World War II were recovered during building recording. A detailed specialist report on these objects, including a full discussion of their historical context, is held in the project archive; a summary is presented here.

Three of the helmets are recorded as being found in made ground above the HAA (Heavy Anti-Aircraft) gun emplacement ZE21 to the south of the Eastway, and immediately to the west of Temple Mills (Robertson 2008, 109, pl. 45); despite their provenance, they were almost certainly associated with the use of the gun emplacement during World War II. These three helmets were not retained for further

Plate 7.16: World War II steel helmet, exterior and interior showing fittings

analysis, but comment has been made, based on the published photograph. Two of the helmets, and possibly all three, are of a type manufactured from 1941 onwards as the 'Civilian Protective Helmet', issued to civilian fire guards and other civilian services such as the Women's Land Army, as well as being sold to the general public.

No contextual details survive for the fourth helmet, which was retained (Pl. 7.16), but it is assumed to have come from the same site. It takes the form of a bowl-shaped metal pressing. The surface is heavily corroded and there is no obvious surviving indication of surface paint. At the crown of the bowl of the helmet is a fixing screw which passes through the fabric of the helmet bowl to attach the remains of a (formerly cruciform) rubberised pad. The bowl of the helmet is edged with a metal strip which has the effect of rounding the edge. The interior of the helmet also preserves a riveted fixing retaining its bent steel wire 'bail' to which are attached two low tension springs. The opposite fixing and 'bail' are missing.

Taken together, the evidence of the surviving form and fabric of this helmet and its component parts show that it is a British-made Mark 2 helmet, which was standard issue from 1938 to the British Armed Forces and many civilian services, such as the police, fire-fighters and ambulance personnel. Internal evidence, in particular the type of liner pad and chin strap fitted, shows that this particular helmet was almost certainly manufactured after 1939. The Mark 2 helmet continued in use even after the introduction of the Mark 3 helmet in 1943.

The lack of any surviving paint on this example prevents any definitive comment as to the service to which the original wearer might have belonged. However, on balance and given the location of the find, it is reasonable to speculate that the wearer was most likely to have been a member of the Army or Home Guard crewing Anti-Aircraft Gun Site ZE21.

Button

A copper alloy button was recovered from Trench 118 (pit 9). It is corroded and worn, but the obverse is decorated with the profile of a man's head, and an inscription was present around the edge. Although no longer visible, it included the letters '… VS V D….' It might be a 19th century military button (Egan cited in Richardson 2009, 34).

Discussion

The late 17th/early 18th century (Phase 2) metal objects from Trench 75 were predominantly structural: mostly nails but also including a collar, an L-shaped fitting, a staple and binding fragment. These probably relate to the use of Building 2 as a foundry.

During the late 18th/early 19th century (Phase 3), a number of industries were undertaken at Temple Mills, including calico printing, and a row of terraced cottages was built, probably for the workers.

Plate 7.17: Lead fishing weights from Trench 75

Many more metal objects were recovered from this phase. Copper alloy dressmaking pins and a small dress hook came from the Building 3 drains. The metal objects from Building 4 were mostly structural, comprising eight nails and a possible door fitting. A small fragment from a tin can was also recorded in this area. The surface next to Building 4 produced 91 nails and a washer, but also evidence of domestic activity in the form of two dressmaking pins, a curtain weight and a possible iron bobbin. From Plot 4 came a small copper alloy lock plate, probably from a small box or casket; a lead stamp 'S. B. & Co.'; and part of a horseshoe. A copper alloy curtain ring, dressmaking pin, lead (?fishing) weight and three nails were recovered from Tumbling Bay Stream. Iron hoops were all that survived of the four sunken barrels set in pits between the cottages and the stream. A few iron nails relate to the demolition of the foundry.

As the cottage drains went out of use they became filled with sandy silts (Phase 4) that incorporated a number of household and personal objects. These included 49 copper alloy dressmaking pins; a small copper alloy dress hook; a two piece copper alloy locket frame; part of a tin can and two paper fasteners. From the infill of the barrels came further evidence of the daily lives of the families who lived in the cottages, including a copper alloy curtain ring; a lead fishing weight (Pl. 7.17); an iron S-shaped hook, probably from the kitchen; part of a bird cage; a trowel and part of a horseshoe. Associated with the new revetment of Tumbling Bay Stream were copper alloy and iron wire fragments (one with a rubber ?handle) and an L-shaped iron strap, possibly a binding.

Most of the Phase 5 objects came from the final infill of Tumbling Bay Stream, comprising three large nails; a sickle/scythe; a large iron weight; a dessert spoon; a copper alloy stud and a fitting. A drain cover and iron wire fragments were associated with a metalled surface; two nails came from a Building 3 pavement and a nail from a cobbled road.

The metal objects from Trench 59, from where the clinker-built boat was recovered, came predominantly from the fill of the revetted Pudding Mill River (where they were clearly redeposited), and most are Victorian in date. They include a child's toy sword (Pl. 7.13); an oval-shaped frying pan (Pl. 7.7); an S-shaped hook (which could have been used to suspend a range of items in a kitchen); a coffin fitting (Pl. 7.14); a heel iron; the handmade horseshoe of a draught horse and several iron structural fittings. From the boat itself came 789 pieces of 0.3 mm shot; part of a tablespoon and a range of fittings, including a hook that had been hammered flat and was attached to, or suspended from a chain. It may have been used to secure the shot locker on the boat.

Catalogue of images *(Pls 7.7–7.17)*

Pl. 7.7. Oval iron frying pan, 300 mm x 245 mm x 50 mm, rectangular-sectioned handle, Victorian era. Trench 59, <1001>, context 1000, fill of revetted Pudding Mill River.

Pl. 7.8. Cutlery from various trenches (clockwise from left): leaf-shaped copper alloy tablespoon (Trench 59, <1010>, fill of boat); fiddle pattern dessert spoon, copper alloy with iron core to handle (Trench 53, context 10); Old English dessert spoon, copper alloy, cracked bowl and remains of burr (Trench 75, <37>, context 105, final infill of Tumbling Bay Stream, Phase 5); fiddle pattern teaspoon, silver-plated copper alloy (Trench 75, <35>, unstratified); scale-tang knife, iron with bone handle (Trench 75, <61>, drain

571); round-sectioned scale-tang bone handle, probable fork (Trench 75, <60>, unstratified); scale-tang bone pistol-grip handle, probable knife, carved with the initials TN or IN (Trench 75, <4>, levelling deposit 193, Phase 5); rectangular-sectioned scale-tang bone handle, probably knife (Trench 46, <2>, layer 502, deposit over channel fill).

Pl. 7.9. Detail of fiddle pattern dessert spoon, copper alloy with iron core to handle. Trench 53, context 10.

Pl. 7.10. Detail of scale-tang bone pistol-grip handle, probable knife, carved with the initials 'T N'. Trench 75, <4>, levelling deposit 193, Phase 5.

Pl. 7.11. Iron tools from Trench 75 (from left): curved cutting tool (context 94, final infill of Tumbling Bay Stream, Phase 5); chisel with rectangular burred head (<66>, layer 567, surface external to Building 4, Phase 3); mason's pointing trowel (<65>, context 253, infill of barrel 255, Phase 4).

Pl. 7.12. Lead figure of a farmer's wife, part of the Home Farm series, dating to the 1930s. Trench 75, <1>, unstratified.

Pl. 7.13. Iron toy sword, early to mid-20th century date. Trench 59, <1012>, context 1000, fill of revetted Pudding Mill River.

Pl. 7.14. Coffin fitting, gilded lead, Victorian. Trench 59, <1000>, context 1000, fill of revetted Pudding Mill River.

Pl. 7.15. Wooden hame from horse harness. Trench 75, <1000>, unstratified.

Pl. 7.16. World War II steel helmet, exterior and interior. HAA Gun emplacement ZE21 (OL-01907).

Pl. 7.17. Lead fishing weights from Trench 75 (from left): <47>, context 376, Tumbling Bay Stream, Phase 3; <41>, context 180, infill of barrel 182, Phase 4; <36>, unstratified.

Objects of Stone

by Matt Leivers and Kevin Hayward

Ten objects of worked stone were recovered, most of which came from Trench 75.

Approximately one half of a small shale bracelet was recovered from ditch 1518 in Trench 9 (Fig. 7.6). The piece is plain, with a D-shaped section and one chamfered inner edge; approximately 60 mm in diameter. It is probably Romano-British.

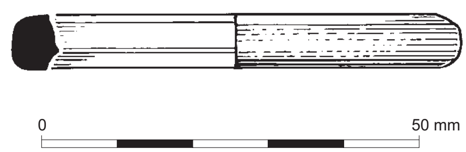


Figure 7.6: Romano-British shale bracelet fragment

Possible small-scale craft activities may be indicated by some of the stone objects, although the provenance (the final infilling of Tumbling Bay Stream in Trench 75) means that these cannot be linked definitively to on-site activities, and are most likely to have been brought in from elsewhere during late 19th and 20th century organised refuse dumping. Two small jet rings (Pl. 7.18) were found in association with a group of very small glass beads (see below), and may have been used in some form of craft work, such as embroidery. The rings are complete, with diameters of 14 mm. Further dress fittings and acces-

Plate 7.18: Jet rings, bead and pin

sories were recovered from Trench 75, from cottage drain 508 (Phase 3, Building 3), including a finely worked trefoil-shaped flat jet bead with a transverse perforation (Pl. 7.18).

Other stone objects from Trench 75 indicate everyday tasks: slate pencils came from the disuse fill of cottage drain 507 (Phase 4, Building 3) and an unstratified location; two alleys (12 mm and 30 mm diameter) were unstratified, as was an incomplete jet pin, 40 mm long.

An incomplete fine greensand hone, 11 mm by 40 mm by 50 mm, with numerous cut marks came from a robbing cut associated with the disuse of the cottage drains in Trench 75 (Phase 4, Building 3).

Illustrated objects (Fig. 7.6; Pl. 7.18)

Fig. 7.6. Part of shale armlet. Trench 9, <101>, context 1518, Romano-British ditch 1212.

Pl. 7.18. Four jet objects from Trench 75 (from left to right): two small rings (<81>, context 79, final infill of Tumbling Bay Stream, Phase 5); pin, incomplete (<77>, unstratified); trefoil bead (<10>, context 514, disuse of drain 508, Phase 4).

Objects of Glass

by Lorraine Mepham

A group of over 1500 minute glass beads was found in the final infilling (early 20th century) of Tumbling Bay Stream in Trench 75 (Phase 5); they were associated with two small jet rings (see above), and may have been used in textile work or embroidery, or some form of craft work, such as the manufacture of artificial flowers or jewellery. The beads are all around 2.5 mm in diameter, apart from one which measures 4.5 mm, and are mostly dark blue/black, grey and turquoise and annular in form, with a few hexagonal black examples.

Other glass objects, all from Trench 75, include two small beads (opaque blue and opaque pink); a lens-shaped button with rear (metal wire) loop attachment; a colourless marble (possibly a Codd bottle stopper); and two doll's eyes. Household fittings are represented by a globular, 'cut glass' door handle, and a chandelier crystal. There are three fragments of a small female figurine with applied beaded decoration. Other objects, including three lens-like pieces and a short length of hollow, twisted rod, are of unknown function. All the objects are likely to be of 19th or 20th century date.

Objects of Bone, Ivory and Shell

by Lorraine Mepham

All of the bone, ivory and shell objects recovered are post-medieval. Three scale-tang cutlery handles are discussed with the metal objects (see Jones, above). The remaining objects all came from Trench 75.

An incomplete ivory comb (Pl. 7.19), double-sided with fine and coarse teeth, is of a type which became the standard form (with ivory the commonest material used) by the early 17th century, replacing earlier examples in wood (Margeson 1993, 66–8; Egan 2005, 65). The comb was found unstratified.

A brush handle (probably a toothbrush), found in the final infilling (early 20th century) of Tumbling Bay Stream, is marked with the name 'The Carlton' and also 'Wire Drawn' and 'Sterilized' (Pl. 7.19). The Carlton Hotel in London operated from 1899–1940.

Two shell and two bone buttons, all plain discs with four-hole attachments (Phase 4, Building 3; Phase 3, Building 4; unstratified) constitute further personal items.

The final object is a bone domino piece, also from Trench 75, found unstratified (Pl. 7.19). Bone dominoes are known from the 16th century onwards, although Margeson notes that after the 18th century they were usually made of wood (1993, 217).

Plate 7.19: Ivory comb, bone toothbrush and bone domino

Illustrated objects *(Pl. 7.19)*

Pl. 7.19 Three bone and ivory objects, all from Trench 75 (left to right): comb, double-sided (<72>, unstratified); brush handle, marked 'The Carlton', 'Wire Drawn' and 'Sterilized' (final infill of Tumbling Bay Stream, Phase 5); domino piece (<73>, unstratified).

Leather

by Quita Mould

A small quantity of leather was found, representing a wide range of items. Most appear to be the result of casual rubbish disposal and while some may be of very local origin others are likely to have been brought some distance among other general waste material. Leather was recovered from six trenches (Trenches 9, 46, 59, 66, 75 and 118), but the only group of any size came from Trench 59. The diverse group from this trench came from an upper fill (1000) of Pudding Mill River, overlying the remains of an early 19th century wooden clinker-built boat. The group comprised the upper part of a rifle bucket, part of a case with a carrying handle, items of harness and a shoe. Waste leather that provides evidence for the manufacture of leather goods or its repair was also recorded from layer 1000, but was not available for study so the nature of this waste and the quantity is unknown.

Methodology

The majority of the leather described here was assessed when wet in February 2009 by the author and later re-examined for this report. Some of the material is now dry while some remains damp having been treated to limit mould growth. A small proportion of the material, namely a wooden and leather clog, a highly fragmentary front-lacing shoe, and a group of leather waste/offcuts were not available for study.

Diagnostic measurements were taken of the wet leather at assessment and it is these measurements that are principally used here. Any measurements taken following drying out or conservation are followed by (measured dry) in the catalogue. Shoe size has been estimated from measurement of the insole. Shoe sizing has been calculated according to the modern English Shoe-Size scale; continental sizing is given in brackets. The insole measurement was rounded up to the nearest equivalent modern English shoe size as appropriate. Where only the sole was preserved an estimate has been tentatively made from the sole measurement, and this is also stated in the catalogue.

Leather species were identified by hair follicle pattern using low powered magnification. Where the grain surface of the leather was heavily worn identification was not always possible. Where cattle hide could not easily be distinguished from calfskin from the grain pattern, the term 'bovine' has been used. Shoe soles and repairs are assumed to be of cattle hide unless stated otherwise.

Footwear

A small number of shoe parts and items of footwear, all dating to the early modern period, were recovered and are discussed below roughly in date order. A stacked leather heel was found in Trench 75, in the

Plate 7.20: Leather square-toed ankle boot

backfill of the construction cut (1091) for a timber-lined water channel, possibly a wheel-pit (Phase 2). Another came from the same trench, from the backfill of a construction cut for brick-lined rainwater gully (Phase 3). The sole from a small child's shoe, no larger than child size 2(18), made straight with a short pointed toe, found in 19th–20th century made ground in Trench 118, appears to be of 18th or early 19th century date, and residual in the deposit.

The remains of a square-toed, welted shoe of adult size 8(42) of thick bovine leather was found with other leather items in an upper fill (1000) of the revetted Pudding Mill River in Trench 59. The thick bovine leather upper had been cut off to salvage reusable leather before the remaining upper seam and shoe bottom were thrown away. The sole appears to have been heavily hobnailed, and the thickness of the upper leather suggests it was a work boot. As so little of the upper remains, the style of the shoe or boot is unknown, but the shape of the toe suggests it is of early to mid-Victorian date (*c.* 1825–1875). This appears to be the only item of cobbling waste recovered (but see the waste leather below); the other shoe parts found are all likely to be casually discarded domestic rubbish.

The remains of a square-toed ankle boot of suede calfskin (flesh side outward), of riveted construction, appears to be of mid-late Victorian date (Pl. 7.20); it was found in landfill/made ground of 19th/20th century date in Trench 46.

A near complete 'wood and leather clog', found in the fill of a post-medieval ditch (1469) in Trench 9, was thought to be of late 19th century/early 20th century date, though it was not seen by the author. Wooden clogs were favoured by those working in a number of trades that involved wet or rough conditions under foot (Salaman 1986, 185). Trench 9 was in an area formerly occupied at the end of the 19th century by a gasworks, later replaced by the Lea Valley Distillery, then Hydrogen Works, Kensington Works (potted meats) and the Goswell Works (paint, enamel and varnish) and it may well be that the clog had been the work wear of a member of staff of one of those industries.

Eight pieces broken from a front-lacing shoe of Oxford or Derby style with a stacked leather heel were found unstratified in the north-eastern corner of the compensation reservoir in Trench 66. The shoe was machine-stitched with copper eyelets in the lace holes, indicating a date no earlier than 1823 when metal eyelets were patented (Swann 1982, 32). The shoe parts have not been seen by the author but are thought likely to be of late Victorian or earlier 20th century date (Richardson 2008).

The lasting margin torn from a ladies' court shoe, was found in made ground (10) of 19th–20th century date within Trench 59. The remains of a light green/turquoise-coloured surface treatment is preserved which might suggest the shoe dated between *c.* 1925–30 when pastel colours for ladies' footwear was first popular (Swann 1982, 61).

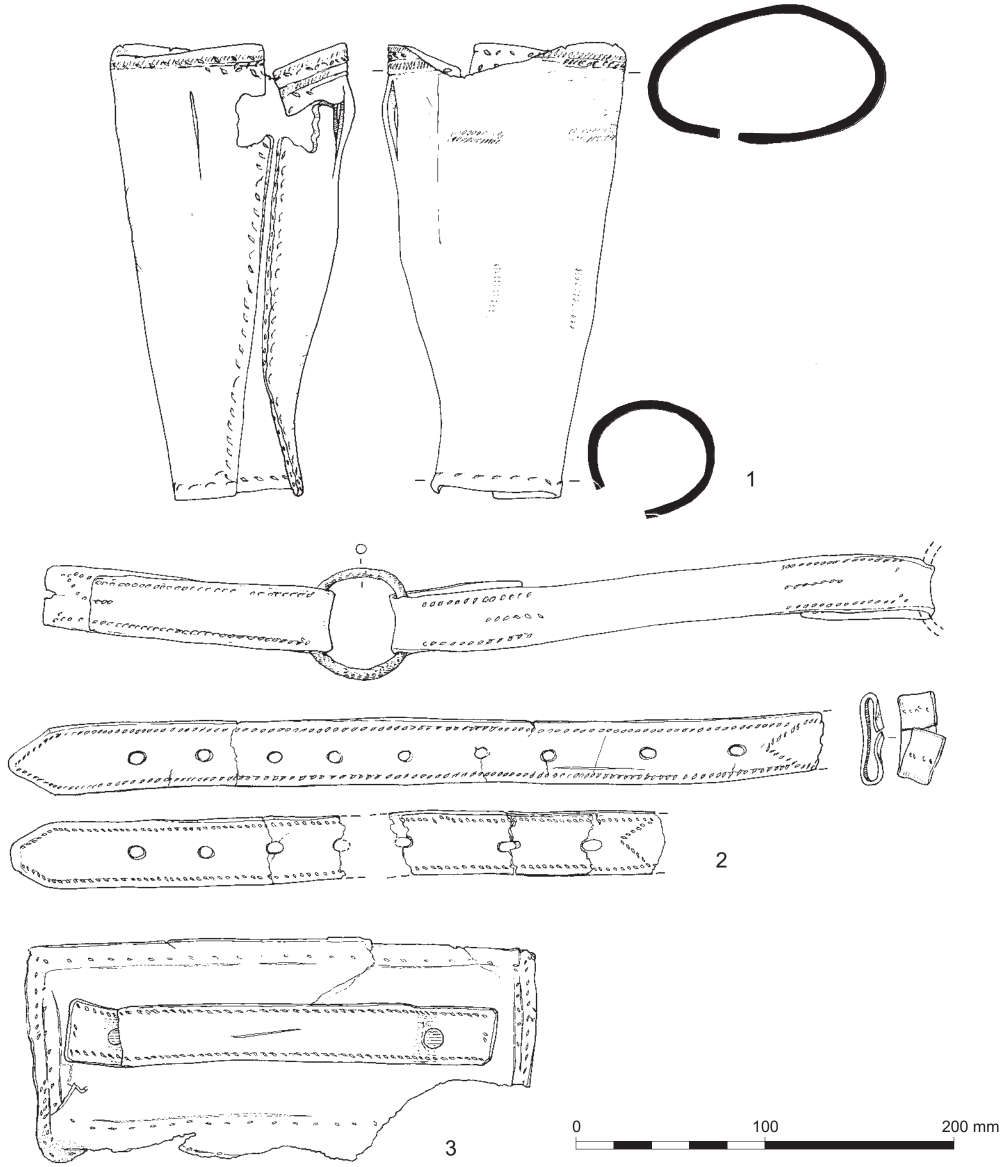


Figure 7.7: Selected leather items: 1) upper part of rifle bucket; 2) strapping with iron ring; 3) case with strap handle

The Rifle Bucket

The upper part of a rifle bucket of moulded cattle hide was recovered from an upper fill (1000) of the revetted Pudding Mill River, overlying the sunken boat in Trench 59 (Fig. 7.7, 1; Pl. 7.21). A rifle bucket is a saddle holster used to carry a weapon safely when on horseback. The term rifle bucket is used here for convenience but the specific type of gun it originally carried is uncertain. The upper part of the rifle bucket, equating to the stock of the weapon, is heavily worn along the outer edge of the mouth. A rectangular area of the back seam has been cut away close to slots through which the straps passed to attach it to the saddle. The lower edge is seamed to join to the barrel part of the bucket which is now missing. The bucket measures 240 mm in length, with a width at the mouth of 70–120 mm, while the diameter at the lower edge is *c.* 55 mm.

This is an unusual object and few have been recognised in archaeologically excavated material previously, the only one currently known to the author being a mid-17th century pistol holster from the well at St Paul-in-the Bail, Lincoln (Mann 2008, 93–5). Research suggests that few are held in the

Plate 7.21:
Leather rifle bucket

major collections of military equipment in this country. This rifle bucket does not appear to belong to a member of the Snider, Martini or Enfield families of rifle or carbine (Ordnance pattern) as might be expected for a rifle bucket recovered from a 19th century context (J. Ferguson, Royal Armouries, pers. comm.). Images of later 19th and early 20th century rifle buckets suggest that they are predominantly of single piece construction, the mouths are curved upward and they are generally brown in colour.

This example, being of rigid moulded leather, seamed at the base and so of multi-part construction, with a straight mouth, and black in colour, appears to belong to an earlier tradition, being more closely comparable with the pistol holster found amongst the material dumped in the well at St. Paul-in-the-Bail, Lincoln around the time of the Civil War (Mann 2008, 94) than those of later 19th and early 20th century date. It may be that the Olympic Park example is of considerably earlier date than the rest of the material with which it had been dumped, possibly belonging to the 18th century. Other finds from the same context (1000) date to the 19th century (1830–1900+ pottery, glass and clay pipes), however, with only a single sherd of 17th century tin-glazed pottery (1612–1650) being of earlier date. Examples of 18th and early 19th century rifle buckets have proved difficult to locate and, as direct comparison has not been possible, an 18th century date can only be tentatively suggested.

Why the remains of a heavily worn rifle bucket should be found here discarded amongst a mixed group of rubbish is intriguing. The only military structures excavated at the Olympic Park date to World War II and this piece appears to be significantly earlier in date and was of some age when it was disposed of. It has been suggested previously that it may have been part of the kit of a member of a local Yeomanry division, discussed in more detail by Fairman (2011).

Items of Harness

Two probable items of horse harness were also part of the group of material recovered from the upper fill (1000) of the revetted Pudding Mill River in Trench 59. A piece torn from a curved and moulded long, rectangular panel of cattle hide may come from an oval-shaped item, possibly the forewale, a straw-filled tube from the front of a horse collar from draught harness. A collection of thick straps of cattle hide, including two pieces of plain strap joining (502 mm long in total) with an iron ring 56 mm in diameter, and straps with saddle stitched sides and large buckle pin holes are also likely to come from harness (Fig. 7.7, 2; Pl. 7.22).

Plate 7.22: Leather strapping with iron ring

Plate 7.23: Leather case panel with strap handle

Case or Box Cover

A calfskin top flap or possibly a side panel, torn from a case or a small leather covered box came from the same context (1000) in Trench 59 (Fig. 7.7, 3; Pl. 7.23). The panel measures 300 mm by 140 mm. It has a flat strap carrying handle of thicker cattle hide secured by large, flat-headed, brass rivets. Such cases may have had a variety of uses and a possible use carrying a wide range of military equipment, including ammunition has been suggested (Fairman 2011, 13) so that it might derive from the same or a similar source as the rifle bucket.

Hose Pipe

A long, slightly tapering tube of thick leather identifiable as an 18th century feed hose was found in Trench 75, in the lower fill of a sunken barrel 184 (Phase 4) (Fig. 7.8, 4, Pl. 7.24). The hose, 710 mm in length, has a single, butted seam that stops short of the narrower end indicating that this end was open. A series of fine ridges impressed around the wider end relates to its insertion into a brass coupling, probably from wound copper alloy wire used in the manner of a 'jubilee clip' to help secure the hose in place. It is directly comparable to a leather feed hose on a force pump dated to

1735 that was used at Windsor Castle for fire fighting and is now part of the Merryweather collection in the Museum of London (R. Payton, Museum of London, pers. comm.). Sturdy, flexible hose may have been used by a number of the industries that were present along the river at this time but this length is likely to be a feed hose from an 18th century force pump used for fire fighting.

Figure 7.8: Leather: 4) feed hose

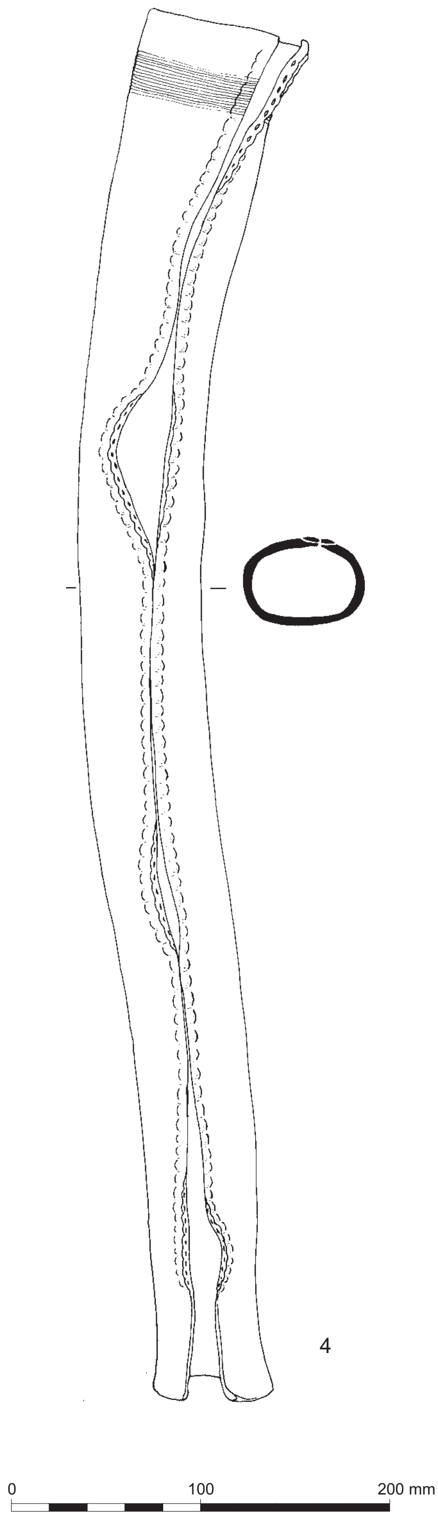


Plate 7.24: Leather feed hose

Waste Leather

Leather waste/offcuts were recorded from an upper fill (1000) of the revetted Pudding Mill River overlying the sunken boat. It might be seen alongside the shoe with the cut down vamp as a small group of cobbling waste cleared from a workshop; however, it has not seen by the author and no further information was available.

Catalogue of illustrated leather

(Figs 7.7–7.8; Pls 7.20–7.24)

PL 7.20 Leather boot, iron riveted construction, left foot, adolescent/small adult size. Half sole repair, sole and insole all worn through, square-toed galosh, left quarters and leg fragments leg. Upper calfskin suede 1.76 mm thick

Fig 7.7.1 (Pl. 7.21) Upper part of moulded holster with vertical butted edge/flesh seam, tapering from oval mouth to circular lower edge with grain/flesh seam. A single and a double slot for straps present with a double line of oblique stitching running around the mouth and in two vertical lines, 29 mm long and 38 mm apart, below. Leather cattle hide 4.94 mm thick

Fig 7.7.2 (Pl. 7.22) Plain strap with each end looped around an iron ring and secured with saddle stitching; a second strap is attached to one of the rings, and a matching strap loop. Fragments of strap with saddle stitched sides, buckle pin holes and pointed terminals. Width 35–8mm . Leather cattle hide 4–5mm thick.

Fig 7.7.3 (Pl. 7.23) Rectangular flat panel torn along one side, with a strap handle with stitched sides stitched and riveted to the centre. Panel calfskin. 1.52 mm thick, handle cattle hide 3.03 mm thick.

Fig 7.8 (Pl. 7.24) Hose with central butted edge/flesh seam, the wider end (67 mm interior width) with ridged impressions. Leather cattle hide 4.6 mm thick flesh side outward.

Worked Wood

by Damian Goodburn with Lorraine Mepham, and microscopic waterlogged wood identifications by Catherine Barnett

Anaerobic (waterlogged) conditions preserved prehistoric and historic woodwork on several trenches, of which selected individual and structural pieces are described here. Microscopic species identifications of the waterlogged wood were made of those pieces made available for Phase 5 analysis (Table 7.13).

The worked wood included timbers from a number of structures, mainly riverside revetments of late medieval to 19th century date, but also including a well lining and casks sunk in the ground and reused as tanks, as well as the remains of more enigmatic structures of apparent prehistoric date. A timber-framed water channel was revealed at Temple Mills (Trench 75), as well as foundation pile alignments or trackway supports, dating from the late 16th to the early 17th century. Of particular interest was the recovery from Trench 59 of an almost intact clinker-built boat, probably of early 19th century date. A few miscellaneous objects were also recovered.

A wide variety of timber species was used, some of which may have been locally available, and some brought in from further away, or imported. A considerable number of the timbers incorporated in the post-medieval structures had been reused from buildings, boats, ships or barges, or were offcuts, probably from the ship- and barge-building yards located further to the south around the mouth of the River Lea.

In addition some evidence of the bases of growing, possibly deliberately planted trees were visible in Trench 75, along the eastern bank of Tumbling Bay Stream.

Background

The survival of waterlogged structural woodwork from the Romano-British and medieval periods is well known from the London and wider region, with a large corpus of published material. However a substantial amount of prehistoric woodwork has also been found and systematically recorded since the mid-1980s. Some of this material is published in outline (eg, Meddens 1996) and a small number of assemblages have been published in some detail (eg, Goodburn 1996; 2003).

In very recent years, excavations in the eastern parts of Greater London near the Thames and its tributaries have yielded much more prehistoric and post-medieval woodwork. Much of the latter has not yet reached full publication, but it is fair to note that there is a huge archive with which the material from the Olympic Park can be compared.

Recent finds of prehistoric and historic woodwork from the Lea Valley itself include Bronze and Iron Age stake alignments and off-cuts from the Stratford Box area (Valler and Crockett 2012); a Romano-British gateway and bridge from Crown Wharf (Stephenson 2008); an Early Saxon 'crannog-type' platform further north at Enfield (Goodburn in prep.); a Middle Saxon bridge or jetty at the

Table 7.13: Waterlogged wood identifications made during analysis stage (available samples)

Tr.	Description	Context	Species ID	Common name
41	Phase 1 post line	711	*Quercus* sp.	Oak
	Phase 1 post	716	*Ulmus* sp.	Elm
	Phase 2 revetment: post	707	*Pinus sylvestris*	Scots pine
	Phase 2 revetment: plank	708	*Pinus sylvestris*	Scots pine
58	RB post-and-plank structure 42: post	193	Pomoideae roundwood	Pomaceous fruit wood eg. hawthorn, apple, whitebeam
	RB post-and-plank structure 42: plank	253	*Quercus* sp.	Oak
	RB post-and-plank structure 42: post	267	Pomoideae	Pomaceous fruit wood
	RB post-and-plank structure 42: plank	280	*Betula pendula/pubescens*	Silver/downy birch
	Med/post-med wattle revetment 100: post	31	*Quercus* sp.	Oak
	Med/post-med wattle revetment 100: post	235	*Quercus* sp.	Oak
	Med/post-med wattle revetment 100: wattle rods	246	6 x 6–8 years *Fraxinus excelsior*; 4 x 6–8 yr *Salix/Populus* sp.	Ash Willow/poplar
	Med/post-med wattle revetment 114: post	234	*Salix/Populus* sp.	Willow/poplar
	Med/post-med wattle revetment 114: wattle rods	245	10 x 8–10 yr *Salix/Populus* sp.	Willow/poplar
59	19th century boat	1004	*Ulmus* sp.	Elm
	Cask in well 2000	2001	*Pinus sylvestris*	Scots pine
75	Phase 1 timber pile structure	662	*Quercus* sp.	Oak
	Phase 1 timber pile structure	663	*Quercus* sp.	Oak
	Phase 1 timber pile structure	667	*Quercus* sp.	Oak
	Phase 1 timber pile structure	715	*Quercus* sp.	Oak
	Phase 1 timber pile structure	727	*Pinus sylvestris* roundwood	Scots pine
	Phase 1 timber pile structure	749	*Quercus* sp.	Oak
	Phase 1 timber pile structure	772	*Quercus* sp.	Oak
	Phase 1 timber pile structure	807	Cf. *Alnus glutinosa*	Alder
	Phase 1 timber pile structure	990	*Quercus* sp.	Oak
	Phase 1 timber pile structure	990	*Quercus* sp.	Oak
	Phase 1 timber pile structure	998	*Salix/Populus* sp.	Willow/poplar
	Phase 1 timber pile structure	1002	*Quercus* sp.	Oak
	Phase 1 timber pile structure	1003	*Quercus* sp.	Oak
	Phase 2 timber channel/watermill wheel pit	994	*Ulmus* sp.	Elm
	Phase 2 timber channel/watermill wheel pit	1066	*Quercus* sp.	Oak
	Phase 2 timber channel/watermill wheel pit	1068	*Ulmus* sp.	Elm
	Phase 2 timber channel/watermill wheel pit	1069	*Quercus* sp.	Oak
	Phase 2 timber channel/watermill wheel pit	1070	unidentified	–
	Phase 2 timber channel/watermill wheel pit	1072	*Larix/Picea*	Larch/spruce
	Phase 2 timber channel/watermill wheel pit	1074	*Ulmus* sp.	Elm
	Phase 2 timber channel/watermill wheel pit	1077	*Quercus* sp.	Oak
	Phase 2 timber channel/watermill wheel pit	1077	*Quercus* sp.	Oak
	Phase 2 timber channel/watermill wheel pit	1079	*Quercus* sp.	Oak
	Phase 2 timber channel/watermill wheel pit	1081	*Quercus* sp.	Oak
	Phase 2 timber channel/watermill wheel pit	1082	unidentified	–
	Phase 2 timber channel/watermill wheel pit	1083	*Pinus sylvestris*	Scots pine
	Phase 2 timber channel/watermill wheel pit	1084	unidentified	–
	Phase 2 timber channel/watermill wheel pit	1087	*Ulmus* sp.	Elm
	Phase 3 revetment/fence: post tip	493	*Salix/Populus* sp.	Willow/poplar
	Phase 3 revetment/fence: post tip	500	*Salix/Populus* sp.	Willow/poplar
	? phase 3 tree stump on bank of stream	483	*Salix/Populus* sp.	Willow/poplar
	? phase 3 tree stump on bank of stream	484	unidentified	–
	? phase 3 tree stump on bank of stream	485	*Salix/Populus* sp.	Willow/poplar
	Phase 4 cask used as tank	182	5 x degraded mature wood cf. *Ulmus* sp.; 2 x unidentified deg.; 6 x *Salix/Populus* sp. twigwood; 1 x Pomoideae twigwood	Elm, willow/poplar, pomaceous fruit wood
	Plank	518	*Quercus* sp.	Oak
105	Stake in ditch 135/311	276	Cf. *Quercus* sp.	Oak
	Medieval stake line in ditch 135/311: stake tip	280	*Alnus/Corylus*	Alder/hazel
	Medieval stake line in ditch 135/311: stake tip	282	unidentified	
	Medieval stake line in ditch 135/311: stake tip	284	*Salix/Populus* sp.	Willow/poplar
	Medieval stake line in ditch 135/311: stake tip	286	*Alnus glutinosa*	Alder
	Medieval stake line in ditch 135/311: stake tip	288	*Corylus avellana*	Hazel
	Medieval stake line in ditch 135/311: stake tip	290	unidentified	
	Medieval stake line in ditch 135/311: stake tip	292	*Quercus* sp.	Oak

cont.

Table 7.13 continued: Waterlogged wood identifications made during analysis stage (available samples)

Tr.	Description	Context	Species ID	Common name
118	Neolithic structure: stake	577	*Alnus glutinosa*	Alder
	Neolithic structure: stake	578	*Alnus glutinosa*	Alder
	Neolithic structure: stake	581	*Alnus glutinosa*	Alder
	Wood from Bronze Age channel deposit	574	*Prunus* sp.	Stone fruits eg blackthorn, cherry
	RB displaced structure: stake	66	*Alnus glutinosa*	Alder
	RB displaced structure: stake	68	*Corylus avellana*	Hazel
	RB displaced structure: stake	69	*Alnus glutinosa*	Alder
	RB displaced structure: stake	70	*Salix/Populus* sp.	Willow/poplar
	RB stake in section	180	*Alnus glutinosa*	Alder
	Degraded wood in RB context	182	3x *Quercus* sp.	Oak
	RB 4-stake structure: stake	73	*Alnus glutinosa*	Alder
	RB 4-stake structure: stake	74	*Alnus glutinosa*	Alder
	RB 4-stake structure: stake	75	*Alnus glutinosa*	Alder
	RB stake in channel	565	*Salix/Populus* sp. roundwood	Willow/poplar
	RB stake in channel	567	*Alnus glutinosa*	Alder
	? Stake in RB channel 600	571	*Euonymus europaeus*	Spindle tree
	Drift log in RB channel 600	573	*Betula pendula/pubescens*	Silver/downy birch
	Medieval timber structure: stake	539	*Alnus glutinosa*	Alder
	Medieval timber structure: stake	541	*Salix/Populus* sp.	Willow/poplar
	Medieval timber structure	544	*Salix/Populus* sp.	Willow/poplar
	Medieval timber structure	545	*Salix/Populus* sp.	Willow/poplar
	Medieval timber structure: stake	546	*Salix/Populus* sp.	Willow/poplar
	Medieval timber structure: stake	548	*Salix/Populus* sp.	Willow/poplar
	Medieval timber structure	549	Degraded cf. Pomoideae	Pomaceous fruit wood
	Medieval timber structure	550	*Salix/Populus* sp.	Willow/poplar
	Medieval timber structure: stake (pollard end)	554	*Salix/Populus* sp	Willow/poplar
	Medieval timber structure: stake	556	Juvenile *Quercus* sp.	Oak
	Medieval timber structure: stake	557	*Quercus* sp. roundwood	Oak
	Post-medieval stake in section	188	*Quercus* sp.	Oak
	Undated stake	533	*Alnus glutinosa*	Alder
	Undated narrow stake, axed ??	558	*Salix/Populus* sp.	Willow/poplar
	Undated stake	560	*Salix/Populus* sp.	Willow/poplar
	Undated axed chips	561	*Alnus glutinosa*	Alder
120	Wood from possible palaeochannel	–	3 x *Alnus glutinosa*	Alder
	Unworked from ?Late Neolithic tree-throw hole	20	1 x degraded *Quercus* sp.; 1 x *Alnus glutinosa* twigwood; 1 x *Cornus* sp. twigwood; 7 unident. degraded	Oak, alder, dogwood

Stratford Box where Late Saxon revetments were also found (Valler and Crockett 2012); and a Late Saxon dugout boat at Clapton (Marsden 1989). Just to the south of the site, at 150 Stratford High Street, on Waterworks River, stake and wattle structures of early medieval date have also recently been found (MoL code WHU08; Wroe-Brown in prep.). From the later 16th/17th century to the mid-19th century a number of revetments, docks and other structures have also been identified, often linked to known watermill sites, including at 150 Stratford High Street and at Barking Creek, where abandoned mill timbers were found. Many of the post-medieval timber structures incorporate reused timbers from boats, ships, buildings or other timber structures (below).

Large amounts of structural woodwork recorded on these waterlogged sites in London and elsewhere have been closely dated, principally by tree-ring dating, so it is now clear that variations in the use, working, jointing, fastening and wood species of timber can indicate broad dating in many cases. Comparative variations in subtle features such as the proportions of large timber used versus small roundwood and the species range and inclusion of reused or 'off-cut' material can also broadly indicate the status of the work. Key areas of investigation have included toolmark studies in dated assemblages and broad patterns of change in tool mark types are becoming apparent (eg, O'Sullivan 1996; Sands 1997; Goodburn 2003). Recently experimental archaeological work has also sharpened abilities to recognise diagnostic features of tool marks and in some contexts to provide broad initial dating of excavated material. However, for clear diagnostic tool marks to survive, the material worked has to be well preserved timber or large roundwood.

By linking tightly-dated timber structures to adjacent contemporaneous dry land surfaces such as quay surfaces, building floors, and riverside roads, it has also been possible to link the levels of survival of early woodwork to their broad dating when close to the tidal Thames (Milne 1985; Brigham 2001). Recently, the terms of reference and periods covered by the data have been expanded and refined, although much of this work has not been published yet. In short, although more work needs to be done in this field, we have considerable information on approximate levels of large high tides from all but the end of the Romano-British and Early Saxon periods where there is still a gap. This approximate OD level/dating relationship clearly applies at the mouth of the Lea, but may be slightly affected by the gradient effect by the time the tidal flow has reached Temple Mills (the location of Trench 75). However, the known trends in Thames-side levels and dating still seem broadly applicable even as far up as this site. Very recently, a few sites have also started to produce dated approximate low tide levels, so that we can start to refine our understanding of past tidal amplitudes and tidal forces (eg, the recently discovered East Greenwich 12th century tide mill; Goodburn and Davis 2010). Clearly, trends in tidal levels are fundamental to understanding the operation of historic mills and navigation on the Lea and this site has produced important data relating to these issues.

The trenches within the Olympic Park lay close to where the Lea channels joined the Thames and these are known to have been tidal in medieval times; indeed, the current main channel of the Lea is still fairly strongly tidal today. Roman shore-side timbers not far from the mouth of the Lea in the City of London are documented to have survived between *c.* 2.0–1.5 m OD in the 1st century AD to around 0.0 m OD at *c.* AD 300 followed by a rise back up to *c.* +1.70 m OD by *c.* AD 690 as seen at the Ebbsfleet tide mill dam (Hardy *et al.* 2011, 329–31). Late prehistoric woodwork has been found in the Thames floodplain nearby, surviving between *c.* 1.0 m to -1.0 m OD (occasionally lower). The current safe ground surface near the mouth of the Lea would be around +5 m OD except for surge tide conditions when it is protected by the Thames Barrier.

Methods of Recording

A sampling strategy was adopted to deal with the timber present. Many timbers were partially exposed and planned but not lifted for more detailed recording, for reasons of safety and access. Others were sampled because the worked items were repetitive in nature (eg, groups of many roundwood stakes), or were both common and recent in date (eg, staves of Victorian revetments).

After lifting, the selected timbers were cleaned and rapidly examined and, where required, additional records were made. These records comprise *pro forma* timber sheets with measured sketches and selected drawings to scale, together with selected detailed photographs. These records accord with the standards set out in the English Heritage guidelines for recording water-logged wood (Brunning 1996), and the Museum of London Archaeological Site Manual (MoLAS 1994). Items of common native species that can be reliably identified by sight, such as oak or elm, were not sampled for species identification, but a range of less distinctive species were. Samples for dendrochronological dating were also taken where appropriate (for oak or any other of the dendrochronologically viable species, from timbers with *c.* 45 or more annual rings); this amounted to three samples from Trench 9 and six from Trench 58; those from Trench 9 were analysed but were unsuccessful. In addition, samples were taken of tarred hair waterproofing material from Trench 58; and of tarred hair, tar and paint from the boat from Trench 59.

Prehistoric Structures and Miscellaneous Items

Structural timbers from Trench 118

A group of three alder stakes (577, 578 and 581; Fig. 2.4, above) cut through a channel fill containing worked and burnt flint, and produced radiocarbon dates in the Early Neolithic of 3650–3520 cal BC (SUERC-36223, 4785±30 BP), 3640–3370 cal BC (SUERC-36224, 4740±30 BP) and 3640–3370 cal BC (SUERC-33686, 4735±30 BP), respectively (see Table 2.2). Stake 581 (Fig. 7.9) was found at an inclined angle, possibly as a result of scouring, whilst the other two were more vertical, but their function is uncertain. Diameters ranged from 75 mm to 120 mm (stake 581 was the largest). The point forms were of the pencil type (faceted all round), but the compacted sand and gravel they were driven into resulted in generally poor tool mark survival. However, on the sides of stake 578, where the axe shaping of the point had begun, curved axe stop marks 38 mm wide could be seen. Slightly larger, vague axe stop marks were seen on the other stakes. Such width in the axe stop marks appears very atypical in the British and Irish Neolithic, where a maximum of *c.* 25 mm is to be expected, due to the thick, lentoid form of blade and lack of penetration (O'Sullivan 1996). The axe marks were on original examination considered to be of a form that would fit the typical, small socketed axes of the Late Bronze Age (Goodburn 2003). However, the secure Early Neolithic radiocarbon dates on all three stakes shows that flint or stone axes must have been used. Unfortunately the surviving timber was too degraded for these axe marks to be re-examined. There are two possible explanations for this apparent anachronism: either the radiocarbon dates are too early (which seems unlikely, given that three dates were obtained), or the stop marks were made with an atypical stone axe such as a fine jadeite 'ceremonial axe', or a 'square-butted' stone axe of Scandinavian form.

Miscellaneous prehistoric timbers from Trench 9

A small number of miscellaneous wood fragments came from late prehistoric contexts in Trench 9. Of these the item of most interest (2180), from the base of an Iron Age ditch 1384, is an oak stud end (squared tenon post), 240 mm long, from a small timber frame, perhaps a wall frame (Fig. 7.10, 2). Similar studs are known from timber

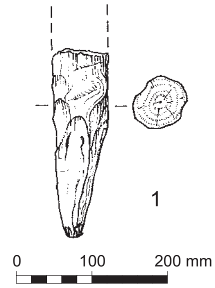


Figure 7.9: Worked wood: 1) Early Neolithic alder stake (Timber 578), Trench 118

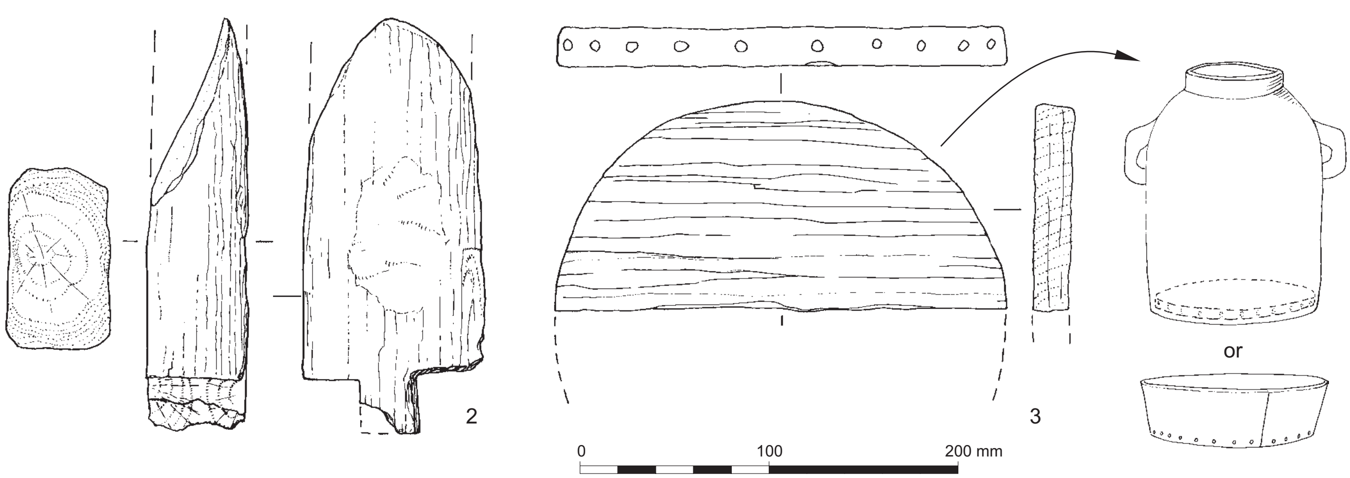


Figure 7.10: Worked wood from base of Middle Iron Age ditch 1384, Trench 9: 2) oak stud end – tenon post (Timber 2180); 3) base or lid of bentwood vessel, with possible reconstructions (Timber 2212)

framed buildings in Roman London (Goodburn 1991), but the Middle Iron Age context of this example makes it unique in Britain. Roughly rectangular mortise-like socket joints are known from the period, but no tenoned posts to fit them. Instead, whole stakes or poles or tusked tenoned timbers seemed to have been used to pierce them.

From the base of the same Middle Iron Age ditch was recovered the base or lid of an oak bentwood box or tub, approximately 240 mm in diameter and 20 mm thick (Fig. 7.10, 3), with peg holes around the perimeter. Such items are rare but not unknown, and can be paralleled in the Iron Age and Romano-British period and later (eg, Earwood 1993, 43–5). Solid hewn tubs from the Bronze Age and Iron Age are known with pegged-in bases but not from the Romano-British period.

Five other radially cleft pieces from Trench 9, all in oak, and including off-cuts and stakes, could be late prehistoric or rustic work of the Romano-British period; all came from one feature (pit 2084) which is otherwise undated but stratigraphically probably belongs to the Middle Iron Age Phase 1 enclosure. Three of these miscellaneous late prehistoric timbers from Trench 9 were sampled for dendrochronological dating, but none was successfully dated (Payne and Spurr 2009, 101-3).

Romano-British Structures

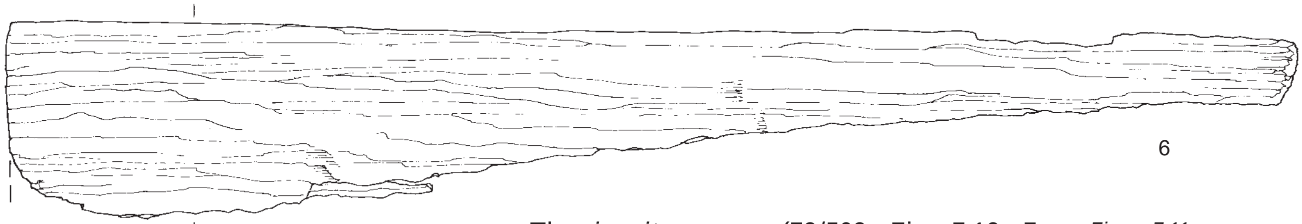
Post-and-plank structure in Trench 58

The truncated base of a post-and-plank structure (structure 42; Pl. 4.2, Fig. 4.6 above) was uncovered in Trench 58, comprising 79 timbers including 65 driven stakes (see Chapter 4). It is clear from the considerable number and variety of stakes that the structure was fairly long-lived and much repaired. Initially thought to be of early post-medieval date on technological grounds, one of the planks (280) produced a date in the late Romano-British period of cal AD of 120–340 (SUERC-36581, 1795±35 BP), which was consistent with the Romano-British finds from the ditch.

Most of the lifted stakes were oak but varied in size and type of conversion. Stake 159, for example, was a slightly bent section of roundwood only 80 mm in diameter with a flat chisel type tip (ie, two opposed facets). More elaborate stakes include boxed halved timbers such as 264 (Fig. 7.11, 4). The small parent log appears to have been cleft in half and then the half log axe-hewn to a roughly rectangular cross-section. Other uprights were made from cleft quarter logs, eg, timber 197 (Fig. 7.11, 5). As well as oak, there were also examples of Pomoideae and silver/downy birch. A small number of the larger uprights were carefully hewn boxed heart, ie, squared up from whole small oak logs.

All the sheathing plank elements were of oak, mostly surviving as small fragments, but at the north-eastern end the best preserved found was timber 41 (Fig. 7.11, 6). This piece retained timber both sides of the heart of the parent log and it must have comprised just over half of a weathered and eroded plank, tangentially sawn, ie, across the full width of the log. Plank 41 had a surviving width of 213 mm, although it must have been much wider originally, perhaps around 400 mm. No clear signs of reuse were found and it may have been used fresh or possibly as part of a batch of leftovers from building work close by.

Most of the oak used in this structure was probably brought from a short distance away, and the fast-grown material may well be of coppiced origin; the wet pasture land of the time around the site would not have produced it. Such a structure could be built by semi-skilled workers who may have had to use some form of light ram to drive the larger retaining piles. Clearly it was also important enough to maintain and repair by driving in extra piles as it subsided. This structure could have functioned as a small wharf frontage for shallow draft barges and small boats.



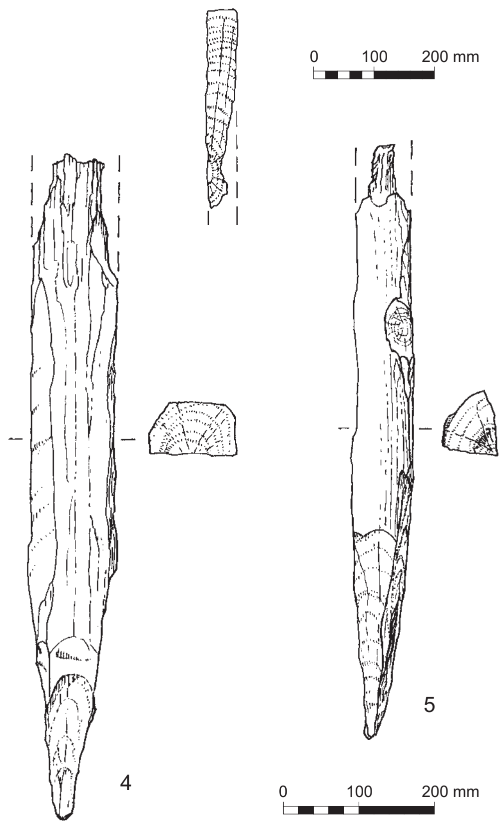


Figure 7.11: Worked wood, Romano-British structure 42, Trench 58: 4) stake, (Timber 264); 5) stake (Timber 197); 6) plank (Timber 41)

Structural timbers from Trench 118

Several groups of worked wood recorded from Trench 118 (Fig. 4.7, above), found close to the edge on the outer bend of a Late Iron Age/Romano-British channel, were originally tentatively dated as prehistoric on a combination of technological features, OD level and associated finds, but were subsequently radiocarbon dated to the Romano-British period. They comprise a group of three roundwood stakes *in situ* and forming a possible structure, one other group of driven stakes and a singleton, and a group of displaced roundwood stakes and piles. Their function is uncertain, but they may have formed part of a jetty or revetment on the river edge.

The *in situ* group (73/503: Fig. 7.12, 7; 74/504; 75/505), with a fourth stake implied by a stake-hole (77), formed a possible small square structure, measuring 0.8 m long by 0.6 m wide and was first seen at *c.* -0.43 m OD, but the stakes were clearly truncated and would have extended at least to 0 m OD. The stakes, which were of alder, all had pencil-type metal axe-cut points and were made of whole stems; diameters ranged from 70–90 mm. A radiocarbon date of cal AD 80–240 (SUERC-35345, 1855±30 BP) was obtained from timber 74/504.

Just a short distance to the north-west a fifth stake (180: Fig. 7.12, 8), roughly made and also in alder, was found in a vertical position, exposed in section. The stake had many branch stubs protruding, showing that it was either cut from a branch or parts of a tree-crown and had been used the reverse way up to the growing direction. It

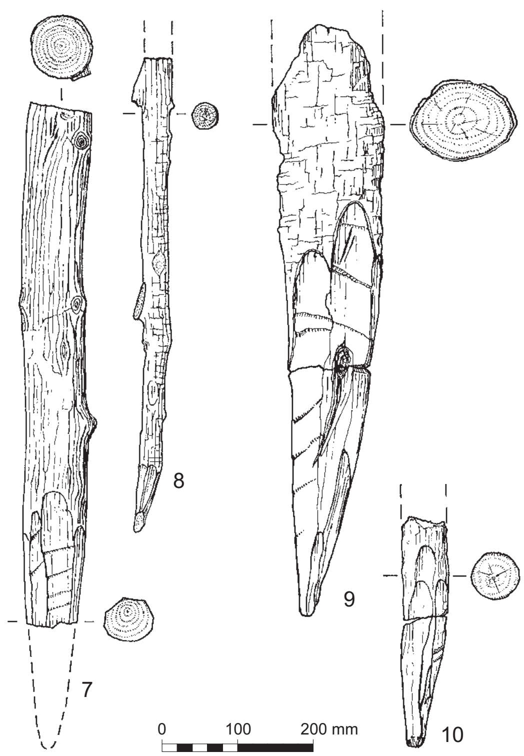


Figure 7.12: Worked wood, Romano-British timbers from Trench 118: 7) alder stake (Timber 73/503), four-post structure; 8) alder stake (Timber 180); 9) stake, probably alder (Timber 568), three-post alignment; 10) alder stake (Timber 69)

could only have been driven into very soft ground. It yielded a radiocarbon date of cal AD 80–330 (SUERC-34960, 1820±35 BP).

Close to timber 180, a group of four stakes or piles (66, 68–70) was recorded lying flat on the basal step of the section (possibly flattened by the mechanical excavator). Two were alder, one hazel and one willow/poplar. All four had neatly cut pencil-type points. The best preserved was the largest (69: Fig. 7.12, 10), which was the size of a small pile, slightly squashed to an oval section of 140 x 100 mm and surviving to a length of 0.78 m with the bark intact. It appeared to be of alder. The tool marks were well preserved with very straight, incomplete axe stop marks up to 70 mm wide left by a blade at least 75 mm wide with a rather straight edge. This size and form of blade is known from the Iron Age, Romano-British and early medieval periods in the south-east. In the case of this large stake even some signature striations left by nicks in the axe blade survived. The other stakes were similarly made from whole stems but smaller, except for stake 68, which had been hewn out of a cleft half log giving a D-shaped cross-section. Stake 69 provided a radiocarbon date within the Romano-British period cal AD 80–240 (SUERC-33687, 1850±30 BP).

Within the middle of the channel was a group of three stakes (565, 567 and 568: Fig. 7.12, 9) in a roughly north-south alignment, with their truncated tops surviving up to +0.09 m OD. They varied in diameter between 40 mm and 60 mm. Two (565, willow/poplar; and 567, alder) had pencil-type points, and 568 (probably alder) had a point formed from the natural curve of the stem and two smooth, metal-cut facets. An Iron Age or Romano-British date seemed likely from the stratigraphic situation and depth of survival, and was confirmed by radiocarbon dates of cal AD 80–260 (SUERC-34959, 1835±35 BP) on timber 565, and cal AD 60–230 (SUERC-36225, 1875±30 BP) on timber 567.

Saxon and Medieval Timbers

Possible wattle-lined feature 159 in Trench 56

The very disturbed remains of a possible roundwood structure (159) were found in a shallow feature in Trench 56 (Fig. 4.8, above). Three pointed stakes (175, 176 and 177), forming part of what appeared to be the base of a wattle lining, survived *in situ* near the north-east corner. The longest stake (175), in the north-east part of the cut, was 40 x 60 mm wide, and 450 mm long; stake 176 was 40 x 60 mm wide and 200 mm long; both were made from small, cleft quarter poles. The third, stake 177, was a whole small stem, 20 mm in diameter and 120 mm long.

The base of the cut was strewn with around 30 small diameter regular rods, probably of coppiced origin (if this feature were part of a channel edge, these small rods would probably have been washed away). In the north-east corner several regular rods (178: 20 mm in diameter and 230 mm long; 181: 10 mm in diameter and 500 mm long; and 182: 10 mm in diameter and 600 mm long) were wedged behind one of the stakes, and thus possibly also *in situ*.

This type of disturbed wattlework has no datable features on technological grounds, but charred plant material from layers overlying the timbers produced radiocarbon dates broadly in the early medieval period, cal AD 1030–1210 (SUERC-35335, 905±30 BP) and cal AD 980–1160 (SUERC-34943, 985±35 BP). Although initially suggested to be a possible retting pit, no direct evidence for this was recovered.

Stakes in Trench 105

A series of nine stakes were found *in situ* in Trench 105 (Fig. 4.14), although not all necessarily forming part of a single structure or feature. Only the tips survived, the rest having been machined away. The stakes varied in dimensions, wood species (including oak, alder and hazel) and conversions (box quartered, tangentially faced, or whole in conversion). Two of the stakes were of oak and were notably larger than the rest (diameters up to 130 mm; lengths up to 500 mm); they were the best preserved, and are likely to have been of more recent date.

One of the stakes (286) produced a radiocarbon date of cal AD 1039–1215 (SUERC-36585, 895±35 BP), ie, in the Late Saxon or early medieval period. The function(s) of the stakes is not clear, although they could have formed part of a fish trap.

Structural timbers from channel in Trench 118

Twenty worked items (17 pieces of worked round wood and three small off-cuts) were recovered from a medieval river channel in Trench 118. The tops of the worked material survived up to between *c.* +0.40 and +0.70 m OD. In some cases the material comprised vertically set stakes, which had truncated tops, and in other cases the cut material lay horizontally.

The vertical stakes were varied in character but generally of small diameter, mostly cut from rods but with two made from large stems split in half. One (554) produced a radiocarbon date in the medieval period of cal AD 1290–1410 (SUERC-36221, 610±30 BP). The horizontal material seems also to have included branch loppings and possibly displaced horizontal wattle fragments. Of ten samples taken for species identification, six were willow/poplar, two oak, one alder and one Pomoideae.

Evidence for medieval basketry?

Within this group, timber 554 comprised a willow/poplar stem, *c.* 50 mm in diameter, with what seems to be a slightly charred surface ending in a multi-stemmed bulbous end *c.* 110 mm across. This end was found set in the ground in what must have been a small post-hole with the smooth straight stem sticking up as a very small post. The bulbous multi-stemmed end would have been uppermost originally and resembled the ends of a small pollarded or shredded stem or branch. Evidence of what were probably annually cut small regrowth stems remained with smooth metal blade cut ends. This is the sort of item that may be an indicator of hedgerow basketry in which young pliable stems, often only one year old, are repeatedly harvested from established trees.

Early Post-Medieval to Modern Revetments and Other Riverside Structures

Two post-medieval wattlework revetments in Trench 58

Two parallel wattlework revetments, *c.* 6.5 m apart, were uncovered in Trench 58, structure 100 on the north-east side of channel 300, and structure 114 (a little more heavily built) on the south-west side (Fig. 5.10).

The stakes in structure 114 (seven timbers: 239–245; Fig. 7.14, Pl. 7.25) were substantial, whole log stakes of oak, driven in on 0.70–0.85 m centres. Stakes 240 and 241 (Fig. 7.13, 11) survived to over 2 m in length, and had unusually large diameters for wattle stakes (120 mm and 150 mm respectively). Both had been debarked and had axe-trimmed, pencil-form points. Although clear axe marks did not survive, incomplete axe stop marks are present at up to 60 mm wide. As both these stakes are of medium growth and fairly straight, an origin in secondary woodland seems possible, or alternatively from coppiced woodland on very poor soil.

Plate 7.25: Post-medieval wattlework revetment (structure 114), Trench 58

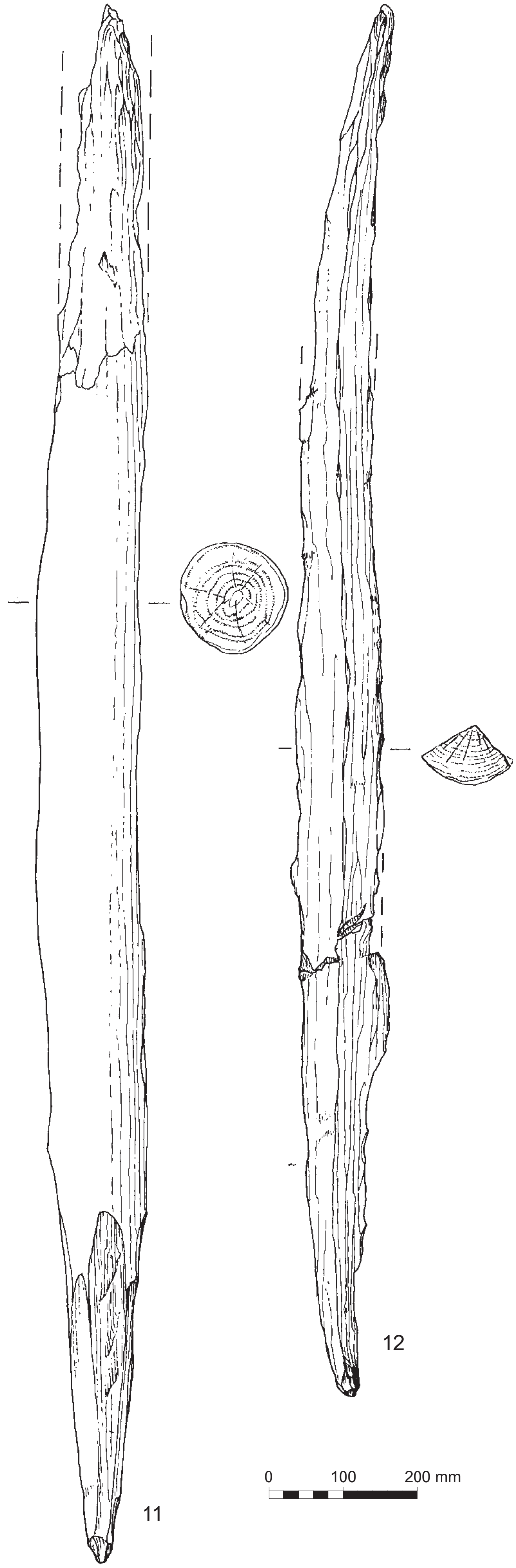


Figure 7.13: Worked wood, post-medieval timbers from Trench 58: 11) oak stake (Timber 241), wattlework revetment 114; 12) oak stake (Timber 31), wattlework revetment 100

The stakes in structure 100 (11 timbers: 31, 229–238, 246) were more varied in size, species and conversion type. The oak stakes here were interspersed with smaller stakes of a softer deciduous wood. The largest stakes were oak cleft-out quarter logs, such as timbers 31 (Fig. 7.13, 12) and 235. Stake 234, in contrast, was of soft deciduous roundwood, *c.* 75 mm in diameter, possibly of a species such as willow or poplar. The larger cleft-oak stakes derived from fairly straight logs at least 240 mm in diameter to the outside of the bark.

The weavers or rods (willow/poplar, with one ash) were *c.* 15–35 mm in diameter. They were woven in and out of the uprights in handfuls of three or four rods at a time, which is a quick, but not strong way to weave wattlework. In basketry this weave is called slewing (Wright 1972, 35). These relatively small wattle rods used would not have lasted very long in use, and clearly the revetments were not intended to be long-lived.

The revetments reinforced the banks of a water channel running north-west–south-east. Technological aspects offer no clues as to close dating of this structure, but the solidity of the wattlework and its survival to a decayed top level at *c.* 2.80 m OD suggests that it was of post-medieval date, and this is supported by a radiocarbon date of cal AD 1470–1650 (SUERC-36580, 315±35 BP) on stake 234. Although wattlework structures have an ancient appearance they can still occasionally be found reinforcing the banks of rivers in England today, where their aesthetic and environmental value is often prized. Indeed, a short area of river bank on the opposite side of the River Lea has very recently been reinforced with a low wattle revetment (it was within a small nature reserve) (Bower and Thompson 2008, pl. 20).

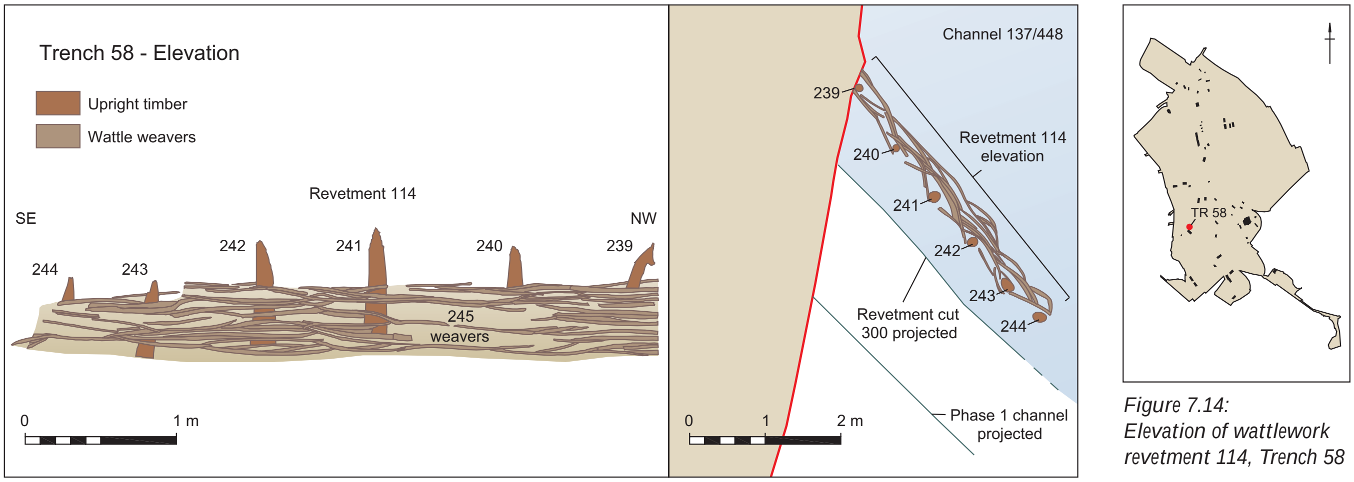


Figure 7.14:
Elevation of wattlework revetment 114, Trench 58

Isolated post-medieval piles and reused ships' timbers in Trench 58

Further structural woodwork from Trench 58 included items made of reused timbers. One vertically-set timber (60: Fig. 7.15, 13) consisted of a small section of oak hull planking from a medium-sized vessel such as a river barge. The main element was part of a hull plank pierced with nail holes and 25 mm oak treenails (specialised wooden rivet-like fastenings). It had an edge-halved scarf at one end and still had a slight curvature longitudinally. On one face a softwood 'tingle' or 'dutchman' had been fastened with small iron nails over a mat of tarred hair. Manual saw marks were present on the face of the softwood tingle, which was chamfered at one edge and one end. Taken together these technical features suggest a date in the 17th century or later. Ship-breaking and repair yards towards the mouth of the Lea would have been a ready local source of cheap, second-hand nautical timbers.

A group of three other timbers with relict features clearly indicating a nautical origin (84, 85 and 86) were found outside the channel cuts. The first two survived only as small pile tips with relict nails and treenail holes

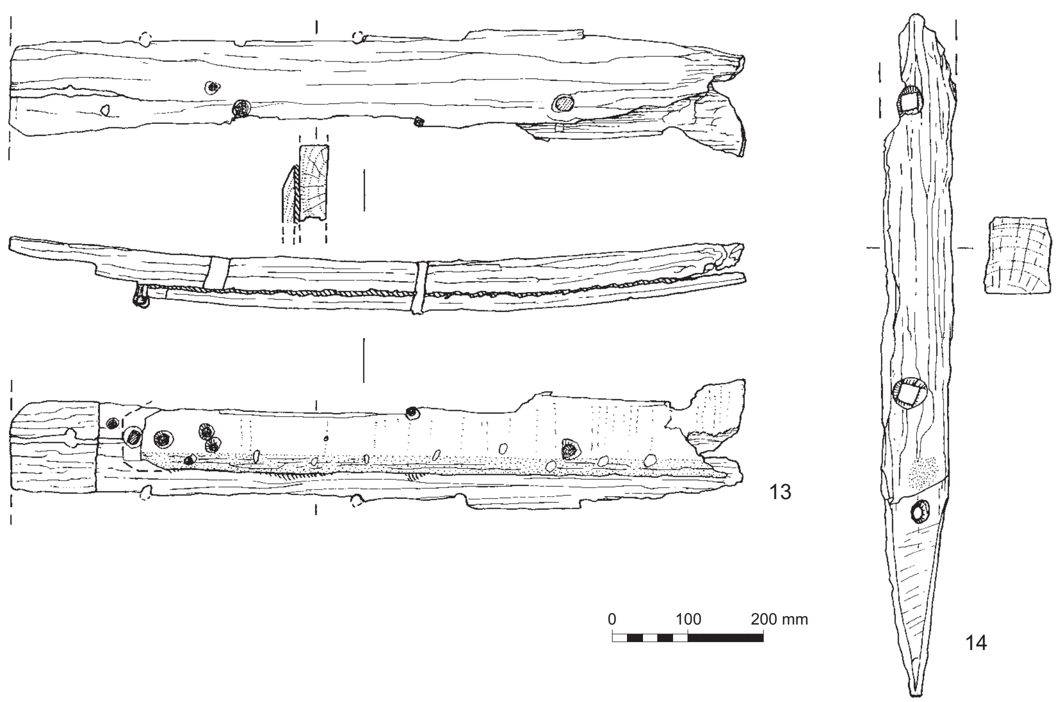


Figure 7.15:
Worked wood, post-medieval timbers from Trench 58:
13) reused ship's timber – oak hull planking (Timber 60);
14) reused ship's timber – oak hull planking (Timber 86)

but timber 86 (Fig. 7.15, 14) was a little more complete. It was clearly roughly split from a section of large carvel ship hull planking with two sizes of large oak treenails. Both had four caulking spits to expand the end of the treenail, to make it grip like a rivet and be watertight. Faint traces of tarred hair and manual saw marks could also be seen, together with an empty bolt-hole. Such a timber was taken from a ship far too large to progress beyond the mouth of the Lea, again indicating the local trade in cheap second-hand ships' timber. The technological features suggest quite a wide date range, between *c.* 1500 and the mid-19th century, for the original use of the timber.

Late 16th–mid-18th century pile structure in Trench 75

A north-south line of piles and smaller stakes (a total of 24 timbers), mostly set in pairs, was recorded in Trench 75. They comprised a heterogeneous mix of materials and forms. Some were rather crooked whole elm logs (eg, timbers 989 and 999), whilst others were small oak logs cleft in half (eg, timber 1049). Some of the smaller stakes were willow, and there were also examples of alder and pine (*Pinus sylvestris*).

Some of the piles were clearly reused timbers, such as oak pile 1000, which had been roughly hewn to boxed-heart section and had several relict iron nails in it. Other oak piles appeared to be off-cuts from preparing larger timbers, eg, pile 1003, which was a waste slab still bearing clear pit-saw marks. One of the larger piles was a rectangular sectioned oak timber (772: Fig. 7.16, 15) which proved to have been a frame timber from a flat-bottomed barge of some kind. It was punctured by oak treenails and iron spikes and was similar to other examples found reused on the Thames, for example at the Millennium Bridge site (Goodburn 2002) and at Crown Wharf on the Lea, a little to the south of Trench 75 (Goodburn 2008a). The ship- and barge-breaking yards around Leamouth would have been a cheap source of such second-hand timber. Another interesting reused timber in this group was a box-quartered, sawn oak post with part of a tenoned end preserved and the nails and mortar marks from lath and plaster covering (timber 749: Fig. 7.16, 16). It is quite possible that this timber was salvaged from buildings on or close to the site. Finally, timber 1001 was a very decayed oak plank fragment, just possibly remnants of the planking slabs

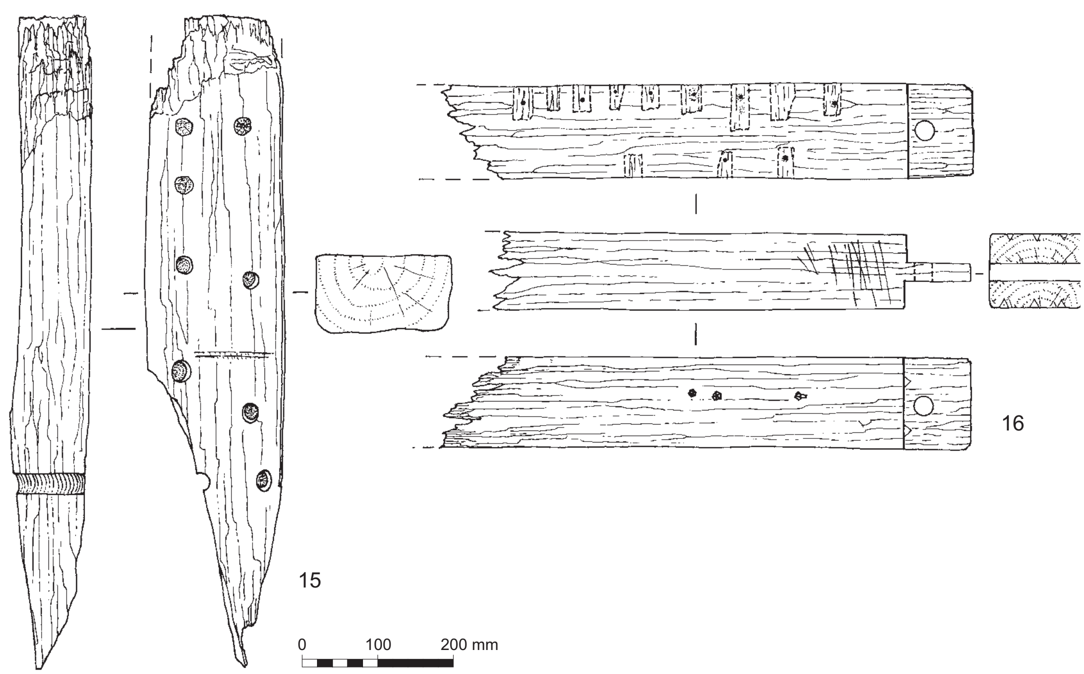


Figure 7.16: Worked wood, post-medieval timber from Trench 75: 15) oak pile (Timber 772), pile structure; 16) oak post – part of tenoned end, nails and mortar marks (Timber 749)

that probably sat atop the pile group. The use of such a mix of raw materials suggests that it was inexpensively built out of what could be cheaply obtained locally.

The structure, possibly supporting an elevated walkway or a building foundation (see Chapter 5), has been assigned to the Phase 1 activity in Trench 75 (late 16th–mid-18th century), and the piles themselves show features typical of the 16th–17th centuries, such as being partly of elm, although the use of probable willow for some of the smaller stakes is not a normal feature of such work at this period. Overall, the technological features of this group easily correspond to the late 16th to early 17th century.

Plate 7.26: Part of post-medieval timber-lined channel, Trench 75

Mid-late 18th century timber-lined channel, Trench 75

The short length of timber-lined channel to the south of Building 2 in Trench 75 (Fig. 5.25, above; Pl. 7.26), was interpreted as a wheel pit, revetted to prevent scouring around the base of an undershot mill wheel. The channel, made with largely reused timbers, was built as a simple, timber-framed structure (a total of 26 timbers were recorded), with oak posts with barefaced tenons set into two parallel softwood sill beams *c.* 0.70 m apart (sills 994 and 1072, one of elm and one of larch/spruce). The planking of the channel lining was also of imported softwood and was tangentially sawn and nailed to the inner faces of the posts. Both of the sill beams as well as a softwood cross beam (1070) had many relict mortise and groove joints. These had clearly been used in timber-framed buildings before reuse in the mill race. Again, the parent buildings may have been from the site or close by. The lifted oak post (1069) was a box-quartered timber with a barefaced tenon and three relict rebates, indicating previous use.

Other timbers associated with the structure include box-quartered elm locating piles, which had relict halving joints cut into them at close intervals, eg, 1068. These timbers derived from some form of heavy grating such as those used over large ship hatches to let in light and air, or just possibly a grating placed over a mill head race as a debris screen.

Early 19th century revetment in Trench 46

The north–south timber structure (506) in Trench 46 comprised two vertical posts (42 and 44) supporting one course of horizontal plank sheathing (Fig. 5.20, above) with a further pile (43) lying at an angle to the west. The piles were of a neatly rectangular cross section *c.* 140 mm wide by 110 mm thick, probably sawn out. Such piles could have been driven without any kind of elaborate ram, using only a heavy maul. The planks, also probably sawn out, were set on edge, and survived up to 220 mm at the widest in plank 46, which appears to have split along a central pith. The sheathing was therefore almost certainly originally wider, perhaps up to 330 mm. The nails in the east faces of the piles could have secured the top edge of the planking, while the bottom edge may simply have been toed into the underlying deposits. From the woodworking technology only a broad post-medieval to recent date can be suggested.

Table 7.14: Details of the timber from revetment 2014 in Trench 59

Timber	Type	Conversion	Species	Dimensions (mm)			Level (m aOD)
				N–S	E–W	Height	
Revetment							
1013	Post	Box-halved	Oak	200	100	>650	2.34
1014	Post	Box-halved	Oak	210	130	>650	2.35
1015	Post	Halved	Oak	200	90	>650	2.32
1016	Post	Halved	Elm?	180	100	>650	2.31
1017	Post	Box-halved	Oak	170	110	>650	2.31
1018	Post	Box-halved	Oak	210	160	>650	2.37
1019	Post	Box-halved	Oak	200	100	>650	2.42
1020	Post	Box-halved	Oak	160	120	>650	2.45
1021	Plank	Tangentially faced	Oak	>2240	45	130	2.29
1022	Plank	Tangentially faced	Pine?	>3960	60	210	2.19
1023	Plank	Tangentially faced	Pine?	>2240	50	280	2.16
1024	Plank	Tangentially faced	Pine?	>3960	60	180	1.98
1025	Plank	Tangentially faced	Pine?	>2240	60	>80	1.88
Rubbing posts							
1026	Post	Unconverted	?	100	120	>200	2.28
1027	Post	Unconverted	?	60	70	>200	2.60

19th century revetment in Trench 59

Fifteen timbers were recorded from a plank and pile revetment (2014) found in Trench 59 (Fig. 5.16, above). Two courses of sheathing planking survived. The uprights were inclined with their heads to the east giving the frontage a batter for greater strength. The posts varied in scantling between 160 x 120 mm and 210 x 160 mm (Table 7.14); they did not show any signs of reuse. Most of the uprights were rectangular in section, hand-sawn, boxed heart timbers cut from reasonably small oaks. Two were halved round logs, one of oak and one of elm. The flat side was set against the sheathing planking. It is likely that these varied uprights were driven as piles rather than posts set in a sill beam. No evidence of the use of land-ties was found, but it is very likely that they were originally fitted but later removed as part of the careful truncation of the structure. Two posts to the immediate west of revetment may have been rubbing posts to prevent contact between river vessels and the revetment face.

The northern, uppermost plank was of oak, while the southern example was of softwood (probably imported *Pinus sylvestris*). The planking was set on the landward side of the posts and sparingly nailed to them, with iron nails. From the varying slope of the saw marks on the sheathing planking it is likely that that was also hand converted, at this period 'pit-sawn'. The sheathing planking varied in species and thickness and may well have been 'leftovers' from other projects.

The use of batter in the revetment is a feature first seen on the Thames in the 17th century at sites like The Stowage, Deptford, and at Rotherhithe Street in Rotherhithe (MoL site code ROZ00; Heard and Goodburn 2003; Divers 2004), and it is also sometimes seen today. The general character of the materials and workmanship suggests a late 17th to early 19th century date. The use of oak and apparently new materials indicates that some money was being spent on this structure. The tops of the uprights of the revetment had the appearance of being sawn down by hand in the relatively recent past. At an OD level of *c.* +2.40 m they would also have been too low by the 19th century by at least 1 m, as far as we can tell from the level of riverside works at the mouth of the River Lea. The original height is likely to have been at least 3.5 m OD. The truncation was probably carried out to allow ramped access for the next phase of land-filling behind a new river wall closer to the current frontage.

Post-medieval/modern revetments and other structures in Trench 41

A series of wooden structures in Trench 41 lay parallel to the north-east bank of Pudding Mill River (Fig. 5.18, above).

Within the centre of the trench, two lines of posts ran in a north-west–south-east orientation, flanking a line of vertical planking. The line to the east, structure 709, comprised 23 posts, each circular in cross-section with a diameter between 40 mm and 80 mm. The wood used to construct the posts was straight-grained and missing its bark. However, the sapwood remained and only the base of the posts had been worked crudely into points. The posts spanned a length of 5.10 m, closely spaced, only 60–150 mm apart. They were set diagonally (the tops slanting eastwards), and were driven below revetment planking (structure 710), which ran for 5.68 m directly to the west of the post line. The planks were set diagonally against the sloping posts of 709, adjacent to larger vertical posts (structure 711) further to the west, although no fixing mechanism was visible. The planking was 40 mm thick and varied between 0.90 m and 1.20 m in length. No tool marks, intentional marks or evidence of surface treatments were visible.

Post-line 711 comprised seven posts located to the west of 709 and 710. Each post was circular in cross-section, formed from unmodified branches, rather than trunk wood, that had been minimally worked to remove any extraneous side branches and partly cut and split, to form a (very) crude 'point'. The posts measured between 80 mm and 120 mm in diameter and up to 1.15 m in length. The posts were all of oak. Much of the sapwood was soft in contrast to the dense extremely hard, and blackened, heartwood. Although the outermost wood was present the bark was not.

Two post-lines (of 3 timbers and 7 timbers respectively) were situated in north–south orientated rows, west of revetment 709/710 and post-line 711, suggesting that they represent supports for a structure related to the revetment, such as a jetty, bridge or trackway. The three posts of the easternmost alignment were of roundwood, the bark surviving except at the worked points. The seven posts of the westernmost alignment comprised unworked logs, with bark still attached in places. Only one post was excavated to its base, which was roughly worked to a point. The post-line may also incorporate two other posts which were not in full alignment with the line. One was of elm, and was fashioned from a trunk that was felled, side branches removed and, without further modification, one end skilfully tapered to a point. Woodworking marks suggest a well-sharpened metal axe with a flat cutting edge.

Between the two lines of posts, within the centre of the trench, was a revetment feature formed from four vertical posts and stakes of varying sizes (718–9, 721–2), generally becoming smaller towards the south, set to the east of vertical planking (724). Between the post supports and the planking ran horizontal unworked branches. All of the stakes and posts still had remnants of bark attached and were unworked, although the full extent of the timbers was only exposed in the shorter stakes that did not have a worked base.

The most westerly structure (structure 707) (Fig. 5.18, above) consisted of 19 posts, each made from a sawn, de-barked, squared log of *Pinus sylvestris* (Scots Pine). The base of each post tapered into a chisel point, formed by hewing, most probably with an axe with a flat cutting edge. One post was extracted during the excavation; it measured 1.61 m in length. A continuous line of overlapping vertical planks (708) was secured to the eastern side of 707 with square-headed iron nails. These planks were associated with a revetment and almost certainly were employed to retain earth within the revetment; they were probably originally fixed by being nailed to uprights. They were in *Pinus sylvestris* (Scots Pine) and were closely comparable in shape to modern 'shiplap', as used for fence panels and for the exterior cladding of out-buildings. Though certainly native to Scotland most, if not all, Scots Pine in southern Britain has been planted, though not uncommonly becoming naturalised (Preston *et al.* 2004). It is therefore most likely that the pine identified here was imported from elsewhere or, alternatively, acquired from a more local source of planted pine woodland.

Seven overlapping wooden planks (725) of varying sizes were laid in a rudimentary east-west alignment at the southern end of the trench. The planks, all machine-cut, spanned a length of 5 m. This may represent a simple dump of broken materials within a river environment, or a rudimentary crossing within a marshland environment.

An unworked, vertically set stake (729) was situated to the north of planking 725. The stake was not excavated to its full depth and it measured 60 mm in diameter. The wood was knotty and still had bark attached. The stake may represent a continuation of revetment 711 to the north, as may similar stakes 727 and 728 situated further to the north.

To conclude, two distinct phases of revetment in Trench 41 show a continuation of river management on Pudding Mill River. The earlier revetment formed from a line of crudely worked, large oak logs, a line of partially worked stakes and crudely worked planks differed greatly from the later revetment of precisely sawn Scots Pine posts and planks, suggesting that the earlier revetment underwent extensive use, or may have been abandoned for some time. A parallel line of posts projecting on an east-west alignment from the earlier revetment, also formed from partially worked, sizeable timbers, most probably represents a jetty or bridge constructed after the initial revetment, as the posts show the use of greater woodworking skills. There was no dating evidence for the wood structures.

19th/20th Century Boat

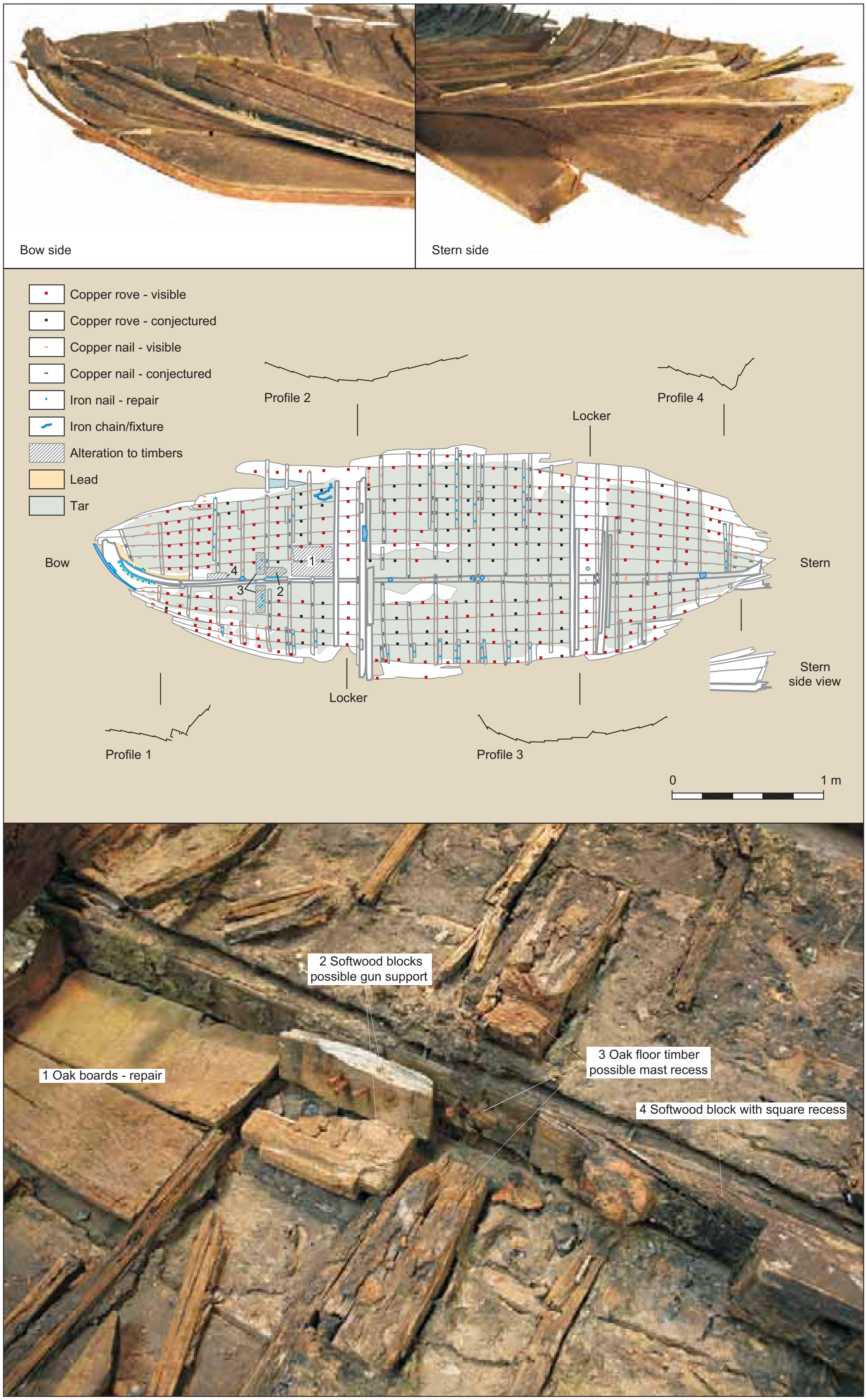
An abandoned wooden boat (1004) (Fig. 7.17, Pl. 7.27) was found in Trench 59, adjacent to pile and plank revetment 2014 beside Nobshill Mill on Pudding Mill River (Fig. 5.16, above), and buried within and on top of fluvial deposits laid down since the late 19th century. It is clinker-built, a technique in which a rounded hull was constructed of partially overlapping planks fastened along their edges; it had a straight keel with a stem forward and transom aft. The vessel survived relatively intact, although there were some areas of distortion and missing sections of the uppermost parts of the hull; approximately 70% survives. The remains of the vessel measured 4.51 m in length, it had a beam of 1.51 m and a depth of 0.50 m. The highest surviving part lay at a level of 2.61 m OD.

The following description is summarised from the original archive report (Goodburn 2009c).

Construction

The centre line assembly

The builders would have shaped and assembled the centre line ('backbone') members of the boat first, including the straight-grained elm keel. The sides of the one-piece keel appear to have been slightly cut away to provide a narrow flange for most of its length to accommodate the garboard fastenings ('garboard' is the first plank next to the keel on either side). Towards the bow the keel was narrowed without flanges and towards the stern a rabbet (a groove cut to receive planking edges) was cut. The keel (1009) was cut from a sawn slab of elm as were the keels of some other post-medieval London boats. The curved grain elm stem and straight oak stern post were then fitted to the keel, the latter with a pegged mortise and tenon joint, the only place where such a joint was used.



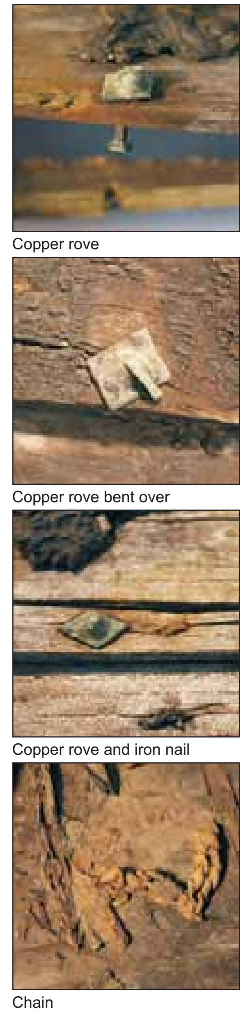


Figure 7.17: Plan and profiles of boat showing various construction details, Trench 59

The later false keel and stem band

The false keel was only slightly worn where unprotected by the iron stem band and had clearly been fitted during the 'middle age' of the boat. Manual saw marks could just be seen through the tar coatings in places, probably left by pit-sawing. The plank false keel was secured by substantial iron bolts through the keel, and the iron stem band was fastened by round-headed iron spikes. Towards the stern it was apparent that the last users of the vessel had tried to cut off the false keel by chiselling through it round the aft keel bolt, but had given up.

The boards and hull shell

The thin planks or boards of the articulated hull survived up to the partial remains of the ninth strake on the starboard side, and up to the sixth strake on the port side. Originally there must have been a minimum of 10–11 ‘strakes’ (or ‘courses’ of boards) on either side of the keel.

In a very few places on the boards faint saw marks with changing angles could be seen, indicating that they had been sawn out manually, at this date almost certainly by pit-sawing. The thickness of the fine hull boards varied but generally it was around 8mm or 5/16th of an inch. Only in the very lightest of Victorian craft such as canoes were thinner boards used (Goodburn 2009c, 35), and these are the thinnest boards found in any excavated boat remains from the region. The planks were tapered longitudinally with curved edges, which allowed them to fit correctly in one place, and account for the curved shape of the hull.

On the port side two scarfs (end to end joints) were visible on the 4th strake between frames 5 and 6 and on the 5th strake between frames 17 and 18. There are two scarfs visible on the starboard side on the 7th strake between frames 9 and 10 and on the 8th under the frame 16. The scarfs were designed to open aft so the water would not seep into the joint under pressure as the boat moved forward. The sealant in the joint (or 'luting') was a minimal layer of tar.

The timber of the hull has been identified as elm (*Ulmus* sp). Over the last 150 years many elm species and regional varieties have been used for clinker boat work, some much preferred over others, such as home-grown, small leaved Cornish elm or Wych elm over common elm. Particularly tough, straight-grained elm was also imported from north-east USA and Canada – called 'rock elm' in the timber trade. This was often specified for keels and widely used for yacht work in Victorian times. The keel, stem and two of the locker planks (see below) were also of elm. Both the elm locker planks are the most rot-degraded elements of the hull – quite different in condition to the hull planking or keels. This may be a result of surface treatments of the latter elements or possibly a result of species variation (although these cannot be distinguished on botanical grounds from the samples), ie, the planking and keels may be of rock elm.

The framing

There were originally 26 frame stations. The frames of the boat were particularly small in dimensions and were laid out and fitted in an intricate, not totally regular pattern affected by repairs and doubling. They were cut out of straight-grained pieces of oak, probably planks. In places, what looked like hand rip-saw marks were visible although the surfaces were generally tar covered, worn or planed smooth. It is assumed that the oak species used was probably one of the two north European natives *Quercus robur* or *Q. petraea*.

The dimensions of the frames varied a little – *c.* 18-24 mm (*c.* 1 inch) wide or 'sided' to *c.* 18 mm (¾ inch) deep or 'moulded'. It is clear that the frames were bent to shape, probably using steam, a technique initiated in the 18th century (Phillips-Birt 1979, 167), but it is unclear in what sequence they were made.

Plate 7.27: Boat from Trench 59 during conservation and recording

In a more recent clinker boat from the Thames region with bent frames, the ribs would not have been ‘joggled’ (notched to fit overlapping planks) and would have run across in one piece, a much faster method of framing out. The great overlap and close spacing of the light framing over most of the hull indicates that they were thought weak when introduced, some time in the 18th century (*ibid.*, 167). Previously more widely spaced 'grown' frames made from naturally curved logs, where possible, were used throughout, as they still were in some 20th century work boats in England, and even in some pleasure craft on the Thames.

Near the bow the decayed remains of a short oak floor timber crossed the keel just aft of the stem knee (Fig. 7.17, lower photograph, no. 3). It spanned the keel and the first two strakes on each side. Despite the condition, a central recess 140 mm wide could be seen that may originally have accommodated a removed mast step or similar fitting. Towards the stern another oak plank-like floor timber was also fitted for strength and possibly to support the aft section of original floorboards.

The fastenings

A key feature of this small boat find compared to the rest of the London archaeological corpus is that the original fastenings were principally of copper (Fig. 7.17). The roves used for most of the lap fastenings were of irregular shapes, but predominantly diamond-shaped, like medieval iron ship roves, and also including many of square and rectangular form. They had been hand cut from a copper strip. The nails accompanying the roves appear to be some form of early cut nail, possibly handmade, square in section with a chisel point. Although in most cases the inboard tip of the nail was peened over to make a rounded rivet head in some cases, particularly towards the ends of the vessel eg, the starboard bow, nail tips were bent over the rove without full riveting. This was a time-saving ploy increasingly common from the 16th century in the London corpus of clinker boat material. Right at the bow and stern end most of the nails were simply turned twice back into the inner board without using a rove. The frames were secured by nails turned twice or sometimes only once. In the original frame elements these were all of copper but in the repairs they were of iron of the same size and treated in the same way. In the softwood repair planking both iron turned and roved nails were used and were of the same proportions and form as those of copper.

The same basic copper nails appear to have been used as plain 'dead nails' for plank hood ends etc. Copper tacks were also used to fasten the ends of scarfs where the long tapered points were twice turned, and the heads were driven flush with the surface.

The locker planks were secured by substantial copper spikes. Iron nails were also used in the elm planks. Finally, iron bolts were used to secure the false keel. They had square outboard heads but the inboard ends were obscured by concretions, so their form is uncertain.

Surface finishes and waterproofing

The surface finish which now dominates the inside of the hull comprises at least two thick coatings of gritty black tar, clearly applied principally as a leak stopper and surface coating late in the life of the boat. A similar tar had been applied less thickly to the outside of the hull. Analysis of a sample of this tar by Gas Chromatography-Mass Spectrometry (GC-MS) indicated a probable identification as coal tar, a cheap by-product of making coal gas and probably available locally in the mid-19th century. The tar appears to have been mixed with Pinaceae resin (pine, cedar or fir) and oil or fat (whether plant- or animal-derived is uncertain). Painting a thick layer of tar inside clinker working boats continued into the 20th century.

In places underneath the tar a mid-brown staining could be seen, possibly an initial sealing layer of some type of diluted wood tar or varnish. In the archaic softwood repair tarred hair was used as luting in the laps. Earlier studies of such material have shown a wide variety of materials was used, some being chronologically or geographically specific. In this instance, examination of the fibres under a Scanning Electron Microscope (SEM) suggested that they were animal derived, although with few characteristic features to enable definitive identification. All that can be said is that the relative size and shape of the fibres is more consistent with wool, rather than cattle, horse or porcine fibre.

Some of the upper elements of the hull found loose over the articulated section and the forward locker plank also had a layer of creamy off-white paint followed by one of mid-blue paint. Both of the latter are likely to be oil-based with lead additives. Analysis of a sample of the paint by GC-MS yielded a small number of components including fatty acids, which cannot be further interpreted and which may have been intrusive (full details of the analysis of the tar and tarred hair by Dr Andrew S. Wilson, and of the paint by Dr Ben Stern, both of the University of Bradford, can be found in the archive).

The lockers added later in the life of the craft: from pleasure boat to work boat

Another distinctive feature of the boat are the two lockers made by close fitting two pairs of planks into the boat in the manner of bulkheads. These were clearly made late in the life of the craft in an *ad hoc* way. One function may well have been to strengthen up an old, very lightly built hull, but storage and support (crew seating) functions seem most likely. The forwardmost planks of each pair were of elm. All the locker planks had small lengths of softwood or elm off-cuts iron nailed to them near their bases, no doubt to act as crude ledges for floor boards. These floor boards had been removed but were also indicated by a large iron screw eye set in the top of the keel amidships. Such fittings were sometimes used to hold boards in place so that they did not move around or float when the boat's bilge water was high.

It seems likely that, originally, some form of horizontal lid plank was set over the bulkheads which could then keep some material dry and possibly secure if it was in containers. At some stage near the end of the vessel's life this included bird shot and probably powder in the forward locker, where spilled bird shot was found. Indeed, the paired recesses and hinge housings on the upper edge of the forward locker plank are strongly indicative of this, and/or possibly providing support for the wildfowling 'punt gun' with which the boat appears to have been fitted. This locker plank was clearly reused and of softwood, probably imported pine (*Pinus sylvestris*). Two upper case letter Bs were found carved or stamped in the forward face of this plank, presumably dating from its first use.

Fittings in the bow: mast steps or gun supports

The bow area of the boat had several small fittings placed along the centre line, the function of which is not entirely certain. The solid oak floor timber with a fore and aft recess has already been discussed (see above; Fig. 7.17, lower photograph, no. 3) and provisionally ascribed the function of holding a removed mast step dating to the sailing phase of use. But forward of that timber a short squared block of softwood was found nailed to the stem knee (Fig. 7.17, lower plate, no. 4). The block had a shallow square recess and deep cut in it that must have held an upright element. The later was probably some sort of pillar for a crosswise beam or thwart (bench). The fitting would have been too insecure for a mast step itself. Just aft of that fitting are two small softwood blocks nailed one on top of the other over the keel (Fig. 7.17, lower photograph, no. 2), probably fitted shortly before the abandonment of the boat. The blocks' function is uncertain but could have had something to do with the support of a heavy punt gun.

In thick tar on the starboard side, just forward of the bulkhead, a short length of iron chain ending in an iron staple was found, the function of which is uncertain. However, chain was used as a device to keep the floor boards together if they became buoyant when the bilge water filled the bottom of the boat. The ends of the chain would be attached to the hull and bulkhead of the vessel, and the floor boards were fitted with rings through which the chain passed.

Evidence for the existence of a rudder

The large iron concretion attached to the bottom of the stern post must be a 'gudgeon' – that is, the female part of one of a pair of simple hinges on which a rudder was pivoted by the use of a male hinge part or 'pintle'. The rudder would have been crucial in the vessel's sailing phase of use but not essential in its first or last uses.

Repairs

There were several places in the hull which had been patched with metal patches and two small patches of oak. On the outside of the hull several small patches of thin sheet metal were found. These patches (or 'tingles') may be made of zinc sheet which was made from the 18th century onward. At the bow on the port side a lead strip was used for a tingle over the stem hood ends joints. A lead tingle was also found on the outboard face of the port garboard near the forward locker. The last repair patches to be fitted were two oak boards tacked down over tar covering a break in the starboard garboard and adjacent plank near the bow. They were not tarred or painted and must have been amongst the last repairs carried out to the hull, not very long before its abandonment.

Just above the articulated hull of the boat, a displaced hull fragment was found comprising a softwood repair plank joined to original elm planking by scarfing at the laps. The fragment could not be refitted to the articulated hull but was clearly from the upper part of the craft. The repair board was of softwood, probably pine (?*Pinus sylvestris*).

Evidence for changes in use of the craft

There is clear evidence of three main phases of use in the structure of the boat and many sub-phases of repair. The very light construction, sharp stern but flat-floored central hull and shallow original keel would suit the function either of a small rowed pleasure boat or a small boat for moving people and light luggage – a small 'water taxi'. Later on in the life of the boat, the owners decided that it was to become an early sailing pleasure craft and a deep plank keel was added, rather than the dagger or centreboard that would be typical by the end of the 19th century, following American usage. At least 15, perhaps 20 or 30 years after the boat was first built it was given *ad hoc* alterations by the addition of two lockers and fittings for the bow end of the craft. By this time it was weak, old and leaky but still useable on the sheltered waters of the lower River Lea. This was indicated by the thick tar layers applied inboard and out, and metal repair tingles. The last alterations bore no tar on the external faces and were repair tingles of oak and a pair of softwood blocks, perhaps added to support a heavy punt gun in the bow. It is likely that the boat was between 20 and perhaps 40 years old when eventually abandoned beside Nobshill Mill on Pudding Mill River.

Discussion

The boat was abandoned after several phases of repair. Most of the timber and the copper and iron fastenings and metal and wooden repair patches ('tingles') were in good condition when first exposed. However, the disturbance was greatest at the bow where timbers and lead tingles had been bent out of shape or broken. A number of loose fragments of what clearly had been part of the boat were found in close contact with it in the base of the overlying dump layer, and it seems likely that the upper parts of the boat's sides were partly smashed out of the way to provide access for the later 19th century dumping.

The clinker-built boat was in line with an ancient system of boat-building introduced to England in Saxon times, in which a rounded hull was made of partially overlapping planks fastened along their edges. These planks or boards were set around a back bone of longitudinal timbers forming a hull shell into which strengthening frames were added after the planking, a so called 'shell-first' system. It was one of several systems of boat-building used in the Thames estuary region over the last 500 years, surviving into recent times for a variety of small boats. This system of building vessels changed greatly over the last 1500 years or so and the boat can in some senses be seen as a rare technological missing link between recent 'traditional' craft and those of the early post-medieval period.

Dating of the associated ceramics and clay tobacco pipes in the layers around and above the boat indicates that the vessel was abandoned during the mid- to late 19th century. If we take into account that it was remodelled and repaired several times then an original building in the first quarter of the 19th century is currently the most likely broad dating. Very limited parallel technological information from other vessels suggests a date range of 18th to mid-19th century would not be out of place.

Clearly we cannot, as yet, prove the regional origin of the craft except to suggest that such a small, transom-sterned clinker boat of these proportions would be at home almost anywhere in southern England. Also due to its small size a fairly local origin is taken to be most likely, although if it was designed for carriage aboard ship then a more remote origin remains a possibility. It also appears virtually certain that all the changes to the hull except possibly the first phase of repairs to the midships side planking and framing (see below), were made locally as they would have made the boat less easy to transport on deck and less suitable for selling on.

The next most likely origin for the boat was as a very light 'gig' or fast, light rowing boat possibly carried on a ship for use as a water-taxi for the crew or passengers in calm conditions. It is likely that such boats could be bought cheaply from ship breakers in the area and it is also certain that they were also built within the region.

A possible context for the commissioning of the building of the boat was for use as an early pleasure rowing boat for folk attending the famous nearby Bow Fair. Various outside activities were carried out there from the 1760s to 1820s for large numbers of people. If this association were true it would be very early in what was by the 1850s in southern England to become a craze in pleasure boating (Vine 1983).

Detailed records or extant remains of small open boats from before the 1880s in England are very rare. No detailed archaeological studies of surviving small boats of the late 18th to mid-19th century have been carried out in this region and even where a small number of naval architects' drawings exist they only show simplified, nominal, hull outlines. Apart from one small fragment and a poorly provenanced fragmentary find from Essex (Goodburn 2004), the detailed published archaeological small boat finds of the region stops with material of the 17th century (eg, Marsden 1996).

A generally close but later parallel may be the 12-foot long 'Teddy' built in 1877 as a shallow, fast clinker rowing vessel for use in the river Deben in Suffolk (Simper 2007, 105). The published account of the craft is very brief and it is a little smaller than the Olympic Park boat. However, it does have a broadly similar framing pattern, and was built of narrow elm boards. In terms of features such as the framing patterns there are some similarities with traditional Thames clinker vessels such as Thames wherries, but the parallels are not exact. The same can also be said of some traditional Cornish sea-going rowing gigs and possibly the last 'Deal Galley' seen by this writer on Deal beach 20 years ago. Here similarities would include the use of very thin elm planking with light notched bent frames (Phillips-Birt 1979, 186). Earlier parallels for individual constructional details can be cited, such as for the handmade copper rove nails. Very similar nails can be seen, for example, in Prince Frederick's ceremonial barge of 1732 (held in the National Maritime Museum), the hull planking of the latter vessel appears to be quarter-sawn oak.

Moving backward in time to the 18th century two rather similar fragments of small clinker boats have been found, including small sections of keel and adjacent sawn oak planks. However, in both cases the oak planking was a little thicker and the fastenings iron and the fragments appeared to have derived from larger work boats of some type (Goodburn 2004). In 2008 some clinker plank fragments were found reused near the Southwark waterfront (Goodburn 2008b; MoL site code HLS07) which were only a little thicker than those of the Olympic Park boat at 12–15 mm. But in this case they dated to the 17th century and were made of radially split oak.

In sum, the evidence from the Thames region and England as a whole is very scant for small clinker boats from the period 1500 to *c.* 1880. In some respects it may be fair to note that the boat stands as an example of the last transitional phase of clinker boat-building prior to the finalisation of recent practices with machine worked timber and mass produced copper nails by *c.* 1890. By the late 20th century even those practices had been supplanted by glued clinker plywood construction and fibre glass.

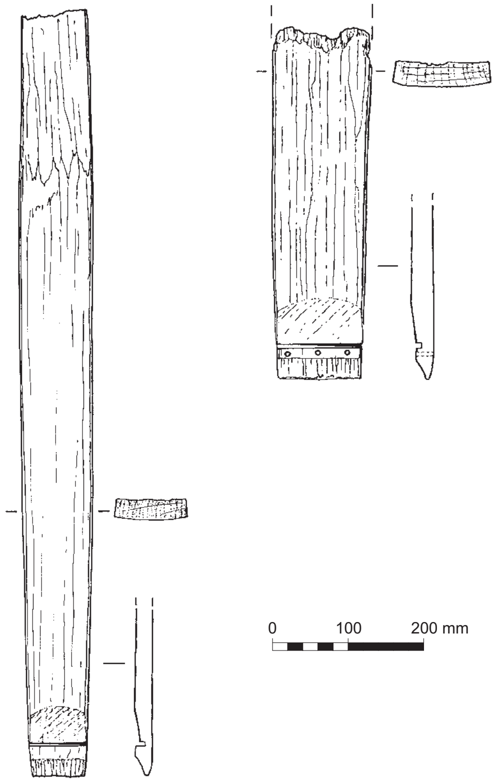
Despite this, parallels in design and construction can still be seen on later vessels stretching into the 20th century. Such vessels include watermen's skiffs, which were well crafted working boats. Skiffs evolved from the watermen's 'bumboats' of the 18th century and carried passengers, towed rafts of timber, received ships' mooring cables and delivered post to ships in the Pool of London. They also provided a service to lightermen, stevedores and other port workers who had to reach vessels moored in the tideway. Known extant examples include the PLA waterman's rowing skiff, built in 1920; the *Thames*, a waterman's skiff built for the Blackwall waterman, George Egalton, in 1934 (both these are clinker built with overlapping planks into which frames were added); and the *Defiant of Lyme Regis*, a replica of a 13-foot Bristol Channel pilot cutter's rowing punt, built in 2008.

Other Worked Timber

19th century casks reused as well lining (Trench 59)

Nearly all of the timbers from the back-fill of a 19th century brick well (2000) (a total of 27 timbers were lifted) derived from two stave-built containers which had had their ends knocked out to make what was effectively a wooden shaft in sections (timber 2003). It is quite likely that the reused wooden casks originally protected a pump shaft, as has been found in late post-medieval and 19th century contexts on several London excavations recently, such as those at Holland Street in Southwark (MoL site code HLS07), and Belvedere Road, Lambeth (MoL site code BVD97). The proximity of the tidal River Lea suggests that the water from such a well might be a little brackish in the summer, so perhaps the possibility that it was a soak-away could be considered, although less likely.

Twelve staves, all sharing the same basic dimensions and patina, derived from a small oak cask. The best preserved cask staves were 0.76 m long, between 85–152



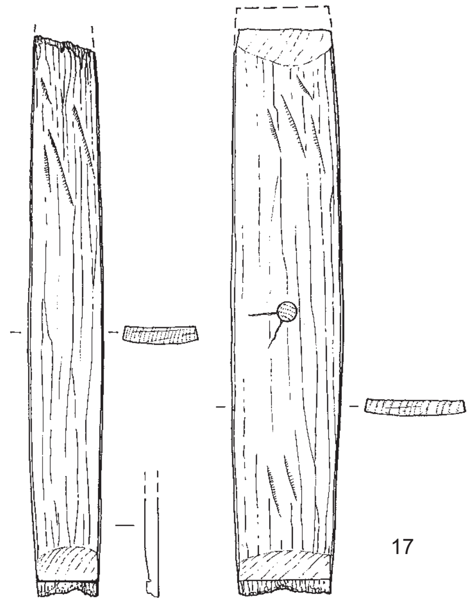


Figure 7.18: Worked wood: 17) post-medieval oak cask staves (Timber 2003), Trench 59

mm wide and *c.* 15 mm thick (Fig. 7.18). They were all of radially cleft oak and had been shaved convex on the outside and flat on the inside, some still bearing occasional broadaxe marks. The edges had been planed and no sapwood was left. The widest stave had a bunghole 25 mm in diameter with an *in situ* wooden bung. The 'howel' (internal hollow on stave ends, so that cask lids fit snugly) and 'croze' (groove where the top or bottom of the cask is fitted) survived on both ends of many of the staves. No clear traces of any marks were found on the timbers, but rusty staining where the original iron hoops fitted did survive. No traces of any head pieces were seen. The staves must have come from a small cask like those used to carry water on the barges that probably passed by regularly.

Twelve more decayed, radially cleft oak staves belonged to a larger but less well preserved cask. All but two only survived for about one-third of their original length. The two most intact appeared to be *c.* 85% intact, missing one howel, and had a length of 0.99 m (Fig. 7.18). The widths varied between 95 mm and 130 mm, and they were 25–28 mm thick. The surfaces of the staves were nearly flat and the insides had been well charred. In one stave end three pegs were found that would have held a cross-wise batten reinforcing the heading. This technique is still used on some types of traditional French wine casks and it seems likely that this was the function of this cask in its first use. Again, faint iron staining suggests that originally iron hoops were used.

List of illustrated timbers and structures

(Figs 7.9–7.18)

Figure 7.9

1. Stake, alder, Early Neolithic. Timber 578, Trench 118.

Figure 7.10

2. Oak stud end (tenon post). Timber 2180, base of Middle Iron Age ditch 1384, Trench 9.

3. Base or lid of bentwood vessel (with possible reconstructions). Timber 2212, base of Middle Iron Age ditch 1384, Trench 9.

Figure 7.11

4. Stake, Romano-British. Timber 264, structure 42, Trench 58.

5. Stake, Romano-British. Timber 197, structure 42, Trench 58.

6. Plank. Timber 41, structure 42, Trench 58

Figure 7.12

7. Stake, alder, Romano-British. Timber 73/503, four-stake structure, Trench 118.

8. Stake, alder, Romano-British. Timber 180, Trench 118.

9. Stake, probably alder, Romano-British. Timber 568, three-post alignment, Trench 118.

10. Stake, alder, Romano-British. Timber 69, Trench 118.

Figure 7.13

11. Stake, oak, post-medieval. Timber 241, wattlework revetment 114, Trench 58.

12. Stake, oak, post-medieval. Timber 31, wattlework revetment 100, Trench 58.

Figure 7.14

Revetment 114 in Trench 58; plan and elevation.

Figure 7.15

13. Reused ship's timber (oak hull planking), post-medieval. Timber 60, Trench 58.

14. Reused ship's timber (oak hull planking), post-medieval. Timber 86, Trench 58.

Figure 7.16

15. Pile, oak, post-medieval. Timber 772, pile structure, Trench 75

16. Post, oak, post-medieval; part of tenoned end; nails and mortar marks. Timber 749, Trench 75.

Figure 7.17

Clinker-built boat, Trench 59. (Top left) Detail of bow side; (top right) detail of stern side; (middle) plan of boat; (bottom) detail of forward section, viewed from starboard side; (small photos on right) details of copper roves and iron chain

Figure 7.18

17. Oak cask staves, post-medieval. Timber 2003, Trench 59

Human Bone

by Jacqueline I. McKinley

Human bone was recovered from Trenches 9 and 43 (see Chapter 3). The remains of four inhumation burials and redeposited bone from a ditch fill were recovered from Trench 9 (Figs. 3.7, 3.11). Two cremation-related deposits were recovered from the same trench (Fig. 3.5), with a third being found in Trench 43, located *c.* 500 m to the south-west (Fig. 3.12).

All three cremation-related deposits, which include a minimum of one unurned burial with redeposited pyre debris (though all three may be of this type), have been radiocarbon dated to the Late Bronze Age (see Chapter 3, Table 3.1). Samples of bone from the four unaccompanied inhumation burials were also submitted for radiocarbon dating but due to the poor condition of the bone (see below) all except one failed (see Chapter 8). The one date returned, for the bone from grave 1852, is Late Iron Age/Romano-British. Grave 1662 was cut by a Middle Iron Age ditch and therefore must be of that date or earlier. The other two burials remain undated.

Methods

Osteological analysis of the cremated bone followed the writer's standard procedure (McKinley 1994a, 5–21; 2004a). The degree of erosion to the unburnt bone was recorded using the writer's system of grading (McKinley 2004b, fig. 7.1–7). Age (cremated and unburnt individuals), was assessed from the stage of tooth and skeletal development (Beek 1983; Scheuer and Black 2000), and the patterns and degree of age-related changes to the bone (Buikstra and Ubelaker 1994). Sex was ascertained from the sexually dimorphic traits of the skeleton (Gejvall 1981; Bass 1987; Buikstra and Ubelaker 1994). Measurements were taken from the unburnt bone (Brothwell and Zakrzewski

Tr.	Cut	Context	Period	Radiocarbon date	Deposit type	Quantification	Age/sex	Pathology
Cremated bone								
43	527	526	LBA	1120–900 cal BC (SUERC-34931, 2830±35 BP); 1050–860 cal BC (SUERC-35326, 2810±30 BP)	un. burial + rpd/?rpd	246.2 g	adult *c.* 25–40 yr ?female	osteophytes – C1; mv – wormian bone
9	1972	1971	LBA	1130–910 cal BC (SUERC-3493, 2845±35 BP); 1420–1260 cal BC (SUERC-35323, 3075±30 BP)	un. burial + rpd	489.9 g	adult *c.* 30–40 yr ??female	?trauma – rib shaft; periosteal new bone – ?fibula shaft; enthesophytes – innominate; osteophytes – hand prox. IP joint
	2052	2051	LBA	1120–900 cal BC (SUERC-34932, 2835±35 BP); 1120–910 cal BC (SUERC-35324, 2840±35 BP)	un. burial + rpd/?rpd	156.2 g	subadult *c.* 13–16 yr	–
Unburnt bone								
9	1041	1057	undated	–	prone burial	*c.* 53% (some missing?)	adult >45 yr. male	calculus; *ante mortem* tooth loss (2); osteochronditis dessecans – right distal femur; osteoarthritis – right 1st T-MtT & Mt-P joints; ?fracture – left 5thmetacarpal; osteophytes – 2L, S1, innominates, right scapula, left hand IP joints (2), right calcaneum; ddd – S1; enthesophytes – left prox. ulna, calcanea
	1158	1156	undated	–	burial	*c.* 64% a.u.l. (some missing inc. skull)	adult *c.* 25–35 yr ?female	spondylolysis – L5; Schmorl's node – T10; pitting – right medial clavicle; osteophytes – left distal tibia, left talus, 1 right rib, right 7th c-v; cortical defects – prox. humeri, right distal femur; enthesophytes – left prox. ulna, right patella, tibia tuberosities, distal tibiae, calcanea; exostoses – left distal fibula
	1160	1723	prehist.	–	redep.	*c.* 5% l.	= 1163	–
	1662	1663	prehist.	–	burial	*c.* 74%	adult *c.* 45–60 yr male	calculus; periodontal disease; dental hypoplasia; *ante mortem* tooth loss (4); dental abscesses (5); dental caries (3); DISH – T8-10, L5; osteoarthritis – left 1st C-MtC joint, right carpal joint, left knee , 3 left c-v joints, C3; ddd – C5-7, T6-12; Schmorl's node – T10-12, L1; osteophytes – right s-c joint, left scapula, elbow joints, C-MtC joints (2 each side), left hand distal IP joints (2), hip joints, right knee, right c-v joint, all vertebral bsm, C ap joints, T1 ap joint; pitting – left a-c joint, left s-c joint; enthesophytes – right rib, right ilium, prox. humeri, prox. femurs, patellae, right tibia tuberosity; mv – mandibular & palatine tori
	1852	1810	LIA/RB	110 cal BC–cal AD 60 (SUERC-33678, 2020±30 BP)	burial	*c.* 44%	adult female	pitting – 2 c-v joints; ?trauma – 3 left MtC; enthesophytes – prox. *c.* 35–40 yrfemora, calcanea

Key: un. = unurned; rpd = redeposited pyre debris; s.a.u.l. (skull, axial skeleton, upper limb, lower limb; skeletal areas represented where not all were recovered); C/T/L/S = cervical, thoracic, lumbar, sacral vertebrae; c-v = costo-vertebral; s-c = sterno-clavicular joint; a-c = acromio-clavicular joint; ddd = degenerative disc disease; IP = interphalangeal joint; C-MtC/T-MtT = carpo-metacaral/tarsal- metatarsal joint; a-p = vertebral articular joints; mv = morphological variation; prox. = proximal; bsm = body surface margins

Table 7.15: Summary of results from analysis of human bone

2004) and skeletal indices calculated where possible (Trotter and Gleser 1952, 1958; Bass 1987). Non-metric traits were recorded in accordance with Berry and Berry (1967) and Finnegan (1978). A summary of the results is presented in Table 7.15. Full details are in the archive.

Results and Discussion

Disturbance and condition

The surviving depths of the graves ranged from 0.08 m to 0.31 m; most fell between 0.10–0.20 m, with only one at less than 0.10 m (0.08 m, inhumation grave 1852) and one greater than 0.20 m (0.31 m, inhumation grave 1662). At least two of the graves had been truncated slightly during machine stripping of the trench, resulting in the loss of parts of the skull and the right arm bones from inhumation grave 1041 (the burial had been made prone and the right arm must have lain at a slightly higher level than the rest of the torso), and the skull and fragments of the rest of the skeleton from grave 1852 (though some had probably already been lost from this shallow grave by other mechanisms).

It is probable that the depth of all the graves will have been reduced over time. In the case of inhumation graves 1158 and 1162 this does not appear to have affected the burial remains, but any impact on the cremated remains is less easily deduced since it is unclear whether or not bone was evident at surface level. Evidence from elsewhere has shown that the remains of unurned cremation burials can survived totally undisturbed in graves surviving to as little as 0.05 m in depth (eg, Dinwiddy and Schuster 2009, figs 36–8; McKinley forthcoming a) and such may be the case here, but a lack of detail regarding the distribution of the archaeological components within the cremation-related features means that no confident statement regarding possible loss of bone by this mechanism can be made.

Only one grave was subject to disturbance by a later feature, the distal end of grave 1662 having been removed by the cutting of the Middle Iron Age ditch 1384. This resulted in the removal of most of the lower limb bones, parts of which were recovered from the adjacent excavated segment of ditch fill. The skull and all the vertebrae from inhumation burial 1156 were recorded and lifted in excavation but were not available for osteological examination. The loss of bone from the inhumation graves due to disturbance is reflected in the relatively low levels of skeletal recovery (Table 7.15).

The unburnt bone has a slightly eroded appearance (grade 2–3). Much has a light covering of a mineral precipitate which at times obscures the bone surface and in one case had fused some bones together. There is moderate–heavy fragmentation of the larger skeletal elements, particularly those from the two shallowest graves.

The cremated bone is in good visual condition, and a moderate amount of trabecular bone (generally subject to preferential destruction in free-draining, acidic soil conditions such as the gravels seen here; McKinley 1997a, 245; Nielsen-Marsh *et al.* 2000) was recovered from each deposit (but see below).

Demography

The remains of seven individuals were identified, three from the Late Bronze Age cremated bone assemblage and four from the unburnt bone assemblage (Table 7.15). Although only one of the three Late Bronze Age deposits was confidently identified as a burial (see below), the remains from each deposit clearly derived from different individuals. There is duplication of skeletal elements between the two deposits containing the remains of adult females (in addition to which they derived from different trenches). The second deposit from Trench 9 contained the remains of a subadult.

The four inhumation graves each contained the remains of an adult, comprising two females less than 40 years of age and two males over 45 years. Any possible significance which may be attached to the apparent gender-based age differences is tempered by the small size of the group and the possibility – despite their spatial proximity – that they may not be contemporaneous. The two females and one of the males appear to form a fairly close group (all within 10 m of each other) and the other male lay only *c.* 35 m away on the edge of the palaeochannel (Fig. 3.7, above) but, whilst this suggests an association, such cannot be stated with confidence.

The Late Bronze Age deposits formed dispersed singletons scattered amongst the remnants of Middle Bronze Age field systems and contemporaneous pit groups. The inhumation graves appears to sit within an abandoned Middle Iron Age settlement in what, by the Late Iron Age, formed enclosures possibly for cattle. The locations of these deposits, and their recovery as singletons or small groups, is commensurate with the expanding corpus of prehistoric material being recovered from (often large-scale open) excavations.

Despite the small size of the assemblage, it represents an important addition to the very small number of prehistoric burial remains from the immediate area and, to a lesser extent, the wider vicinity. Several Early Bronze Age cremation burials were found at Fennings Wharf (Sidell *et al.* 2002, 23–26) and a few Middle Bronze Age examples have recently been found *c.* 1 km to the north-west of Trench 9 (Holden and Langthorne 2010, 20-3). Inhumation burials of Early Iron Age and possibly Late Iron Age date were found at West Ham (Boyle 2005), Southwark (Dean and Hammerson 1980; Werner 1998) and the Tower of London (Parnell 1985). However, most of the few prehistoric burials remains found to date have come from slightly further afield (Adkins and Needham 1985; Andrews and Crockett 1994, 15, 63–4; Boylston *et al* 1995; Cowie 2001; Framework Archaeology 2010; McKinley forthcoming a and b; Werner 1998).

Metric and non-metric data

Stature could be estimated for two of the inhumed individuals, one female (1156; *c.* 1.63 m (5ft 4¼ in) and one male (1663; *c.* 1.76 m (5ft 9¼ in)). The latter is well above the mean of 1.68 m given by Roberts and Cox for the Iron Age (2003, 103), and is slightly greater than their recorded maximum (it is also above the 1.69 m average given for the Romano-British period; *ibid.*, 163), whilst the female estimate falls close to the given mean of 1.62 m. The skeleton of the elderly male 1663 was generally massive, including the bones of the hands and feet, suggesting major long-term overall physical stimuli to the skeleton and musculature.

Cranial index could be calculated for only one individual, the adult male 1663; index 68.3 (dolichocrany).

The platymeric index (demonstrating the degree of anterior-posterior flattening of the proximal femur) was calculated for all four inhumed adults. All fell in the platymeric range (index 75.1.0–81.0; with a mean of 77.5 and SD of 3.4) suggesting a broad homogeneity within the assemblage. In the three cases where both femora were available for measurement, the left consistently showed a higher index than the right by between 1.3 and 5.2. In the latter case (the female 1156) the difference is such as to suggest greater physical stress was being placed on the left leg.

The platycnemic index (illustrating the degree of meso-lateral flattening of the tibia) was calculated for three of the adults (both males and one female). The indices for two individuals was very close and fell in the mesocnemic range (68–69.1); the remaining index (1663) was substantially greater at 77.9 (eurycnemic).

Variations in skeletal morphology may indicate population diversity or homogeneity, but the potential interpretative possibilities for individual traits is complex particularly on a 'local' archaeological level (Tyrrell 2000). Some traits have been attributed to developmental abnormalities or mechanical modification, and such may be the case with both variations observed in this assemblage (see Table 7.15).

Pathology

Pathological changes were observed in all the adult remains recovered (Table 7.15); the smaller proportion within the cremated bone assemblage is a reflection of factors associated with the mode of disposal rather than the presence/absence of pathological conditions in the living individual (McKinley 2000). All the rates shown below refer only to remains from the unburnt assemblage.

Dental disease

All or parts of two male permanent dentitions were recovered, comprising 40 teeth and 59 socket positions. Dental calculus (calcified plaque/tartar) was observed in both dentitions; one showing mild deposits with limited distribution (1057) and the other heavy deposits, especially in the distal teeth with some coverage of the occlusal surface of one mandibular molar (1663). Mild periodontal disease (gingivitis) was observed in parts of the distal mandible of the latter.

Both individuals had lost three teeth *ante mortem* (rate 10.2%). A higher proportion of maxillary teeth were subject to loss compared with mandibular (14.3% v. 6.4%). The molars were most frequently affected, though two maxillary premolars were also involved. The overall rate is well above the mean of 3.2% given by Roberts and Cox for their Iron Age sample (2003, table 2.15) but slightly below the 14.1% mean for their Romano-British sample (*ibid.*, table 3.12; NB, the rates vary considerably between individual sites).

Dental caries (acid destruction via oral bacteria present in dental plaque) was recorded in three teeth of one dentition (rate 7.5%). Both molars and premolars are involved; the most extensive lesions are in the maxillary teeth, resulting in almost total destruction of the tooth crowns, the origin of the remaining lesion being in the contact area. The rate is again higher than the mean given by Roberts and Cox for the Iron Age (2.9%; *ibid.*, table 2.46) but is the same as that given for the Romano-British period (*ibid.*, table 3.10). Five lesions indicative of dental abscesses were recorded in the same dentition (rate 8.5%), two in association with carious teeth. In one case the infection had tracked down into the mandibular canal but the infection had almost healed at time of death. The rate is greater than the means of 1.1% and 3.9% respectively from Roberts' and Cox's Iron Age and Romano-British samples (2003, tables 2.50 and 3.13).

Slight dental hypoplasia (developmental defects in the tooth enamel reflective of periods of illness or nutritional stress in the immature individual; Hillson 1979) was observed in several anterior teeth from burial 1663, indicating the individual experienced periods of stress between *c.* 6–7 years of age.

Trauma

Evidence for possible direct trauma to bone was observed in two individuals including one of the cremated adults. In the latter case, a fragment of rib shaft has a slight linear callus set *c.* 20º to vertical on the visceral surface, comprising a central 'groove' with a slight 'bank' to either side (total width 2.7 mm); this may represent a healed blade cut. Despite a lack of clear evidence for a fracture in the X-radiograph, the slight lateral kink and dorsal-lateral callus in the distal half of the right 5th metacarpal shaft from burial 1057 is likely to represent a well-healed fracture. Breaks to this bone are commonly associated with a blow to the knuckles in boxing or a fall on the hand (Adams 1987). Three of the left metacarpals from the adult female 1810 have changes to the surface contours in the distal-palmar sides of the shafts; the normal contours are slightly skewed to the medial (5th) or lateral (2nd–3rd) sides with a break in the boarder-lines and slight enthesophyte-type new bone. The changes are not indicative of a fracture but may illustrate traumatic damage to the joint capsules, possibly due to a violent blow to the knuckles.

One of the two inhumed females has spondylolysis in the L5. Some researchers believe there is an underlying congenital weakness to the condition, which is likely to represent a stress fracture, arguably in the immature individual (Adams 1986, 224; Roberts and Manchester 1997, 78; Aufderheide and Rodríguez-Martín 1998, 63–4). The condition is often symptomless but may cause deep lumbar back pain.

Osteochrondritis dissecans (adult male 1057) is generally believed to be traumatic in origin resulting in the obstruction of the blood supply to the affected area and localised necrosis (Rogers and Waldron 1995, 28–30; Roberts and Manchester 1997, 87–89; Aufderheide and Rodríguez-Martín 1998, 81–83; Knüsel 2000, 116). Males are generally more prone to the condition and, as in this case, the distal femur is most commonly affected.

Enthesophytes are new bone formed at tendon insertions and most frequently appear to represent the result of repeat trauma from muscle exertion (Rogers and Waldron 1995, 24–5). Exostoses are similar lesions commonly associated with injury or damage to the muscle as a result of strenuous exertion causing bleeding in the muscle tissue with subsequent ossification of the haematoma (*ibid.*, 23–4). Both may be indicative of occupational stress or injury, though other causative factors may include advancing age or various diseases stimulating skeletal hyperostosis (eg, DISH; see below), and it is not always possible to be conclusive with respect to the aetiology of individual cases. Lesions were observed at 1–9 sites in the remains of all the inhumed adults and one of the cremated individuals. In most cases the lesions were slight and are probably associated with the normal stresses related to mobility within the prehistoric period, being commonly observed in the patellae, calcanea (Achilles tendon attachment) and parts of the pelvic bones (iliac crest and ischial tuberosities). Lesions in the upper limb (three individuals) are likely to be reflective of occupational stresses linked to lifting and carrying causing minor traumas. The slightly more extensive lesions seen in the distal fibula of the adult female 1156 suggest she may have suffered a severe strain or possible rupture of the ankle ligaments. The cortical defects observed at several tendon insertions in the upper and lower limb of the same individual are likely to have a similar aetiology to the new bone formations, and taken together the stress-related lesions seen in this young female skeleton suggest she had a particularly physically demanding lifestyle.

Infections

Infection of the periosteal membrane covering bone may lead to the formation of periosteal new bone, infection being introduced directly (trauma), spreading via the blood stream from foci elsewhere in the body or developing in response to an adjacent soft tissue infection, and it is often difficult to detect the causative factors involved in individual cases. Slight lamellar (healing) new bone was recorded on a fragment of fibula shaft from cremation burial 1971 but there is no evidence indicative of the cause.

Joint disease

Joint diseases represent the most commonly recorded conditions in archaeological skeletal material. Similar lesions – osteophytes and other forms of new bone development, and micro- and macro-pitting – may form in response to one of several different disease processes, some also occurring as lone lesions largely reflective of age-related wear-and-tear. Many of the conditions increase in frequency and severity with age, though other factors are frequently involved and the aetiology of some conditions is not clearly understood. All or parts of all four spines were recovered (total 50 vertebrae (45 bodies); 31 male, 19 female) and 254 extra-spinal joint surfaces.

Schmorl's nodes represent pressure defects resulting from a rupture in the intervertebral disc, generally in young adult spines (Rogers and Waldron 1995, 27; Roberts and Manchester 1997, 107). Shallow lesions were recorded in two spines, affecting 1–4 vertebrae, none above T10 (rate 11.1%). The rate is below the average of 17.7% for the Romano-British period given by Roberts and Cox (2003, table 3.21). Degenerative disc disease, resulting from the breakdown of the intervertebral disc and reflecting age-related wear-and-tear (Rogers and Waldron 1995, 27), was recorded in the lower cervical and lower thoracic vertebrae of one male older adult spine (rate 22.2%).

Lesions indicative of osteoarthritis (Rogers and Waldron 1995, 43–44) were recorded at 2–7 sites in the remains of the two adult males. Spinal lesions were recorded in only one vertebra (rate 2%); extra-spinal lesions were seen in *c.* 3.5% of joint surfaces. The affected joints include the costo-vertebral joints (3.7%), knee joint (16.7%) and joints of hand (2.4%) and feet (2.8%). Most changes were slight to moderate, but several of the affected joints from burial 1663 show severe changes, including extensive eburnation, particularly in the hand and knee joints.

The smooth bony ankylosis via thick 'flowing' new bone extending over the anterior and right sides of the 8th–9th thoracic vertebral bodies from burial 1163 has the characteristics of diffuse idiopathic skeletal hyperostosis (DISH; Rogers and Waldron 1995, 47–54; Aufderheide and Rodríguez-Martín 1998, 97–9). Similarly located lesions were observed in the 10th thoracic and 5th lumbar vertebral bodies, but there was no fusion to adjacent vertebrae. The lesions indicate ossification of the anterior longitudinal ligament of the spine, with some reduction in vertebral body height and a loss of disc space. The general tendency to hyperostosis elsewhere in this skeleton has already been observed (extensive osteophyte and enthesophytes formation) but there is no conclusive link with the disease and these lesions may be related to the age and lifestyle of this individual rather than (or as well as) the DISH. Symptoms of the disease are generally minimal other than understandable stiffness and some aches/pains. It is predominantly seen in older males and, although the aetiology is unknown, there are indications of a link with diabetes and obesity (Rogers and Waldron 1995, 47–54; Aufderheide and Rodríguez-Martín 1998, 97–9).

Lone osteophytes were recorded in the remains of five adults including two of the cremated females. There is some indication that range and number of sites affected (between one and 41; Table 7.15) and the severity of lesions increased with the age of the individual, the obviously elderly adult male 1663 suffering extensive lesions. Their presence is also, however, testament to this man's physically strenuous life, and will have contributed to debilitating stiffness and aches, and possibly occasional acute pain if they impinged on a nerve.

The elderly male 1663 had obviously experienced a physically demanding lifestyle, possibly with an emphasis on the use of the upper body and particularly the arms and hands. He would, given his height and unusually large build, have presented an imposing figure in his prime. Although there is some indication that he suffered childhood illness (hypoplasia), the absence of other stress indicators, such as *cribra orbitalia* (indicative of childhood anaemia) and his greater than average stature suggests he was well nourished. Similarly, the presence of lesions indicative of DISH – a condition commonly linked with 'good living' – implies that this relatively favoured existence continued into adulthood. The lot of the young adult female (1156) also seems to have been physically demanding and fairly harsh given the frequency of minor tendon/ ligament traumas and early joint disease she appears to have suffered.

Pyre technology and cremation ritual

Oxidation

Although the majority of the bone is white in colour, indicating a high level of oxidation (Holden *et al.* 1995a; 1995b), a substantial proportion of the remains from each deposit, particularly the adult remains, comprised incompletely oxidised bone (black, blue or grey in colour). Variations were seen in at least one but usually more fragments of a skeletal element. With the exception of the subadult 2051, where only the skull vault was affected, all four skeletal areas were involved in each case with variations observed in four to ten different skeletal elements. As is commonly observed (McKinley 2008, table 2) elements of the skull (particularly the vault) were most frequently affected, fragments of femur and radius shaft from both adults showing variable poor levels of oxidation. Several bones of the hands and feet are included amongst the widely affected remains of the adult female 1971.

Factors affecting the efficiency of oxidation have been discussed elsewhere by the writer (McKinley 1994a, 76–8; 2004c, 293–5; 2008). In the cases discussed here some of the variations are quite extensive but not heavily focused on one area of the skeleton. This suggests a general, overall shortfall, most probably in the quantity of wood used to construct the pyres – which influences both time for cremation and temperature sustained. The most commonly affected element was the skull vault, probably resulting from the head being positioned too close to the edge of a slightly undersized pyre; similarly, the hands and feet from burial 1971 were probably laid too close to the cooler peripheries of the pyre. The overall higher level of oxidation to the subadult remains suggests similarly sized pyres were constructed for individuals of different heights and build, resulting in insufficient energy produced to fully cremate the larger individuals.

Bone weight

A variety of intrinsic and extrinsic factors may influence the weight of bone recovered from a burial (McKinley 1993; 2000) and deposits very rarely, if ever, contained all the bone which would have remained at the end of cremation (McKinley 1997b). It is not clear why such variations existed and no consistent pattern has yet been demonstrated other than for the earlier parts of the Bronze Age (*ibid.*). Since the types of deposit represented here cannot all be stated with confidence, and the potential level of disturbance and bone loss from the features is not always clear (see above), it is difficult to deduce how representative the bone recovered from each feature is of the amount of bone originally deposited. The maximum quantity recovered, from burial 1971, represents *c.* 30.6% of the average expected from an adult cremation (McKinley 1993). The weight from the apparently undisturbed Late Bronze Age unurned burial from Imperial College Sports Ground, Harlington, Middlesex, was similarly low (McKinley forthcoming a), as was the average of 473.1 g from the Late Bronze Age burials from the route of the A120 in Essex (McKinley 2007), all falling in the lower range of weights of bone recovered from Bronze Age burials as a whole (McKinley 1997b). At the latter site, however, the range was very broad with several contemporaneous deposits containing quantities in excess of 1000 g, hence the weight variation does not have a simple temporal link.

Fragmentation

The majority of the bone (*c.* 51%) was recovered from the 10 mm sieve fraction only in the case of burial 1971, from which the largest bone fragment (46 mm) was also recovered. The majority of the bone was recovered from the 5 mm sieve fraction in the case of the other two deposits (44–45%), which also had lower maximum fragments sizes (33–43 mm). The degree of fragmentation to cremated bone is influenced by a variety of factors including cremation, burial type and microenvironment, and archaeological processes (McKinley 1994b; 2004c). Unurned burials commonly suffer a greater degree of post-depositional fragmentation than do their more protected urned counterparts, though not consistently so. Here, the type of deposit and post-depositional disturbance (including pressure exerted from above) will have influenced the recorded level of fragmentation. The remains of the subadult were generally more heavily fragmented (only 18% from the 10 mm fraction) probably largely due to the original smaller size and greater fragility of this immature bone, though in this case the possibility of some additional manipulation during cremation or collection of remains for burial cannot be ruled out. This might include deliberate cooling of hot bone (causing greater fragmentation along dehydration fissures) with or without additional movement (eg, water or winnowing), and accidental trampling during collection.

Skeletal elements

Cremation burials generally comprise a range of bone fragments from all skeletal areas, but include a substantial proportion of undistinguished fragments of long bone shaft and trabecular bone. Here 23–49% of the remains were identifiable to skeletal element, the lowest proportion being from the immature individual. As is commonly observed (McKinley 2004c, 298–9), the proportion of skull elements were disproportionately high (*c.* 27–47% identifiable bone; due to the ease of identification of even very small fragments) and axial skeletal elements were under-represented (*c.* 2–8% identifiable bone; resulting from the frequent preferential destruction of trabecular bone). Otherwise, the remains from burial 1971 showed the most 'normal' distribution, whereas those from the other deposits had abnormally high proportions of identifiable skull fragments apparently at the expense of lower limb elements.

Tooth roots and the small bones of the hands and feet are commonly recovered in cremation burials of all periods, and it is believed their frequency of occurrence may provide some indication of the mode of recovery of bone from the pyre site for burial (McKinley 2000; 2004c, 299–301). A substantial number of these elements (particularly in view of the relatively small quantity of bone/deposit) were recovered from both deposits containing adult remains (20–26) with a relatively high number amongst the subadult remains (nine). This frequency suggests collection of bone for burial via raking-off and winnowing of the cremated remains, thereby easing the recovery of the smaller skeletal elements as well as the larger ones; hand collection of individual bones from the pyre site would tend to give a bias towards the recovery of the larger bones, the very small bones being more difficult to distinguish and more likely to be masked by wood ash. Whilst similarly large numbers of such small elements have been observed in Late Bronze Age burials elsewhere the observation is not consistent (eg, McKinley forthcoming a) indicating variations in the method of recovery were not purely temporal.

Redeposited pyre debris and formation processes

The fills of all three features were charcoal-rich (see Challinor, below). The recovery of redeposited pyre debris from a variety of different types of deposit/feature is common throughout most of the temporal range and British geographic areas (McKinley 1997b; forthcoming c). Its presence suggests the close proximity of the pyre site to the place of deposition even where no direct evidence of the former is forthcoming.

Interpretation of the deposit type has to take into consideration a number of potentially inter-related factors including the surviving depth of the feature and potential level of disturbance; the type, quantity and condition of the archaeological components within the deposit, and their relative distribution; and details related to the cremated bone itself (eg, age, sex, skeletal elements represented). In this instance, as the fills of the features containing cremation-related deposits on Trenches 9 and 43 were excavated as single entities, rather than in a more detailed fashion in quadrants and spits, the distribution of the bone within the individual features cannot be ascertained. The condition and quantity of the bone from cut 1972, together with the dimensions of the latter, suggests it is most likely to represent the remains of a burial with an overlaying deposit of pyre debris (itself inclusive of cremated bone). Interpretation is less conclusive with regard to the other two deposits, hence their questionable interpretation.

Animal Bone

by L. Higbee

The assemblage comprises 2443 fragments of animal bone, the vast majority of which was recovered by hand during the normal course of excavation. Bone was recovered from a number of trenches, but only Trenches 9 and 118 produced sizeable assemblages and these are the main focus of this report.

Methods

All anatomical elements were identified to species where possible, with the exception of ribs, which were assigned to general size categories. Where appropriate the following information was recorded for each fragment: element, anatomical zone, anatomical position, fusion data, tooth ageing data, butchery marks, metrical data, gnawing, burning, surface condition, pathology and non-metric traits. This information was directly recorded into a relational database and cross-referenced with relevant contextual information. A detailed method statement is provided in the site archive.

The assemblage includes three associated bone groups (hereafter referred to as ABGs). The definition of ABGs follows the criteria of Grant (1984, 533) with later refinements by Morris (2008a, 34–35; 2010, 12). In order not to over-inflate the number of identified specimens present (or NISP), these groups have been counted as one specimen each in the overall fragment count.

Results

Trench 9

Quantity, provenance and preservation condition

The assemblage comprises 1947 fragments, most of this material being from Middle Iron Age (43%) and Late Bronze Age (28%) contexts (Table 7.16), in particular from pits (28%), ditches (25%) and ring gullies (10%).

The bone is generally in a good state of preservation; however, some fragments have sediment encrusted on to their surfaces, and although this has not hindered identification to species and element, it has

Table 7.16: Trench 9: number of identified specimens present (or NISP) by period

Species	Late prehist.	MBA	LBA	MIA	ERB	M/LRB	post-ERB	Modern	Undated/ unstrat.	Total
Cattle	6	19	67	117	26	2	6	–	22	**265**
Sheep/goat	6	12	80	62	8	–	4	3	22	**197**
Sheep	–	–	3	1	–	1	–	–	3	**8**
Goat	–	–	–	2	–	–	–	–	–	**2**
Pig	–	–	10	20	–	–	1	–	3	**34**
Horse	1	–	1	15	4	–	–	–	2	**23**
Dog	–	–	–	1	–	–	–	–	2	**3**
Red deer	–	–	1	1	–	–	–	–		**2**
Passerine	–	–	1	1	–	–	–	–	–	**2**
Total identified	13	31	163	220	38	3	11	3	54	**536**
% of identified	2.4	5.8	30.4	41.0	7.1	0.6	2.1	0.6	10.1	**27.5**
Large mammal	21	13	125	229	39	–	–	2	25	**454**
Medium mammal	4	1	74	163	–	15	–	–	32	**289**
Small mammal	–	–	–	7	–	–	–	–	1	**8**
Mammal	31	32	193	225	27	45	4	–	103	**660**
Total unidentifiable	56	46	392	624	66	60	4	2	161	**1411**
% of unidentifiable	4.0	3.3	27.8	44.2	4.7	4.3	0.3	0.1	11.4	**72.5**
Overall total	69	77	555	844	104	63	15	5	215	**1947**
% of overall total	3.5	4.0	28.5	43.3	5.3	3.2	0.8	0.3	11.0	**100**

Key: LP = late prehistoric; MBA = Middle Bronze Age; LBA = Late Bronze Age; MIA = Middle Iron Age; ERB = early Romano-British; M/LRB = mid–late Romano-British; post-ERB = post-early Romano-British; Mod = modern and UD/US = undated/unstratified. ABGs include 73 goat bones from MIA context (2014); 22 sheep bones from mid–late Romano-British context (1255) and a further 22 sheep bones from undated context (1374). These have all been counted as one specimen each.

prevented detailed information from being assessed – for example, where sediment masks the wear pattern on teeth or butchery marks on post-cranial bones.

Gnaw marks were apparent on *c.* 5% of post-cranial bones; this is a reasonably low figure and suggests that much of the material was rapidly buried. It is worth emphasising, however, that carnivores can completely destroy bones, and therefore the true extent of any bias caused by scavenging animals cannot be accurately established.

Species represented

Approximately 28% of fragments are identifiable to species and element, and a further 39% to general size categories. The assemblage is largely made up of the bones from domestic livestock species (94% NISP). Less common species include horse (4.5%), dog, goat, red deer and passerine (*cf*. house sparrow: see Serjeantson 2009, 376).

Unfortunately the number of identified bones from livestock species per period is below the optimum recommended sample size required for an accurate assessment of their relative importance (Hambleton 1999, 39–40) and precludes any comparisons at the intra- and inter-site level.

Middle Bronze Age assemblage

A small Middle Bronze Age assemblage of just 77 fragments was recovered from 13 separate contexts in Trench 9, mostly ditch fills. The identified fragments include a small number of cattle and sheep/goat bones. It is uncertain whether an antler from pit 1790 dates to this period, of the Middle Iron Age (see below)

Late Bronze Age assemblage

Bone fragments were recovered from 34 Late Bronze Age contexts in Trench 9; over half are from hollow 1101, the rest are scattered between a large number of pits and a few post-holes. Of the 163 identified bones recovered, sheep/goat bones are common (50% NISP), followed by cattle (42%) and then pig (6%). Less common species, all of which are represented by only one fragment each, include horse, red deer and passerine.

The bones recovered from the hollow include the disarticulated remains of four sheep/goat, three cattle, two pigs, a horse and a red deer. The range of body parts represented in this group indicates that it includes a mixture of waste from different processes (ie, primary butchery and consumption). Indeed the general character of the assemblage as a whole suggests local slaughter and consumption, with no apparent spatial segregation in the disposal of waste material from these different processes.

Horse is represented by a fragment of proximal radius and red deer by a piece of distal humerus shaft. Cut marks were noted on the medial aspect of the latter, a clear indication that deer were occasionally hunted for food.

The available age information is quite limited and no firm conclusions can be drawn about the pastoral economy of the site from this data. The biometric and butchery data are equally uninformative due to small sample size.

Middle Iron Age assemblage

Animal bone was recovered from 57 Middle Iron Age contexts; most fragments are from the fills of ditches and pits, with smaller amounts from a few ring gullies and post-holes. While two phases of activity have been identified, most of the Middle Iron Age contexts are unphased and the proportion of bones from phased contexts is insufficient to provide any meaningful information relating to differences in animal husbandry or disposal patterns between these two phases.

Of the 220 identified bones from Middle Iron Age contexts the majority are from cattle (*c.* 53%) and sheep/goat (*c.* 28%). Less common species include pig, horse, goat, dog and passerine. In general terms, Middle Iron Age sites in the Thames Valley tend to have fairly equal proportions of cattle and sheep/goat, and a low proportion of pig bones (Hambleton 1999, 46).

The body part information for both cattle and sheep/goat indicates local slaughter and consumption. Common skeletal elements include cattle mandibles and sheep/goat tibia, and these are from a minimum of ten cattle and nine sheep/goat. There are too few pig bones to assess whether or not whole carcasses are represented; the most common skeletal elements are mandibles and skull fragments and these body parts generally show a good survival and recovery rate in most Iron Age assemblages (Hambleton 1999, 31).

The available age information for livestock species is quite limited and it has not been possible to reconstruct mortality profiles from this data. In general terms the fusion data for cattle and sheep/goat suggest that most post-cranial bones are from skeletally mature animals (ie, they have fused epiphyses), whilst most pig post-cranial bones are from immature animals. More detailed information is available from the small number of cattle mandibles. These indicate the presence of newborn calves (mandible wear stage A after Halstead 1985) through to senile animals (stage I). This information suggests little beyond the fact that cattle were being bred and reared locally. Age information is also available from four sheep/goat mandibles and three pig mandibles. These are from sheep/goat aged 1–2 years and 3–4 years (stages D and F after Payne 1973) and pigs aged 14–21 months and 21–27 month. One of the younger pig mandibles is from a sow.

The biometric and butchery data are very limited and uninformative. However, it is worth noting the presence of two cattle scapulae, one from pit 2250 and the other from ditch 1929, that both have a hole through the blade caused by the insertion of a hook. The scapula from 1929 also has faint longitudinal cut marks on the medial surface of the blade. This type of evidence is usually seen on shoulder joints that have been hung for storage or for specific purposes such as curing.

Goat was identified from two separate contexts, including a pair of horn cores from pit 2222 and a semi-complete skeleton from pit 2055; a sample of bone submitted for radiocarbon dating failed to return a reliable date (see Chapter 8; Appendix 5). The skeleton is that of a 1–2 year old animal with an estimated withers height of 0.59 m. The presence of this animal in a pit close to the terminal end of Middle Iron Age round-house gully 1940 suggests that special significance was attached to its burial. Similar deposits have been noted in association with the entranceways of round-houses at a number of sites in eastern England. Most are located on the left hand side of the entrance (as viewed from outside) and are generally referred to as foundation deposits. Although these types of deposits are reasonably common in Iron Age Britain (see Morris 2008a; 2008b; 2010), what makes this one slightly unusual is that it involves a goat, which are rare in the archaeological record (Noddle 1994). At Haddenham V, an Iron Age enclosed settlement in Cambridgeshire, a foundation deposit that included an adult goat, an adult sheep/goat and two lambs was discovered within the entranceway of Building 3 (Serjeantson 2006, 221–2 and 242–3). It is suggested that one or two goats were probably kept with the sheep flock to act as leaders, and it is this role which singled goats out for special treatment. The evidence also appears to indicate a concern with boundaries, in particular their transgression (Evans 2006, 247).

A small number of horse bones were recovered from Middle Iron Age contexts; all are from adult animals and butchery marks indicative of skinning and disarticulation were noted on several bones. Evidence that horse carcasses were processed for their hides and meat is not uncommon for the period. Single bones from a dog and passerine were also recovered.

Romano-British and post-Romano-British assemblage

A small amount (*c.* 10% of the total) of animal bone was recovered from contexts in this date range. Identified species include cattle, sheep/goat, pig and horse. Of note are a few calf bones and evidence for horn-working.

Uncertain date

Five samples of animal bone submitted for radiocarbon dating failed to produce reliable results due to the high carbon: nitrogen values (see Chapter 8; Appendix 5). They include a partial sheep skeleton from pit 1256, and a large piece of red deer antler recovered from the primary fill (1933) of pit 1790; there remains some uncertainty as to whether this feature is of Middle Bronze Age or later date (see Chapter 3). The antler includes the beam, from just above the bez tine, and the crown from a ten-point set of antlers. Well-defined cut marks were noted near the tips of the two terminal tines; these marks indicate that the antler was intended for use as raw material but was 'sacrificed' as an offering instead. Similar deposits of useable objects (eg, flint) and raw materials such as antler have been noted at other Bronze Age sites (see Brück 1999). Regional examples include the Late Bronze Age/Early Iron Age pit deposits at Westcroft Road in Carshalton (Proctor 2002).

Trench 118

Most (88%) of the 247 fragments recovered from this trench were from a sequence of alluvial deposits, the identified species from which include cattle, sheep/goat, pig, horse, dog, red deer, fallow deer and mute swan.

A series of radiocarbon dates was obtained from animal bone throughout the sequence (SUERC-34933, 34934, 34938 and 34939, see Chapter 8; Appendix 5). However, it would be unwise to assume that all of the cultural material from these dated contexts is contemporary, given the dynamic nature of riverine environments. Indeed it is highly likely that much of the bone has been redeposited from elsewhere; individual deposits are therefore likely to include a significant amount of residual material. This assumption is supported by the preservation condition of the material, which is generally characteristic of water erosion and abrasion in fine-grained sediments. Furthermore, while many of the cattle and sheep/goat bones from the lowest part of the sequence are small, gracile animals typical of prehistoric rather than post-medieval (ie, post-Agricultural Revolution) livestock, others are quite robust and clearly of a later date. Bones from the upper part of the alluvial sequence appear to be more securely stratified; the bones are less abraded and some of the species, such as fallow deer, are fairly late introduction (*c.* 11th century) to Britain (Sykes 2004; 2007; 2010).

Of note amongst the bones from this trench are two large pieces of red deer antler from channel 602 (580-complex, Pl. 2.5, above). The pieces are both two-point crowns from a single animal. Several flat facets were noted on the tip of one tine, and faint cut marks were observed at the junction between the crown tines on the second piece of antler. The location and character of the facets is consistent with use wear (eg, rake or fork) and the marks could result from cleaning the antler (ie, to remove the velvet) if the piece was retained from a carcass rather than collected as a shed piece. Radiocarbon dates indicate that the antlers are Late Neolithic in date (bone samples SUERC-36289 and 36293; see Chapter 8, Appendix 5), but these and other Neolithic artefacts within the channel had been redeposited (see above, Chapter 2).

Several horse bones were recovered from the 55-complex (cut by channel 602), these are from a large pony with an estimated withers (or shoulder) height of 14.2 hands (1.47 m). The tibia was radiocarbon dated to the Romano-British/Saxon period, cal AD 250–420; (SUERC-34933, 1700±35 BP).

Bone was also recovered from a small number of early modern cut features including two pits and a drain. This material includes a small number of bones from livestock species, as well as single horse and dog bones.

Minor assemblages

Trench 35

A single horse metatarsal from an adult individual was recovered from the interface between the sandy gravel and peat surface at this location and was in association with a piece of worked wood. Radiocarbon dating suggests that this bone is Late Bronze Age/Early Iron Age, 750–400 cal BC (SUERC-36296, 2425±30 BP). Shallow cut and scrape marks were evident on the anterior surface of the shaft; the general location and character of these marks is consistent with skinning. It is not possible to determine precisely whether these marks were made with a flint or metal blade. It is also unclear whether or not the bone had washed in with the sand or been discarded on the peaty surface.

Trench 43

Three cattle bones, a fragment of metatarsal shaft, a proximal fragment of metacarpal and a lower first or second molar, were recovered from three separate contexts. These body parts (ie, heads and feet) are generally taken to represent waste from initial carcass processing (ie, primary butchery waste) or carcass portions of low meat yield and quality.

Trench 44

Ten bones from at least five small equids were recovered from ditch 1029, which may relate to the adjacent 19th century bone works (Chapter 6, Table 6.1). Some of the bones were found in articulation. The bones were determined as belonging to five separate animals based on differences in age and size. The mandibles are almost certainly from small to medium-sized horses based on the lack of either donkey or mule characteristics in the shape of their teeth (Armitage and Chapman 1979). However, the small size of some of the more complete bones (eg, the pelvis), suggests that they are either from small ponies or donkeys. In order to resolve this, biometric data were compared with examples of small horses and donkeys from other sites in London (see Pipe and Rielly 2008, 61). The results of this analysis were largely inconclusive, although the study was successful in highlighting the atypical nature of these particular bones.

Trench 56

Nine bone fragments were recovered from five separate contexts. Two of the fragments, from a prehistoric land surface (217), had been subjected to direct heat (ie, charred and calcined); the rest, from Romano-British ditch 213, were stained brown, which is a common characteristic of bones from organic rich and waterlogged burial environments such as alluvial deposits. Identified fragments include a few teeth from a foal of *c.* 6–10 months of age, a first phalanx from an adult horse and the left horn core from an adult short-horned breed of cattle.

Trench 59

Ten fragments were recovered from three separate contexts. Identified bones include two fragments of sheep/goat rib from the fill (2001) of a brick-lined well. Cattle bones were identified from Romano-British ditch 2005 and medieval/post-medieval alluvium 310; they include a fragment of proximal radius, a distal humerus, the shafts of two femora, a calcaneus, the right innominate (ie, pelvis) from a female individual and a pair of tibiae from an individual with an estimated withers (or shoulder) height of 0.94 m. This type of very small 'dwarf' cattle have been recorded at other British sites, typically those dated to the Iron Age/Romano-British and medieval periods (Armitage 1982, 53).

Trench 75

The assemblage from Temple Mills comprises 209 bone fragments from 40 separate contexts of late medieval to modern date. Approximately 81% were identifiable to species and element; these include horse, sheep/goat, cattle, pig, dog, rabbit, fallow deer, brown rat, pigeon and plaice. The assemblage is a mixture of domestic refuse and the remains of non-food bones, such as horses, dogs and vermin. The most significant bone groups are briefly described below.

Two immature horse bones, a metatarsus and mandible, were recovered from contexts pre-dating the buildings, from two pre-building water channels (843 and 846). The metatarsus has an unfused distal epiphysis and is therefore from a foal aged *c.* 12–15 months; the mandible is from an individual of roughly the same age (ie, *c.* 12 months). This evidence indicates that horse breeding was taking place in the vicinity of Temple Mills.

Horse bones are also common in the assemblage from the Phase 3 gully 209. At least two individuals are represented by these remains; one by a mandible and the other by a fragmented skull, mandibles and bones from the right lower hindquarter. Both animals are male; one is aged *c.* 9–10 years (after Levine 1982) and the other *c.* 7 years. Bit wear damage (see Bendrey 2008) was noted on the mesial aspect of the lower second premolar teeth of both individuals, although the evidence was slightly more pronounced on the teeth of the younger animal.

The post-cranial bones from the younger animal are large and extremely robust. Measurements taken on the metatarsal suggest an estimated withers (or shoulder) height of 1.58 m (or *c.* 15.3 hands); not therefore a particularly tall animal but one with strong limbs of a similar conformation to other draught horses (Daulby and Baker 2003). Patches of woven bone (or periostosis) were noted on the shaft of the tibia; the distribution is slightly asymmetric, being noticeably more pronounced on the medial side; this bony reaction is the result of a non-specific infection and may have spread from a chronic skin lesion.

Evidence for bone-working at Temple Mills (or nearby) is suggested by a cattle scapula blade with a disc cut out of it from the external surface adjacent to Building 4 (Phase 3). Flat discs of bone such as this were probably used to manufacture buttons or gaming pieces (see MacGregor 1985, 99–101, 135–37). Two sawn cattle rib shafts from the same deposit could also be regarded as bone-working waste.

Trench 94

Three disarticulated horse bones and the partial remains of two horses were recovered from alluvial deposit 905. The remains include the skull, parts of the vertebral column and a number of long bones, including two left tibia. One of the individuals is a male of *c.* 9–10 years and the animals have a withers height of 1.33–1.37 m (*c.* 13–13.3 hands). The carcasses had been exposed for a while as indicated by gnaw marks on the left ulna. The alluvial context from which these remains were recovered is relatively low in the sedimentary sequence and radiocarbon dates obtained on the two left tibia indicate a Romano-British date (bone samples SUERC-36294 and 36295; see Chapter 8, Appendix 5) for this deposit.

General Overview

Detailed discussion of the animal bone assemblage recovered from the Olympic Park is limited due to the relatively small sample size and the dispersed nature of the evidence (both temporally and spatially). The largest and most significant part of the

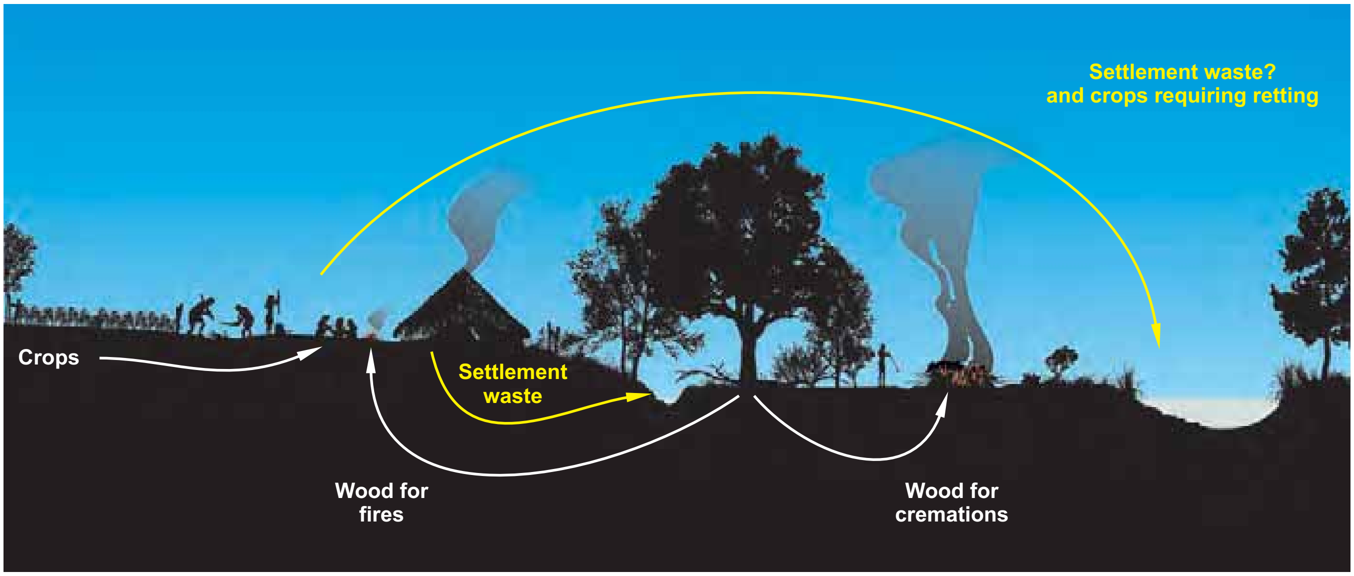


Figure 7.19:
Sources of wood charcoal and charred remains and waterlogged economic plants

assemblage is from Trench 9; this area of the Park produced nearly 2000 animal bone fragments (*c.* 56% of the total), most of which are Late Bronze Age to Middle Iron Age in date. The general character of the late prehistoric assemblage indicates a mixed pastoral economy dominated by cattle and sheep. Livestock were raised and butchered on site and the waste from this process was discarded with general domestic food refuse. There is some indication that horse hides were utilised and that specialist meat preparation techniques were used to preserve shoulders of beef for storage.

Some of the deposits of animal bone revealed by the excavations appear to have had greater significance to the people that created them. These include the 'sacrifice' of useful raw materials such as antler and the burial of animals with particular qualities (eg, vigilance) near the entrance-ways to houses.

The most notable find from the minor sites are the bones of a large male draught horse from Temple Mills. This animal was probably used to pull carriages and carts around the area. It is noted that a wooden hame edged with iron, which would have formed part of a harness of a draught horse, was found unstratified at this site (see Jones, above).

Economic Plants: Charred and Waterlogged Remains, and Pollen

by Sarah F. Wyles, Chris J. Stevens and Michael J. Grant

Introduction

A large number of bulk samples were taken during the excavations for the recovery of charred and waterlogged plant remains and wood charcoal (as well as for molluscs and insect remains). They were taken from both sedimentary sequences and archaeological features, and cover a wide time-scale, from the Late Mesolithic to the post-medieval/modern periods. Their assessment showed considerable variation in the range and quantity of environmental material types preserved in them.

The plant remains derive from a number of different activities (Fig. 7.19). For the charred material these include the collection of wood for hearths, and the burning on these hearths of waste from cereal processing. They can also provide information on the materials collected for pyres, as well as any other material burnt during the creation of fire-breaks and/or for tinder. Waterlogged material can include either crops taken off site, or economic material that was recovered from water channels, ditches or wells.

Phase		MBA	Late Bronze Age									
Feature type		Ditch 1920	Pits								Cremation	
Cut		1738	1019	1219	1322	1584	1645	1730	1896	2115	1972	2052
Context		1737	1018	1218	1321	1583	1644	1729	1895	2114	1971	2051
Sample		599	501	524	528	605	564	586	607	655	633	638
Volume (L)		7	13	9	7	8	15	14	9	14	10	10
Cereals												
Hordeum vulgare L. *sl* (grain)	barley	2	21	2	–	1	6	1+cf1	–	2	–	1
Triticum cf. *dicoccum* (Schübl) (grain)	emmer wheat	–	6	–	–	–	–	–	–	–	–	–
T. dicoccum (Schübl) (glume base)	emmer wheat	–	48	7	–	–	3	2	1	8	–	–
T. dicoccum (Schübl) (spikelet fork)	emmer wheat	–	4	2	–	–	–	–	1	–	–	–
Triticum spelta L. (glume bases)	spelt wheat	–	58	2	4	–	6	2	2	5	–	–
T. spelta L. (spikelet fork)	spelt wheat	–	1	–	–	–	–	–	–	–	–	–
Triticum dicoccum/spelta (grain)	emmer/spelt wheat	–	38	6	3	–	2	2	1	4+cf3	–	1
T. dicoccum/spelta (spikelet fork)	emmer/spelt wheat	–	77	5	1	–	7	4	4	21	–	–
T. dicoccum/spelta (glume bases)	emmer/spelt wheat	1	1036	85	55	3	148	78	72	201	–	–
Cereal indet. (grains)	cereal	5	199	11	7	2	24	12	11	46	1	3
Cereal frag. (est. whole grains)	cereal	1	147	14	13	3	14	13	7	24	–	–
Other species												
Corylus avellana L. (fragments)	hazel	–	5	1	–	–	4	–	–	–	–	–
Chenopodiaceae	goosefoot family	–	2	–	–	–	1	1	–	–	–	–
Chenopodium sp. L.	goosefoot	–	7	–	–	–	–	–	–	–	–	–
Chenopodium polyspermum L.	many-seeded goosefoot	–	1	–	–	–	–	–	–	–	–	–
Chenopodium album L.	fat-hen	–	4	–	–	–	–	–	–	–	–	–
Atriplex sp. L.	oraches	–	1	–	–	–	1	–	–	1	–	–
Montia fontana subsp. *chondrosperma* (Fenzl) Walters	blinks	–	1	–	–	–	–	–	–	–	–	–
Persicaria lapathifolia/maculosa (L.) Gray/Gray	redshank/ pale persicaria	–	9	–	1	–	–	–	–	–	–	–
Persicaria maculosa (L.) Gray	pale persicaria	–	–	–	–	–	1	–	–	1	–	–
Fallopia convolvulus (L.) À. Löve	black bindweed	–	6	–	–	–	–	–	–	–	–	–
Rumex sp. L.	docks	–	3	2	1	–	2	–	–	3	–	1
Rumex crispus L. Type	curled dock	–	1	–	–	–	–	–	–	–	–	–
Malva sp. L.	mallow	–	1	–	–	–	–	–	–	–	–	–
Brassica sp. L.	brassica	–	–	–	–	–	–	–	–	cf 2	–	–
Brassica c.f. nigra (L.) W.D.J.Koch	black mustard	–	–	–	–	–	1	–	–	–	–	–
Crataegus monogyna Jacq.	hawthorn	–	–	–	–	–	–	–	–	–	–	1
Vicia L./*Lathyrus* sp. L.	vetch/pea	1	11	3	1	–	2	3	1	14	–	–
Pisum/Vicia L.	pea/bean/large vetch	–	–	–	–	–	–	–	–	3	–	–
Medicago/Trifolium sp. L.	clover/medick	–	1	1	–	–	–	–	–	–	–	–
Medicago sp L.	medick	–	1	–	–	–	–	–	–	–	–	–
Galium sp. L.	bedstraw	–	19	2	–	1	–	2	1	1	–	–
Eleocharis cf. *palustris* (L.) Roem. & Schult.	common spike-rush	–	1	–	–	–	–	–	–	–	–	–
Carex sp. L. trigonous	sedge trigonous seed	–	1	–	–	–	–	–	–	–	–	–
Poaceae (small indet.)	small grass seed	–	–	1	1	–	–	–	–	–	–	–
Poaceae (mid-large indet.)	medium to large grass seed	–	2	–	1	–	–	1	–	–	–	–
Lolium/Festuca sp. L.	rye grass/fescue	–	10	–	–	–	–	–	–	–	–	–
Poa/Phleum sp. L.	meadow grass/ cats tails	–	3	–	–	–	–	–	–	1	–	–
Arrhenatherum elatius Var. bulbosum (Willd)	false oat-grass	–	–	–	–	–	–	–	–	–	–	2
Avena sp. L. (grain)	oat grain	–	7	3	–	–	1	–	–	–	–	–
Avena sp. L. (awn)	oat awn	–	13	–	–	–	2	5	–	1	–	–
Avena L./*Bromus* L. sp.	oat/brome	2	62	–	1	–	5	–	–	7	–	–
Bromus sp. L.	brome grass	–	11	1	–	–	–	–	1	–	–	–
Small seed indet.		–	6	–	–	–	–	–	1	–	–	–
Parenchyma/dung/bread		–	1	–	–	–	–	–	–	–	–	–
Tuber		–	1	–	–	–	–	–	–	–	–	2

Charred plant remains

Given the non-settlement nature of many of the sites, it is perhaps unsurprising that charred plant remains were only recorded in 31 samples, and these were predominantly either from settlement sites, from sites that were probably peripheral to settlement, or from other sites associated with archaeological features/material. However, even in these cases they were often present only in relatively small quantities.

They were recovered from 17 samples from Trench 9 – from Middle Bronze Age ditch 1738; Late Bronze Age cremation-related deposits 1972 and 2052, and pits 1019, 1219, 1322, 1584, 1645, 1730, 1896 and 2115; late prehistoric pit 1858; Middle Iron Age pit 1101, post-hole 2012 and ring gullies 1106 and 1260; and early Romano-British ditch 1914. Further samples came from Trench 6 – Middle Iron Age pit 352; Trench 43 – Late Bronze Age post-hole/fire-pit 587 and cremation-related deposit 527; Trench 45 – Late Bronze Age post-holes 40, 42 and 46; Trench 56 – probable later prehistoric layer (217), and Late Saxon/early medieval layers in wattle-lined pit 239 (structure 159); Trench 58 – a Romano-British layer (146), and two post-medieval layers (145 dated to after AD 1650–1800, and 124 pre-dating AD 1900); and Trench 118 – several samples from channel deposit 182, probably predominantly Romano-British in date.

On the basis of their assessment all these samples were selected for further analysis, and any unprocessed material from them was processed in an attempt to increase the quantity of charred remains.

Methods

The bulk samples for charred remains were generally of five litres in the first instance, with extra material processed where possible. The samples were processed by standard flotation methods, the flot retained on a 0.3 mm mesh, residues fractionated into 5.6 mm, 2 mm, 1 mm and 0.5 mm fractions. The coarse fractions (>5.6 mm) were sorted for artefacts and ecofacts, weighed and discarded.

At the analysis stage, all identifiable charred plant macrofossils were extracted from the flots, together with the 2 mm and 1 mm residues. Identification was undertaken using stereo incident light microscope at magnifications of up to x40 using a Leica MS5 microscope, following the nomenclature of Stace (1997) and with reference to modern reference collections where appropriate, and the results quantified (Tables 7.17–7.20).

Later Prehistoric

Trench 9 – Middle Bronze Age to Middle Iron Age

Middle Bronze Age

Middle Bronze Age ditch 1920 (cut 1738) yielded two grains of barley (*Hordeum vulgare*), a glume base of hulled wheat, emmer or spelt (*Triticum dicoccum/spelta*), and seeds of vetch/wild pea (*Vicia/Lathyrus* sp.) and oats/brome grass (*Avena/Bromus* spp.) (Table 7.17). The two barley grains provided a radiocarbon date of 1430–1270 cal BC (SUERC-33667, 3085±30 BP).

Late Bronze Age

In contrast, significant quantities of cereal remains were recovered from a number of Late Bronze Age pits, with broadly similar assemblage composition (1019, 1219, 1322, 1645, 1730, 1896, and 2115); pit 1019 was particularly rich (Table 7.17). The identifiable grains were mainly hulled wheat, with a number probably being of emmer (*Triticum dicoccum*), and barley. Chaff elements greatly outnumbered those of grain, the majority being glume bases. The identified hulled wheat chaff comprised roughly equal numbers of emmer and spelt (*Triticum spelta*).

Although the assemblages from these pits were dominated by cereal remains, that from pit 1019 also included a large number of weed seeds, as well as hazelnut

Table 7.17 (left): Charred plant remains from Trench 9 Bronze Age features

(*Corylus avellana*) shell fragments and an unidentified tuber. The weed seed assemblage was dominated by larger-seeded species, in particular those of oats (*Avena* sp.) and brome grass (*Bromus* sp.) which are typical arable weed seeds. The seeds of vetch/wild pea, rye grass/fescue (*Lolium/Festuca* spp.), bedstraw (*Galium* spp.) and redshank/pale persicaria (*Persicaria lapathifolia/maculosa*) are also indicative of arable environments and field margins. The proximity of wetter environments such as marshes and margins of river channels was indicated by the few seeds of common spike-rush (*Eleocharis* cf. *palustris*) and sedge (*Carex* sp.). Also noteworthy is the low-level presence of blinks (*Montia fontana* subsp. *chondrosperma*), which is indicative of lighter circum-neutral to acidic soils (usually sandy or gravelly with a high water table).

The overall assemblage appears to represent crop processing waste, with the relatively high numbers of glume chaff probably deriving from the dehusking of hulled wheats after storage, as seen in some instances at Innova Park, Enfield (Ritchie *et al.* 2008).

The sample from Late Bronze Age cremation-related deposit 1972 produced only a single indeterminate grain, while that from the cremation-related deposit 2052 was a little richer, comprising a grain of barley, a hulled wheat glume base and a few indeterminate grain fragments, as well as a fragment of a hawthorn (*Crataegus monogyna*) fruit, and several tubers, including those of false oat-grass (*Arrhenatherum elatius* var. *bulbosum*) which has an association with cremation-related deposits (Godwin 1984).

Middle Iron Age/late prehistoric

Charred remains

Charred cereal remains formed the major part of the plant assemblages observed in the samples from the Middle Iron Age features, with pit 1101 and ring gully 1260 containing the most remains (Table 7.18). The cereal remains were similar to those recorded in the Late Bronze Age samples, with barley, emmer and spelt wheat being identified. Again, hulled wheat chaff elements greatly outnumbered the grains, with glume bases being more numerous than spikelet forks. The few weed seeds present were mainly those typical of arable environments and field margins, with henbane (*Hyoscyamus niger*) indicative of sandy places, and rough and waste ground, and sheep's sorrel (*Rumex acetosella* group) which is common on acid but infrequent on calcareous soils. A similar pattern was recorded in the plant assemblage from late prehistoric pit 1858.

The Middle Iron Age assemblages are also characteristic of general processing waste, with the small numbers of weed seeds present being mainly from larger-seeded species. Such assemblages are typical of many prehistoric settlements, and indicate the storage of emmer and spelt in the spikelet, after threshing and sieving following harvest in summer. As spikelets are taken out of storage through the year, and processed for clean grain, the resultant waste comprises glume bases that are removed by pounding, further winnowing and sieving, and the large grain-sized weed seeds, removed by hand, which would have been difficult to remove during the earlier stages of processing.

Waterlogged remains

While a number of charred plant remains were seen in the analysed waterlogged samples from the Middle Iron Age enclosure ditch (see Chapter 8), in only two instances (both from the Phase 1 enclosure ditch 1213) were waterlogged cereals identified. These were glumes of hulled wheat, including one positive identification of emmer wheat. Grain does not readily survive in waterlogged deposits, as it is quickly predated and attacked by mould and bacteria before such preservation can occur; and this may also apply to the more robust siliceous chaff. Often waterlogging only preserves evidence from a narrow range of species, by virtue of their seeds having a tough coat to enable their survival in the soil and/or a dense stone in order to pass through an animal's gut.

Given that charred cereal remains were present in the ditch, the almost complete absence of waterlogged cereal remains probably reflects poor survival, rather than processing being confined to areas away from the ditch. The presence of cereal pollen in the fills of ditch 1213 suggests that cereal remains may have been deposited in this feature, although there were no accompanying bulk samples to test this hypothesis.

Table 7.18: Charred plant remains from Trench 9 Middle Iron Age to Early Romano-British features

Phase		Middle Iron Age				Late preh.	Early R-B
Feature type		Pit	Post-hole	Ring gully		Pit	Ditch 1212
Cut		1101	2012	1106	1260	1858	1914
Context		1027	2011	1196	1259	1857	1694
Sample		514	624	519	523	604	594
Volume (L)		8	5.5	6	10	10	8
Cereals							
Hordeum vulgare L. *sl* (grain)	barley	3	1	1	3	cf 1	–
Triticum cf. *dicoccum* (Schübl) (grain)	emmer wheat	–	–	1	–	–	–
T. dicoccum (Schübl) (glume base)	emmer wheat	3	1	–	14	10	1
T. dicoccum (Schübl) (spikelet fork)	emmer wheat	–	–	–	3	2	–
Triticum spelta L. (glume bases)	spelt wheat	9	–	–	20	9	3
Triticum dicoccum/spelta (grain)	emmer/spelt wheat	6	–	–	5	5	–
T. dicoccum/spelta (germinated grain)	emmer/spelt wheat	–	–	–	1	–	–
T. dicoccum/spelta (spikelet fork)	emmer/spelt wheat	3	–	–	26	9	3
T. dicoccum/spelta (glume bases)	emmer/spelt wheat	83	1	4	365	125	12
Cereal indet. (grains)	cereal	27	3	5	12	8	4
Cereal frag. (est. whole grains)	cereal	15	–	6	25	13	2
Other species							
Corylus avellana L. (fragments)	hazel	–	–	–	–	1	1
Chenopodiaceae	goosefoot family	–	–	–	–	1	–
Chenopodium sp. L.	goosefoot	–	–	–	1	–	–
Atriplex sp. L.	oraches	–	–	–	–	1	–
Polygonaceae indet.	knotweeds	–	–	–	–	–	1
Persicaria lapathifolia/maculosa (L.) Gray/Gray	redshank/ pale persicaria	–	–	–	–	3	–
Persicaria maculosa (L.) Gray	pale persicaria	–	–	–	2	–	–
Rumex sp. L.	docks	–	–	–	3	–	–
Rumex acetosella group Raf.	sheep's sorrel	–	–	–	1	–	–
Rumex crispus L. Type	curled dock	1	–	–	–	–	–
Vicia L./*Lathyrus* sp. L.	vetch/pea	2	1	–	7	2	2
Medicago sp. L.	medick	cf 1	–	–	–	–	–
Aethusa cynapium L.	fool's parsley	1	–	–	–	–	–
Hyoscyamus niger L.	henbane	–	1	–	–	–	–
Galium sp. L.	bedstraw	1	–	–	–	–	–
Poaceae (mid-large indet.)	medium to large grass seed	–	–	–	–	–	1
Poa/Phleum sp. L.	meadow grass/ cats'-tails	–	–	–	–	1	–
Avena sp. L. (grain)	oat grain	2	1	1	3	–	1
Avena sp. L. (awn)	oat awn	1	–	–	4	–	–
Avena L./Bromus L. sp.	oat/brome	–	–	–	4	2	–
Bromus sp. L.	brome grass	2	–	–	5	–	–
Small seed indet.		–	–	–	–	1	–

Despite the poor preservation of waterlogged cereal remains, a single seed of flax (*Linum usitatissimum*) was recovered from Phase 2 ditch 1385. While a number of seeds, stones and nut fragments of edible wild species were recovered from the enclosure ditch fills, including sloe (*Prunus spinosa*), bramble (*Rubus* sp.), elder (*Sambucus nigra*) and hazelnut (*Corylus avellana*), given the number of thorns and other general indicators of scrub present (see below), these were not thought to relate directly to their collection as food, although it is probable that such resources would have been exploited as a supplementary food resource.

Trench		6	35	43		45			56			
Phase		MIA	EIA	LBA		LBA			L preh	Saxon/med		
Feature type		Pit	Layer	Pit	Crem-ation	Post-hole			Layer	Pit		
Cut		352		587	527	40	42	46		239/structure 159		
Context		351	94	588	526	39	41	45	217	200	200	199
Sample		72	93	131	107	20	21	23	68	67	67	66
Volume (L)		8	8	8	10	5	5	5	10	hand picked	2	9
Cereals												
Hordeum vulgare L. *sl* (grain)	barley	–	–	–	–	–	1	–	1	–	–	5
H. vulgare L. *sl* (6-row rachis fragment)	barley	–	–	–	–	–	–	–	–	3	–	–
H. vulgare L. *sl* (rachis fragment)	barley	–	–	–	–	–	–	–	–	–	–	1
Triticum sp. L. (grains)	wheat	–	–	–	–	1	–	–	1	–	–	–
Triticum cf. *dicoccum* (Schübl) (grain)	emmer wheat	–	–	–	–	–	–	–	–	1	–	20
T. dicoccum (Schübl) (glume base)	emmer wheat	–	–	–	–	–	1	–	–	–	–	18
T. dicoccum (Schübl) (spikelet fork)	emmer wheat	–	–	–	–	–	1	–	–	–	–	23
Triticum spelta L. (glume bases)	spelt wheat	–	–	–	–	–	2	–	5	–	–	–
Triticum dicoccum/spelta (grain)	emmer/spelt wheat	–	–	–	–	–	–	1	–	7	1cf	172*
T. dicoccum/spelta (rachis fragment)	emmer/spelt wheat	–	–	–	–	–	–	–	–	–	–	7
T. dicoccum/spelta (spikelet fork)	emmer/spelt wheat	–	–	–	–	–	–	–	–	–	–	45
T. dicoccum/spelta (glume bases)	emmer/spelt wheat	–	2	–	1	–	4	–	22	–	–	20
Triticum cf. *aestivum/turgidum* L. sl (grain)	bread wheat	–	–	–	–	–	–	–	–	9	–	49
Triticum cf. *aestivum/turgidum* L. sl (rachis frag.)	bread wheat	–	–	–	–	–	–	–	–	–	–	17
Triticum cf. *aestivum* L. sl (rachis fragment)	bread wheat	–	–	–	–	–	–	–	–	–	–	2
Secale cereale L. (grain)	rye	–	–	–	–	–	–	–	–	6	–	11+cf9
Secale cereale L. (rachis fragment)	rye	–	–	–	–	–	–	–	–	–	1	2
Cereal indet. (grains)	cereal	–	–	7	4	–	–	–	6	20	–	123
Cereal frag. (est. whole grains)	cereal	–	–	–	–	–	–	1	5	2	–	35
Cereal (germinated coleoptile)	cereal	–	–	–	–	–	–	–	–	–	–	1
Cereal indet. (culm node)	cereal	–	–	–	–	–	–	–	–	–	–	27
Other species												
Ranunculus repens L.	creeping buttercup	–	–	–	–	–	–	–	–	–	–	1
Chenopodium ficifolium Sm.	fig-leaved goosefoot	–	–	–	–	–	–	–	–	–	–	2
Persicaria lapathifolia/maculosa (L.) Gray/Gray	redshank/ pale persicaria	–	–	–	1	–	–	–	–	–	–	12
Polygonum arenastrum L.	equal-leaved knotgrass	–	–	–	–	–	1	–	–	–	–	–
Rumex sp. L.	docks	–	–	–	–	–	–	–	–	–	–	1
Brassica sp. L.	brassica	1	–	–	–	–	–	–	–	–	–	–
Brassica c.f. nigra (L.) W.D.J.Koch	black mustard	–	–	–	–	–	–	–	–	–	–	1
Vicia L./*Lathyrus* sp. L.	vetch/pea	–	–	–	–	–	–	–	1	–	–	2
Medicago/Trifolium sp. L.	clover/medick	–	–	–	–	–	–	–	–	–	–	2
Schoenus nigricans L.	black bog-rush	–	–	1	–	–	–	–	–	–	–	–
Carex sp. L. trigonous	sedge trigonous seed	–	–	–	–	–	–	–	1	–	–	–
Lolium/Festuca sp. L.	rye grass/fescue	–	–	–	–	–	–	–	–	–	–	3
Arrhenatherum elatius Var. bulbosum (Wild)	false oat-grass	–	–	–	1	–	–	–	–	–	–	–
Avena sp. L. (grain)	oat grain	–	–	–	–	–	–	–	–	–	–	47*
Avena sp. L. (awn)	oat awn	–	–	–	–	–	–	–	1	–	–	–
Avena sp. L. (floret base indet.)	oat floret base indet.	–	–	–	–	–	–	–	–	–	–	cf1
Avena L./*Bromus* L. sp.	oat/brome	–	–	2	–	1	–	–	–	2	–	2
Bromus sp. L.	brome grass	–	–	–	–	–	1	–	–	–	–	–

* signs of early stages of germination

Table 7.19: Charred plant remains from Trenches 6, 35, 43, 45 and 56

Trench 6 – Middle Iron Age

A single seed of brassica (*Brassica* sp.) was recovered from Middle Iron Age pit 352 (Table 7.19).

Trench 35 – Early Iron Age

Although only two charred glume bases of emmer or spelt wheat were recovered from this trench, they came from a securely stratified organic alluvial layer dated to the Early Iron Age: 760–410 cal BC (NZA-32949, 2462±35 BP). This layer also contained a similarly dated horse metatarsal: 750–400 cal BC (SUERC-36296, 2425±30 BP). The trench lies only 100 m to the west of Trench 9 and so might provide peripheral evidence for settlement pre-dating the Middle Iron Age enclosed settlement, but post-dating the Late Bronze Age pits (Table 7.19).

Trench 43 – Late Bronze Age

The small quantity of charred remains in Late Bronze Age pit 587 comprised indeterminate grain fragments, seeds of oat/brome grass, and black bog-rush (*Schoenus nigricans*) which is indicative of damp, usually peaty, base-rich places, especially near the sea. The Late Bronze Age cremation-related deposit (527) produced a single hulled wheat glume base with a few indeterminate grain fragments, and a tuber of false-oat grass (Table 7.19). A similar assemblage was observed in the Late Bronze Age cremation-related deposits in Trench 9.

Trench 45 – Late Bronze Age

Late Bronze Age post-holes 40, 42 and 46 all contained low numbers of plant remains (Table 7.19). Post-hole 42 yielded the largest assemblage, which included barley, emmer and spelt, with chaff elements being more prevalent than grains. The few weed seeds were generally large seeds of species indicative of arable environments and field margins.

Trench 56 – Late prehistoric

The relatively small plant assemblage observed in the late prehistoric layer 217 (Table 7.19), displayed similarities with assemblages from other prehistoric features, with cereal remains of barley, emmer and spelt, and again with more chaff than grain fragments. The small quantity of weed seeds belonged mainly to those species typical of arable environments and field margins, but with a few more typical of wetter environments, such as sedge.

Romano-British

Trench 9

The small assemblage observed in early Romano-British ditch 1212 (cut 1914) was broadly similar to those from the earlier features in Trench 9, with the remains of both emmer and spelt wheat, but no barley (Table 7.18).

Trench 72

Within a monolith sample, at 2.06 m OD, a single pollen sample was found to be dominated by *Cannabis sativa* (hemp) pollen (78% TLP; LPAZ Tr72–3, see Chapter 8; Fig. 8.17, below). The grains were clearly identifiable as *Cannabis sativa*, rather than *Humulus lupulus* (hop), on the basis of their (protruding) pore structure and (larger) grain size (Whittington and Gordon 1987). The precise date of the hemp-rich layer is uncertain, as it immediately overlies a radiocarbon date of 2870–2500 cal BC (SUERC-35329, 4100±30 BP). However, there is a significant change in the pollen assemblage (notably a large reduction in *Alnus glutinosa* and increase in Poaceae) between LPAZ Tr72–2 and the overlying TR72–4 suggesting a break in the sequence (though not apparent in the stratigraphy at this point). With four overlying radiocarbon dates corresponding to the Romano-British period, and given the general absence of evidence for hemp prior to this date, it is thought that this layer is most likely to also date to the early Romano-British period.

Trench 118

Charred cereal remains were recovered from the interface between the fill (182) of an early Romano-British channel and that

Table 7.20: Charred plant remains from Trenches 58 and 118

Trench		58			118	
Phase		medieval	post-med	pre-1900	MBA/LBA	RB
Feature type		Layer	Layer	Layer	Layer	Layer
Context		146	145	24	182	182
Sample		201	202	49	12	21
Volume (L)		7	10	17	9	35
Cereals						
Hordeum vulgare L. *sl* (grain)	barley	–	–	–	–	3
H. vulgare L. *sl* (6-row rachis fragment)	barley	–	–	–	–	2
H. vulgare L. *sl* (rachis fragment)	barley	–	–	–	–	1
Triticum sp. L. (grains)	wheat	1	–	–	1	–
T. dicoccum (Schübl) (glume base)	emmer wheat	–	–	–	1	2
Triticum spelta L. (glume bases)	spelt wheat	–	–	–	–	7
Triticum dicoccum/spelta (grain)	emmer/spelt wheat	1	–	–	–	cf1
T. dicoccum/spelta (glume bases)	emmer/spelt wheat	–	–	–	–	2
Triticum cf. *aestivum/turgidum* L. *sl* (grain)	bread wheat	–	–	1	–	–
Cereal indet. (grains)	cereal	2	–	–	1	1
Cereal frag. (est. whole grains)	cereal	–	–	4	–	1
Cereal (germinated coleoptile)	cereal	–	–	1	–	–
Cereal indet. (culm node)	cereal	–	–	–	1	3+root
Other species						
Corylus avellana L. (fragments)	hazel	–	2	–	–	–
Rumex acetosella group Raf.	sheeps sorrel	–	–	–	–	1
Brassica sp. L.	brassica	–	–	–	1	1
Vicia L./*Lathyrus* sp. L.	vetch/pea	–	–	–	–	1
Vicia faba L.	celtic bean	1	–	–	–	–
Galium sp. L.	bedstraw	–	1	–	–	–
Poaceae (small indet.)	small grass seed	–	–	–	–	1
Poaceae (mid-large indet.)	medium to large grass seed	1	–	–	–	–
Lolium/Festuca sp.	rye grass/fescue	–	–	–	–	1
Avena sp. L. (floret base indet.)	oat floret base indet.	–	–	–	–	–
Avena L./*Bromus* L. sp.	oat/brome	–	–	–	–	1
Bromus sp. L.	brome grass	–	–	–	–	2

(183) of a Middle/Late Bronze Age channel (which was cut by the Romano-British channel) (Table 7.20). The dating of material from 182 indicated some mixing of this and the underlying deposit, but the cereal remains were generally associated with 182. A radiocarbon date of cal AD 70–240 (SUERC-34944, 1865±35 BP) was obtained on two charred barley grains from layer 182. The two samples from this layer contained low numbers of cereal remains, which included barley, emmer and spelt; the few weed seeds are generally characteristic of arable environments and field margins.

The most important aspect of these remains is that, along with animal bones and a timber structure of similar date, they indicate settlement activity nearby. There is known to have been a Late Iron Age to Romano-British settlement to the north at Warton Road (Perry 2009), on the gravel ridge between this and Trench 9, and it is possible that the evidence here relates to a broadly contemporary settlement.

There were also single waterlogged stones of domestic plum (*Prunus domestica*) and cherry (*Prunus avium*) from layer 564, a fill of the Romano-British channel visible in the trench's south-east section. While cherry is possibly native, domestic plum would have been introduced (although possibly as an escapee). A single seed of fig (*Ficus carica*) was recovered from the underlying deposit (574), but the degree of mixing between the deposits in this channel fill (see Chapter 3) means it may be intrusive. A radiocarbon date in the Middle Bronze Age of 1270–1020 cal BC (SUERC-34950, 2935±35 BP) was obtained on other waterlogged plant material from 574, and in general the plant remains from this layer were in keeping with the earlier date.

Saxon to Medieval

Trench 7

Three samples from an alluvial sequence (deposits 166 and 167) produced small quantities of waterlogged flax remains (*Linum usitatissimum*), including seeds and capsule fragments. While a radiocarbon date could not be obtained from the material itself, a determination on several seeds of water-dropwort (*Oenanthe* sp.) associated with them indicated a probable Early Saxon date of cal AD 580–670 (SUERC-31558, 1415±30 BP).

Trench 27

A single sample from this trench yielded a large number of waterlogged capsules of flax (*Linum usitatissimum*) (Pl. 7.28) which were dated to the Early to Middle Saxon period (cal AD 640–770, SUERC-31390, 1335±30 BP).

Trench 56 - Late Saxon-early medieval

The layer (199), sealing wattle-lined pit 239 (structure 159), contained an assemblage dominated by cereal remains, with unusually those of hulled wheat being the most numerous (Table 7.20) which is atypical for the period. These included grains and chaff elements of emmer (Pl. 7.29), but none positively identified as spelt. A number of the grains showed early stages of germination. Radiocarbon dates on waterlogged material from the underlying fill (200) suggested a Saxo-Norman date, cal AD 1030–1210 (SUERC-35335, 905±30 BP). However, to eliminate the possibility that the material was reworked, radiocarbon determinations were obtained both on the charred emmer chaff and grain, providing dates of cal AD 1010–1160 (SUERC-36288, 970±30 BP) and cal AD 980–1160 (SUERC-34943, 985±35 BP). The results are consistent

*Plate 7.28: Flax capsules (*Linum usitatissimum*) from Trench 27*

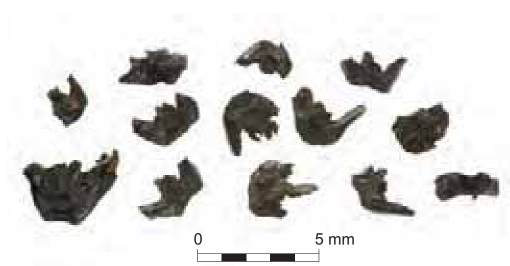


*Plate 7.29: Charred glumes and spikelets of emmer wheat (*Triticum dicoccum*) from an early medieval pit Trench 56*

(χ^2-Test: df=2 T=3.7 (5% 6.0)) and therefore support a date in the 11th to 12th centuries.

More typical of the period was the relatively high number of grains and rachis fragments of free-threshing wheat (*Triticum turgidum/aestivum* sp.), along with a few grains and rachis fragments of barley. Small quantities of rye were also retrieved, which again are more characteristic of Saxon and medieval assemblages.

For all the cereals present, grains were more numerous than chaff fragments, suggesting that the material comprised reasonably clean grain prior to their charring. Such grain-rich assemblages are typical of free-threshing crops eg, bread-wheat, along with rye and barley, whose chaff, comprising mainly rachis fragments, paleas and lemmas, are often removed in the field by threshing and winnowing prior to storage; this is less typical in the case of hulled wheats, which are often stored in the spikelet. The ratio of grain to glumes is slightly less than 2:1 which, given the poor preservation of glume chaff, might even suggest whole spikelets. If the crops were threshed prior to coming to the site, the large number of culm nodes present in this deposit is unusual, although because culm nodes are grain-sized, they can be difficult to remove. Alternatively, it may be that straw was burnt separately in the deposit.

The germination of the grain is also of some interest as it might indicate that the grains were being malted and destined for brewing. However, only early stages of germination were seen on a small number of the grains, and it may be that the crop was poorly stored, or even intended for use as fodder.

Free-threshing wheat, rye and barley are the most common cereals recovered from charred assemblages in southern England in the Saxon and medieval periods (Greig 1991). While emmer has been recovered from a number of Early and Middle Saxon deposits (Pelling and Robinson 2000; Pelling 2003a), it is usually indicative of earlier periods. There were no identifiable remains of emmer, for example, from the Middle Saxon site at the Royal Opera House in London (Davis 2003), or in the large charred cereal deposits analysed from Saxo-Norman features at Wells Court and Peninsular House, London (Jones *et al.* 1991); a wide range of cereals, including rye, free-threshing wheat, barley and cultivated oats, was recorded from both these sites. In this respect, this deposit from Trench 56 is very significant, providing incontrovertible evidence for the consumption of emmer, and potentially also its cultivation, as late as in the 11th–12th centuries AD.

Of the weed seeds, the dominant species was oats, with a number of the grains also showing early stages of germination. The majority of the weeds were typical of arable environments and field margins, although creeping buttercup (*Ranunculus repens*) favours damp meadows, pastures and woods, mainly on heavy wet soils but also in marshes, and as such may indicate the cultivation of heavier clay soils during the Saxon period.

The interpretation of the assemblage is problematic, the remains possibly relating to malting or milling, or perhaps waste from poorly stored crops mixed in with straw waste. The quantity of the remains suggests settlement in the vicinity, but while there is evidence from Lefevre Walk Estate (Leary 2002) for Late Saxon/early medieval buildings along Old Ford Road, this was on the other side of the River Lea. Moreover, although there are known to have been a number of Late Saxon mills in the Olympic Park area, none has been positively located on this part of the river system.

Trench 58

A small assemblage from layer 146 comprised grain fragments, including those of hulled wheat (but no chaff fragments), a single celtic bean (*Vicia faba*) and a medium/large grass seed (Table 7.20). No barley was identified. This seems to be indicative of relatively clean cereal remains, from towards the end of the processing process. The layer, which contained a sherd of Romano-British pottery, may have been a fill of early medieval ditch 442, the lowest fill of which contained further, apparently redeposited, Romano-British finds.

Post-Medieval

Trench 75 (Temple Mills)

Several contexts contained the waterlogged remains of economic species. The earliest relate to a lower fill (845) of north-south channel 846 (and corresponding fill 833 in the opposite section), the precursor channel of Tumbling Bay Stream. These comprised plum stones (*Prunus domestica*), seeds of grape (*Vitis vinifera*) (Pl. 7.30), fig (*Ficus carica*), bramble (*Rubus* sp.) and seeds of strawberry (*Fragaria vesca*) (Pl. 7.31); there was cereal pollen from the monolith through fills 829 (originally 827) and 845.

Taken together, this evidence is indicative of cess, and two radiocarbon dates obtained on seeds and a plum stone indicated a 15th–16th century date, cal AD 1420–1620

(SUERC-36284, 420±30 BP; SUERC-36285, 425±30 BP) for the deposit.

There were also two seeds of possible hop (*Humulus lupulus*) in 845; although poorly preserved, their surface texture and small size were more in keeping with hops as opposed to hemp (*Cannabis sativa*) which are similar. Two pollen grains of Cannabaceae, also probably hop, were recorded in fill 829 (originally 827). The grains were again poorly preserved and although they appeared large in size, the pore protrusion was very slight suggesting that they were from hop rather than hemp (*Cannabis sativa*) (Edwards and Whittington 1990), especially when compared to the hemp pollen found in Trench 72.

*Plate 7.30: Grape (*Vitis vinifera*) and Plum (*Prunus domestica*) from Trench 75*

*Plate 7.31 Wild stawberry (*Fragaria vesca*) and fig (*Ficus carica*)*

Trench 58

A layer (145), broadly contemporary with the wattle revetted channel (137/448), contained a few charred plant remains indicative of the local environment, rather than crop processing and included no cereal remains (Table 7.20). The small number of hazelnut shell fragments suggests hedgerows or scrubby woodland in the vicinity. Another environment in the locality is indicated by the charred fruit of branched bur-reed (*Sparganium erectum*) which is found on mud or in shallow water in ponds, ditches and slow-flowing rivers, and on ungrazed marshland.

Only a small quantity of cereal remains, including a grain of free-threshing wheat but no identifiable barley, was observed in a pre-1900 layer (24).

Discussion

Middle Bronze Age

The small charred plant assemblage only provides a low-level indication of settlement activity during this period. Information pertaining to Middle Bronze Age agricultural practices are generally poor for the immediate area, although assemblages are known to the south-west at Heathrow Terminal 5 (Carruthers 2006; 2010), and to the south-east at Thurrock (Stevens 2009; Pelling forthcoming) and Dartford (Pelling 2003b). These assemblages indicate that together with barley, both emmer and spelt wheat were farmed in south-east England during this period. Substantial weed assemblages are rare for this period, and this one too was sparse.

Late Bronze Age

The charred plant remains provide an indication of settlement activity during this period. Whilst both emmer and spelt, along with barley, were clearly identified from the Olympic Park assemblage, it is noteworthy, that spelt was not recovered from

Late Bronze Age contexts at the nearby site of Innova Park, Enfield (Ritchie *et al.* 2008).

At least some, if not all, of the charred remains in Trench 9 are likely to derive from the dehusking of hulled wheats, after their storage as spikelets. The greater frequency of seeds of larger seeded weed species, such as cleavers and black bindweed, compared to those of smaller seeded species, probably indicates that crops were threshed, winnowed and sieved immediately after harvest, before being stored as semi-clean spikelets.

In addition, to the weed species which occur in the general arable and field margin environments, there were species, recorded in Trench 9 and Trench 43, which favour wetter areas, such as marshes and margins of river channels, although few have strong ecological characteristics. Pit 1019, however, produced an assemblage containing seeds of blinks, sedge and spikerush (*Eleocharis* sp.), all of which associated with the cultivation of wetter soils. Spikerush in particular can be seen as characteristic of marginal, probably autumn-flooded, ard-tilled soils (*cf.* Jones 1988a; 1988b), suggesting that cultivation was taking place on the soils surrounding the settlement, at least during this phase of the site's occupation.

The occurrence of hawthorn and hazelnut shell fragments in samples from Trench 9 may point to small areas of scrub nearby.

Middle Iron Age

The Middle Iron Age assemblage from Trench 9 indicates the continued cultivation of both emmer and spelt wheat, probably again in similar quantities, near the settlement. Hulled barley was also cultivated, although it was generally less well represented than emmer or spelt, and may have been a minor crop or used mainly for fodder. The range of weed species was similar to, although somewhat narrower than, that seen in the Late Bronze Age. Again, seeds of larger seeded species dominated, suggesting the storage of semi-clean spikelets.

While a few seeds indicating the cultivation of drier sandier soils were identified, there were none of clear wetland species. However, given the more limited range of species, this does not preclude the possibility that crops were grown in wetter fields situated close to the settlement. Cereal pollen was recovered from ditch 2222, but could derive from the processing of crops, and cereal waste in general, rather than from crops growing nearby. However, experiments by Davies and Hillman (1988) indicate that both emmer and spelt can be grown on flooded soils, while the frequent finds of spikerush from Iron Age sites demonstrate that such soils were frequently cultivated (Jones 1988a; 1988b). It should be borne in mind that centuries of alluviation in the Saxon to post-medieval period has greatly restricted drainage making cultivation untenable, and work in the Upper Thames indicates that such soils were tilled into the Romano-British period (Lambrick 1992a). As such, it is quite possible that, as in the Late Bronze Age, there was cultivation of local soils during the Middle Iron Age, until flooding once again resulted in the abandonment of the settlement.

Romano-British

Only small amounts of cereal remains, including barley, emmer and spelt, were found from deposits dating to this period, from Trenches 9 and 118. In Trench 118 they were associated with other general indications of nearby settlement including dated horse bones, a wooden structure in the channel and occasional fragments of pottery, while in Trench 9 they were recovered from a boundary ditch 58.

At Warton Road, Stratford (Roberts 2009a), emmer and spelt wheat, and barley in smaller quantities, were recorded from deposits of this date, with a similar range of weed seeds. Spelt wheat grains were also retrieved in low numbers from a few Late Iron Age and early Romano-British features at Stratford Market Depot (Robinson and Campbell 2005).

There is little evidence from the Olympic Park for any of the imported species found elsewhere in the London area, such as coriander (*Coriandrum sativum*), fig (*Ficus carica*) and lentil (*Lens culinaris*) or indeed seeds of other more common crops such as flax (*Linum usitatissimum*). Although these were all recorded from Late Iron Age-early Romano-British deposits at Innova Park, Enfield (Ritchie *et al.* 2008), the assemblages from the Olympic Park provided much less evidence for charred material and general settlement waste, which may account for the general absence of these species.

However, while flax was absent, the high quantities of hemp pollen identified from Trench 72 are very significant, not only for *Londinium* but for Roman Britain as a whole. Hemp is an important economic plant with a variety of uses, including in textile and rope production. However, to free their bast fibres from the surrounding tissue, the stems first need to undergo a process known as 'retting', often involving immersion in a stream or pond for a number of days. This would have led to the shedding of large amounts of pollen within the water body. The high pollen percentage recorded, therefore, is a result of this form of process, rather than a reflection of the abundance of *Cannabis sativa* growing locally.

No seeds of *Cannabis sativa* were found in the associated sediments, although this is a common occurrence in records from other retting sites in the Britain and Europe (eg, Schofield and Waller 2005; Edwards and Whittington 1990; Bradshaw *et al.* 1981). High pollen counts with few or no seeds may be evidence that predominantly male (pollen producing) plants were used for fibre production rather than the female (seed producing) plants (Fleming and Clarke 1988), although differences in the timing of anthesis and cropping/retting may explain some of the variations observed (Edwards and Whittington 1990). In historic times, male plants were often preferred for fibre production (cf. Rasmussen 2005).

While *Cannabis sativa* has sometimes been regarded as not being important as an economic plant until the Saxon period in the Britain (eg, Godwin 1967a; 1967b), the four radiocarbon dates from above this deposit clearly demonstrate that this retting was taking place by at least the early Romano-British period. A number of radiocarbon dated pollen sequences with notable amounts of *Cannabis*-type pollen are known from Roman Britain, eg, Thorpe Bulmer, County Durham (up to 19% total tree pollen; Bartley *et al.* 1976), Crose Mere, Shropshire (15% TLP; Beales, 1980) and Rimsmoor, Dorset (2% TLP; Waton 1983), with several other sequences showing trace amounts (see Dark 2000). Additionally, seeds have been found in a well at Skeldergate, York (Hall *et al.* 1980) and at New Fresh Wharf, London (Willcox 1977), although the pertinent deposit from this latter site was disturbed in the Saxon period.

It is possible that seeds were being imported from Continental Europe at this time, where hemp production is known to have been taken place from at least the Iron Age (Bouby 2002); it is less likely that unretted fibres would be imported. The evidence suggests, therefore, that hemp retting was being undertaken in this area during the early Romano-British period, and that the crop was being grown in the general area of the Lea Valley.

Saxon/medieval

The charred plant assemblage recorded from above wattle-lined structure 159, in Trench 56, may indicate the expansion of cultivation onto heavier clay soils during the Saxon and medieval periods, perhaps corresponding to the increased rate of alluviation seen across the Olympic Park (see Chapter 8).

The combination of emmer, free-threshing wheat and rye is one seen elsewhere, particularly during the Early or Middle Saxon period (Pelling and Robinson 2000). However, while the cultivation of emmer in the British Isles stretches back to the Neolithic, it may not have been continuous and it is likely that different strains of hulled wheat and barley have been introduced or re-introduced at various times. As such, the find of Saxo-Norman emmer wheat in Trench 56 may represent a reintroduction of this crop from the continent, rather than a localised continuation of cultivation.

Post-medieval

The assemblage from Trench 75 is highly suggestive of cess, while the cereal pollen may relate to the grinding and processing of cereals and although no cereal remains were seen, it is questionable to what extent they would survive. Either interpretation is consistent with the trench's location next to the site of the long-established medieval watermills, once owned by the Knights Templar, and passing through other hands, including the Crown, after the Dissolution. The range of remains is suggestive of reasonably high status, suggesting that some of the site's occupants had access to foodstuffs beyond the means of the bulk of the local population.

While several of the foods may have been locally available, eg, strawberry and plum, grape is much less likely to have been grown in Britain at this time, when the climate was less favourable for viticulture. The grapes were probably imported, as figs would also have been for much of the medieval period (Greig 1988). The finding of hops is of some interest. Given the absence at this date of fen-woodlands, the natural habitat of wild hops, it is very likely that the hops are of the cultivated variety. Hop cultivation only became common in the early 16th century, although hops had been used in brewing in the Netherlands from the 14th century (Thirsk 1997; Godwin 1984). It might be noted that brewing in the parish of Leyton is recorded from documents dating to 1449 AD (*VCH* 1973, 197–205), although it is not known whether hops were used. Given the general character of the plant assemblage, it is probable that they relate at least to their use for flavouring, if not brewing itself.

The small quantity of charred remains from Trench 58 appears to show the presence of hedgerows or scrubby woodland in the vicinity, possibly with ungrazed marshland, and much of the area at this date probably consisted of meadows, marshland and pasture. There is no indication in the environmental evidence of any cereal cultivation, although the presence of mills would at least indicate that cereals were brought into the area for processing. Historical records for the general area during the 18th to 19th century point to the growing of potatoes, turnips and leguminous crops, with some market gardening, although such activities had largely disappeared by the end of the 19th century (*VCH* 1973, 74–76; 197–205).

Wood Charcoal

by Dana Challinor

Eleven samples from a range of Middle and Middle/Late Bronze Age features including post-holes in Trench 45, a gully and pit in Trench 24, three Late Bronze Age cremation burials from Trenches 9 and 43, and a Middle Iron Age pit from Trench 6 were examined. The cremation burials were of particular interest for the examination of the selection of wood for funerary activities and, where possible, to examine the nature of the local woodland resources through comparison with domestic-type debris.

Methods

With the exception of the three samples from the cremation burials (527, 1972 and 2052), the quantities of charcoal were very low. Consequently, all fragments >2 mm in size were identified, with 100 fragments randomly selected from the richer assemblages. The charcoal was fractured and

Table 7.21: Charcoal from non-cremation features

Trench		45					24	6
Feature Type		Post-hole					Gully	Pit
Phase		MBA	MBA/LBA	MBA/LBA	LBA	MBA/LBA	MBA	MIA
Context		31	35	39	41	45	24	351
Sample		16	18	20	21	23	24	72
Quercus sp.	oak	**	*	*	*	*	*	*
Alnus glutinosa Gaertn.	alder	*	*	–	–	–	–	*
Alnus/Corylus	alder/hazel	–	–	–	–	–	–	*
Prunus spinosa L.	blackthorn	*	–	–	–	–	*	*
Maloideae	hawthorn group	*	*	–	*	–	*	–
cf. *Cytisus/Ulex*	broom/gorse	–	–	–	*	–	–	–
Acer campestre L.	field maple	–	–	–	–	–	*	–
Fraxinus excelsior L.	ash	–	–	–	–	–	–	**
Indeterminate	bark	–	–	–	–	–	–	*
Indeterminate	diffuse porous	–	–	*	–	–	*	*

Key: * = up to 5; **= 5–25

sorted into groups based on the anatomical features observed in transverse section at x7 to x45 magnification. Representative fragments from each group were then selected for further examination in longitudinal sections using a Meiji incident-light microscope at up to x400 magnification. Identifications were made with reference to Schweingruber (1990), Hather (2000) and modern reference material. The maturity of the wood was noted where possible and the presence of roundwood, sapwood and heartwood is noted in the tables. Classification and nomenclature follow Stace (1997).

Results

Owing to the paucity of charcoal in the non-cremation samples, a scale has been used to indicate species presence (Table 7.21; +=up to 5; ++=5-25), with full quantification given for the richer samples. The charcoal was not generally well preserved, with small fragments infused with sediment or easily crumbled. Seven taxa were positively identified, all consistent with native taxa; *Acer campestre* (field maple), *Alnus glutinosa* (alder), cf *Cytisus/Ulex* (broom/gorse), *Fraxinus excelsior* (ash), Maloideae (hawthorn, apple, service, pear), *Prunus spinosa* (blackthorn) and *Quercus* sp. (oak). The identification of *Cytisus/Ulex* is probable but not confirmed as the single fragment was too small to check the anatomical characteristics in the longitudinal sections.

Most of the fragments did not exhibit any ring curvature, indicating that they came from large branch or trunkwood. A few roundwood fragments with faint to moderate curvature were noted in the cremation samples (Table 7.22), but these were in the minority. With the exception of a probable oak sapwood fragment selected for radiocarbon dating from cremation burial 1972, it was not possible to determine maturity. No tyloses were noted, but a number of the oak fragments (especially in sample 633) were highly comminuted and the early growth was not visible.

All of the post-hole samples associated with the settlement features in Trench 45 contained oak charcoal. This might tentatively be interpreted as the remains of oak structural wood, but the quantities were really too low to be conclusive. It is more likely that the charcoal – from all of the non-cremation features – represents waste material from domestic fires which became dispersed throughout various open features. In any case, they are not all

Table 7.22: Charcoal from Late Bronze Age cremation burials

Trench		43	9	
Feature		527	1972	2052
Context		526	1971	2051
Sample		107	633	638
Quercus sp.	oak	5	100 sr	2r
Maloideae	hawthorn group	74r	–	98r
Acer campestre L.	field maple	19r	–	–
Indeterminate	bark	2	–	–
Total		**100**	**100**	**100**

Key: s = sapwood, r = roundwood

contemporary, although the small dataset inhibits examination of temporal changes. Middle Iron Age pit 352 (Trench 6) contained a slightly more viable assemblage, but was not enough to suggest a deliberate dump of spent fuelwood. A few general comments may be made on the availability of woodland resources in the later prehistoric period on the basis of taxa presence. Woodland trees are represented by oak, ash and field maple with species characteristic of marginal woodland, woodland glades or more open areas such as blackthorn, hawthorn group and gorse/ broom. Alder would have grown on areas of damper ground.

The cremation assemblages (Trenches 9 and 43) came from unurned burials in shallow features. Charcoal was abundant enough to be confident that the material came from the pyre and is likely to have been scooped up with the bone for burial. All were dominated by a single taxon; oak in 1972 (with cremated remains of an adult, *c.* 30–40 years, possibly female) and hawthorn group in 527 (with cremated remains of an adult *c.* 25–40, possibly female) and 2052 (with cremated remains of subadult 13–16 years). The use of both oak and hawthorn group wood is well attested in Middle and Late Bronze Age cremation burials at sites such as Heathrow (Challinor 2010) and the route of the A120 in Essex (Challinor 2007). The presence or dominance of a single taxon in cremation assemblages has been ascribed to a deliberate, and probably ritual, selection of wood for the funerary rite (Thompson 1999, 352). The choice of oak is understandable given its good burning qualities and general ubiquity in archaeological deposits and the use of hawthorn group has been linked to possible odour benefits as apple and pear wood burns with a pleasant fragrance (Challinor 2007). Other factors influencing the choice of wood include beliefs and spiritual associations; but such concepts are elusive and difficult to project backwards in time. The similarity of the assemblages and the consistency with other sites suggests that the cremation practices fit within the Late Bronze Age funerary tradition.

Chapter 8
Environmental and Geoarchaeological Investigations

Introduction

by Michael J. Grant, David Norcott, Chris J. Stevens and Sarah F. Wyles

This chapter provides a summary and overview of the environmental and geoarchaeological work that has been undertaken on the material from the Olympic Park. A number of phases of work were undertaken comprising geoarchaeological/environmental assessment and analysis (Phase 3b), an overall assessment (SWIPEA Phase 4) and further analysis and reporting (Phase 5) (Chapter 1). Many different analyses have been undertaken and a deposit model has been produced, all of which has been combined to form an overview of the palaeoenvironmental history of this part of the Lea Valley. Such a large piece of work has inevitably resulted in many specialist reports and detailed analyses, an overview of which is presented here together with a discussion of the results. The full results are available in the site archive and through the Archaeology Data Service (ADS) (archaeologydataservice.ac.uk).

Table 8.1: River Terrace stratigraphy of the River Lea Valley around the Olympic Park

$\delta^{18}O$ Stage (OIS)	Quaternary Stage	Date (ka BP)	Climate	BGS [1]	Terrace formation Middle/Lower Thames [2]	Members: Lower Thames [2]	Lea Valley [3]
1	Holocene	11.7–0	Warm	Alluvium	Shepperton	Tilbury Alluvial Deposits	Holocene alluvium
Late 2	Devensian	19–11.7	Cold	Shepperton Gravel plus Langley Silts		Shepperton gravel	Lea Valley gravel
5d-2	Devensian	122–19	Cold	Kempton Park Gravel	Kempton Park/East Tilbury Marshes	East Tilbury Marshes upper gravel	Leyton gravel
5e	Ipswichian	128–122	Warm			Trafalgar Square and Peckham deposits	
Late 6	Late-Saalian	186–128	Cold			East Tilbury Marshes lower gravel	
6				Taplow Gravel	Taplow/Mucking	Mucking upper gravel	Leytonstone gravel
7	Intra-Saalian	245–186	Warm			Aveley Sands and Silts deposits	
Late 8	Intra-Saalian	303–245	Cold			Mucking lower gravel	
8				Hackney Gravel/ Lynch Hill Gravel	Lynch Hill/Corbets Tey	Corbets Tey upper gravel	Hackney Downs gravel
9	Intra-Saalian	339–303	Warm			Purfleet interglacial deposits	Highbury Silts and Sands and Stoke Newington Sands
Late 10	Early-Saalian	362–339	Cold			Corbets Tey lower gravel	Stamford Hill gravel
10				Boyn Hill Gravel	Boyn Hill/Orsett Heath	Orsett Heath upper gravel	
11	Hoxnian	423–362	Warm			Swanscombe interglacial deposits	
Late 12	Latest Anglian	478–423	Cold			Orsett Heath lower gravel	
12	Anglian			(not found locally)	Black Park	Within Orsett Heath formation	

A broad correlation has been made between the schemes of the [1] British Geological Survey Mapping (shown on Fig. 8.1), [2] the River Thames terrace system of Bridgland (1994) and [3] the Lea Valley scheme of Gibbard (1994). Grey shading shows known interglacial deposits found within the Thames, with only OIS 9 and 1 represented in the lower Lea Valley around the Olympic Park. Correlation of the Lea Valley OIS 9 deposits is based upon Green *et al.* (2006). Dates are based upon Imbrie *et al.* (1984), Bridgland (1994) and Walker *et al.* (2009), with table adapted from Bridgland *et al.* (2001; 2004) to include the schemes of the BGS and Gibbard (1994)

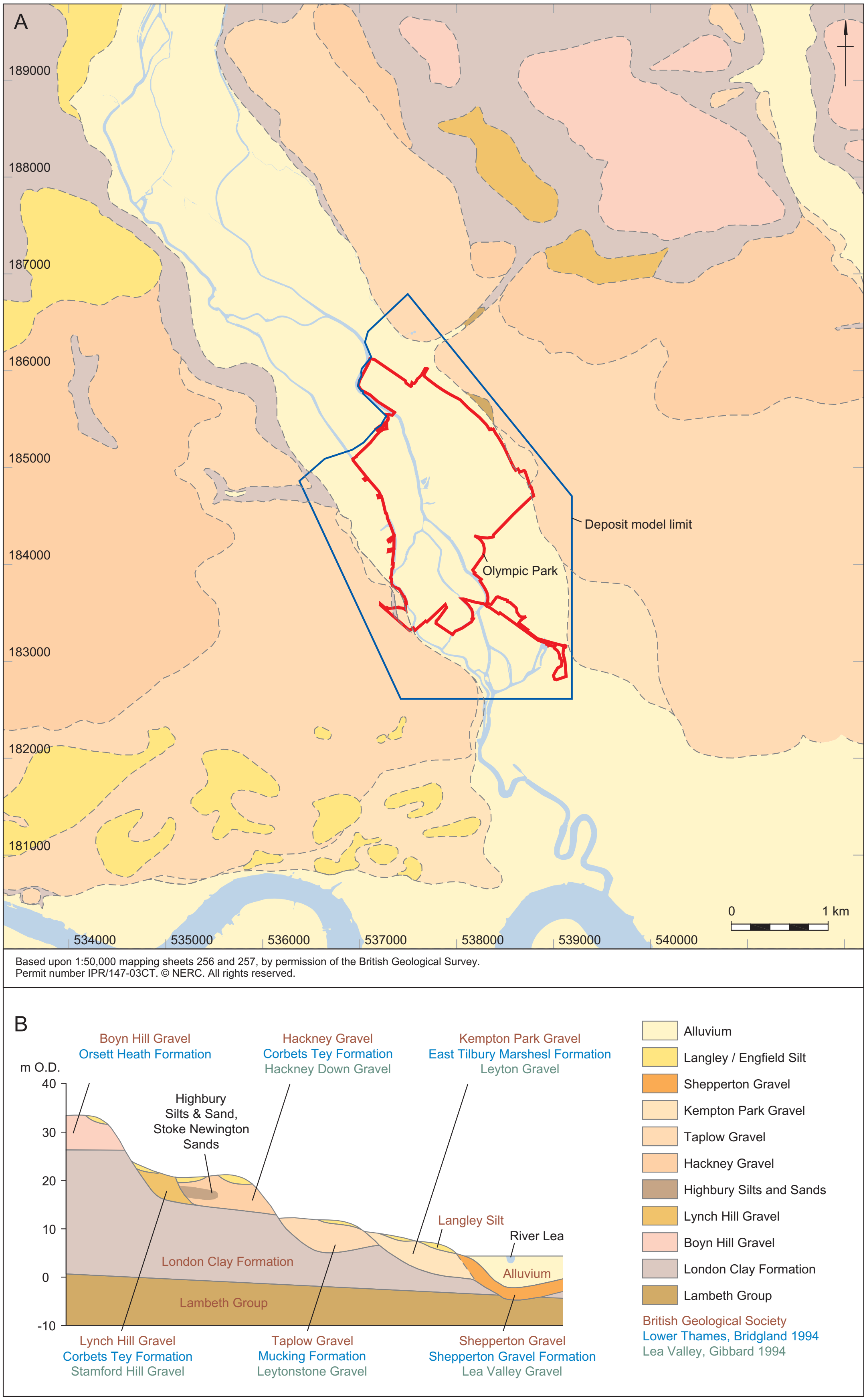


Figure 8.1:
a) Geology and drift map of the site and surrounding area, based upon British Geological Survey (BGS) Sheets 256 and 257 (Ellison et al. 2004).
b) Cross section is modified from BGS (1976) to reflect the local terrace stratigraphy, and broad correlation between the schemes of BGS, Bridgland (1994) Lower Thames and Gibbard (1994) Lea Valley

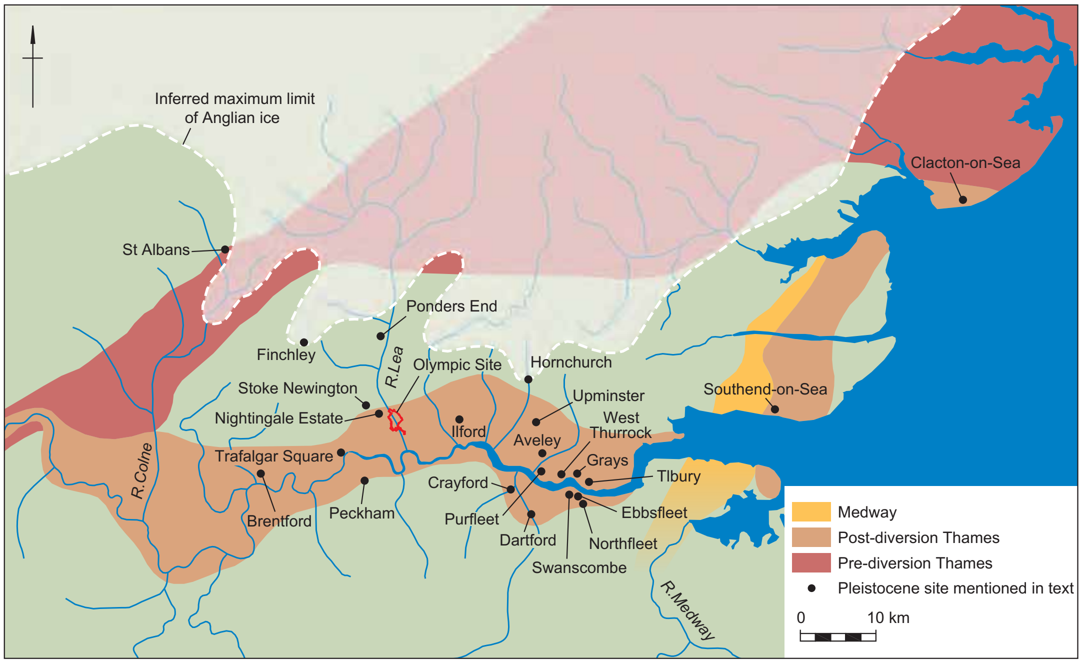


Figure 8.2: Changes in the course of the River Thames, showing the distribution of the pre-diversion and post-diversion deposits of the Thames and the pre-diversion Medway (modified from Bridgland and Schreve 2004, fig. 1), extent of the Anglian (OIS 12) glaciation, and distribution of key Pleistocene sites in the area referred to in the text

Geology

The Olympic Park site lies within the London Basin. London Clay underlies much of the drift geology of the area, although within the river valleys it has been removed by uplift and erosion, as have the upper units of the underlying Lambeth Group sediments. Consequently, the site is underlain mostly by Lambeth Group sediments, surrounded by the younger London Clay (Fig. 8.1). These Tertiary geologies are overlain by a series of Quaternary River Terrace Deposits, laid down following the scouring of the valley floor during the Late Pleistocene (see below), overlain within the valley itself by thick deposits of alluvium.

Pleistocene Terrace Deposits: formation of the modern Lea Valley

The Quaternary, spanning the last *c.* 1.8 million years, is divided into the Pleistocene and the Holocene epochs, the latter being the latest warm period since *c.* 9700 BC. Fluctuations in climate between glacial and interglacial stages led to a series of gravel terraces being formed along the edges of the Lea Valley, resulting from downcutting during the glacial–interglacial transition coupled with long-term uplift of the land surface (Maddy *et al.* 2001). The most recent terraces are buried beneath the current river floodplain (see Fig. 8.1). The switching between warm and cold climates is globally recognised, recorded in a scheme of Oxygen Isotope Stages (OIS; see Table 8.1 for OIS relevant to the Lea Valley). The Holocene is designated as OIS 1 with the most recent glacial stage being OIS 4-2. The last glaciation has also been classified using the Greenland Ice Core record (Svensson *et al.* 2006; Andersen *et al.* 2006), with a series of smaller climatic shifts (Greenland Stadial (GS-; colder) and Greenland Interstadial (GI-; warmer) events) recorded within it (see Fig. 2.2).

The Lea Valley principally owes its origin to a large ice sheet that developed over much of northern Europe during OIS 12 (Anglian Stage) (Table 8.1). Prior to OIS 12, the River Thames was situated much further north, flowing north-east across the Vale of St Albans towards East Anglia (Fig. 8.2). At this time, the river that flowed through the area of the modern Lea Valley was the northward flowing Mole-Wey-Wandle river system, which drained into the Thames basin. The southern expansion of the Anglian ice sheet ultimately led to the diversion of the Thames drainage southwards towards its current position, flowing through London towards Southend-on-Sea where it joined the River Medway and flowed across eastern Essex, rejoining its original course near Clacton-on-Sea. The Rivers Lea and Colne started as outwash streams carrying meltwater from the ice fronts southwards into the new course of the River Thames. By OIS 8 the River Thames had migrated from its north-easterly course across Essex to a more easterly course through Southend-on-Sea on the north side of the Thames Estuary, which in subsequent OIS continued to modify its course until it adopted its current position in the Holocene.

A number of different authors have undertaken mapping of the gravel terraces along the River Thames and Lea Valley, and correlating these is not always easy (Table 8.1). Figure 8.1 shows the mapping of the terraces by the British Geological Survey, which has been correlated with the Lea Valley scheme of Gibbard (1994) and Thames scheme of Bridgland (1994).

The earliest terrace recorded in the area of the Olympic Park is that of the Boyn Hill Gravel (Fig. 8.1), which would have been deposited at the end of OIS 12 and during the subsequent OIS 10 glacial stage, correlating with the Orsett Heath Formation of the Lower Thames (Bridgland 1994). No interglacial (Hoxnian) deposits from OIS 11 have been found in this area, although evidence has been found further down the Thames, notably at sites such as Barnfield Pit, Swanscombe (Ovey 1964; Conway *et al.* 1996) and Southfleet Road, Ebbsfleet (Wenban-Smith *et al.* 2006).

The next terraces to be formed are mapped locally by the British Geological Survey (BGS) as two formations – the Lynch Hill Gravel and the Hackney Gravel, although Bridgland (1994) classified this complex of sediments as the Lynch Hill/Corbets Tey Terrace. Investigations at Nightingale Estate, Hackney Wick (Green *et al.* 2006), showed the presence of an OIS 9 interglacial deposit within silts preserved between the two gravels (Highbury Silts and Sands), with palaeoclimatic indicators suggesting summer temperatures above modern day values (Green *et al.* 2006). Similar (albeit possibly earlier) deposits were found nearby at Stoke Newington (Harding and Gibbard 1983), including possible *in situ* knapping floors (Smith 1894).

Further OIS 9 sites are found downstream along the Thames, including Ilford, Upminster (Ward 1984), Grays (Hinton and Kennard 1900) and most notably Purfleet (Hollin 1977; Bridgland 1994; Schreve *et al.* 2002; Bridgland *et al.* 2012). The later had evidence for a succession of three separate Palaeolithic industries – a Clactonian assemblage in the earliest deposits, followed by an Acheulean (handaxe) industry, and then the first appearance in Britain of Levallois artefacts in the uppermost Corbets Tey deposits, marking the transition from the Lower to the Middle Palaeolithic.

Interglacial deposits equating with OIS 7 have been found within the next terrace to be laid down, the Taplow Gravel, at a number of sites downstream including Aveley (Blezard 1966; Bridgland 1995; Sutcliffe 1995), Ilford (West *et al.* 1964), West Thurrock (Bridgland and Harding 1994; Schreve *et al.* 2006) and Crayford (Kennard 1944). Important archaeological assemblages, characterised by well-developed Levallois technology, occur in the deposits at West Thurrock, Crayford and Northfleet (Wymer 1968; 1999; Bridgland and Harding 1994; Schreve *et al.* 2006) where they represent occupation during late OIS 8 and early OIS 7, often regarded as the last evidence for hominid occupation of Britain prior to a lengthy absence of hominids during OIS 6 and 5. However, recent excavations at Dartford (Wenban-Smith *et al.* 2010) have suggested a possible later presence of hominids indicated by lithics upon a buried

Table 8.2: Radiocarbon dates from Arctic Bed deposits in the lower Lea Valley

Site	Code	Determination BP	Calibrated date (cal BC)	Reference
Nazeing	Q-25	28,000±1500	34,700–28,250	Godwin and Willis 1960; Allison *et al.* 1952
Deephams Sewage Works	Birm-238	21,530±480	25,600– 22,550	Shotton and Williams 1971; Coope and Tallon 1983
Olympic Park (borehole VYA/BH3)	Beta-190630	19,620±250	22,200–20,650	Corcoran and Swift 2004

occupation surface dated by Optically Stimulated Luminescence (OSL) to OIS 5d-b.

The Kempton Park Gravel is found at the margin of the modern floodplain of the lower Lea Valley, while further east this terrace is buried below Holocene alluvium deposits. To the west the terrace has yielded important Ipswichian (OIS 5e) interglacial deposits from sites such as Brentford (Morris 1850), Trafalgar Square (Franks *et al.* 1958; Franks 1960; Gibbard 1985; Preece 1999) and Peckham (Gibbard 1994).

The final gravel deposits in the area are the Shepperton Gravels (Bridgland 1994), also known as the Lea Valley Gravels (Gibbard 1994), which are buried beneath the Holocene floodplain alluvial deposits. These gravels were deposited predominantly in OIS 2 (Late Devensian), as a result of the most recent down-cutting through the Kempton Park Gravel deposits. At this time sea level was *c.* 120 m lower than today which, combined with glacio-isostatic uplift, meant that the river gradient was much steeper, causing the deep incision of the River Lea and Thames to lower levels than previously seen.

Around Edmonton, at Nazeing (Allison *et al.* 1952), Pickett's Lock (Ponder's End) and Angel Road Pit (Warren 1912), a series of organic deposits were recorded at the base of the Shepperton Gravels, commonly known as the Arctic Beds. Warren (1915) also identified Arctic Bed deposits within the Olympic Park site at the Temple Mills Pit (visible in Pl. 6.3, above). The Arctic Beds have been found to contain 'full glacial' plant assemblages (Reid 1949; Allison *et al.* 1952), insect assemblage typical of arctic tundra (Coope and Tallon 1983), cold indicator and dwarfed specimens of molluscs (Warren 1912, 239) and 'steppe tundra' fauna (Lister and Sher 2001). These deposits formed during phases of lower energy water flow, with organic sediment accumulating in a series of floodplain channels or depressions (Gibbard 1994, 193). Many of these deposits were subsequently eroded during episodes of meltwater discharge that scoured out the main channel of the Lea Valley, some possibly transported as rafted peats. Similar deposits have also been found in the peripheral channels of the Lea Valley at Hedge Lane (Warren 1915) and Barrowell Green (Warren 1923). Only a few dates have been obtained from these deposits (Table 8.2) implying deposition between Greenland Stadial (GS) 6 and 2. However, the dating of these sediments should be treated with some caution as it has been observed in other studies that small amounts of contamination by modern carbon can often lead to a significant underestimating of the date of deposition obtained from radiocarbon dating when compared to other dating methods such as OSL (see Briant and Bateman 2009; Hijma *et al.* 2012).

Overlying parts of the gravel terraces are the Enfield and Langley Silts, a series of 'brickearth' deposits predominantly loessic in origin, although the grain size of some of these deposits suggests many are not pure loess but modified by slope wash (Gibbard 1994, 97). The Langley Silts are attributed to sedimentation during the last glaciation, particularly after the last glacial maximum (GS-3), as indicated by thermoluminescence dating of these deposits in the Heathrow area to *c.* 16,000–12,000 BC (GS-2 to Greenland Interstadial (GI) 1; Gibbard *et al.* 1987; Rose *et al.* 2000).

Figure 8.3: Locations of Late Pleistocene and Holocene sequences from the Lea Valley and Lower Thames referred to in the text

GI-1 marks the initial warming period towards the end of the last glaciation when temperatures rose and sea ice retreated northwards, resulting in summer temperatures reaching around 17°C and winter temperatures in the range of 0–1°C (Atkinson *et al.* 1987). This episode of climatic warming began *c.* 12,750 cal BC and lasted for around 1800 years, prior to a return to near-glacial at the onset of GS-1 (Younger Dryas Stadial) between 10,950 and 9700 cal BC (Alley *et al.* 1993; see Fig. 2.2).

Borehole sampling on the Olympic Park has uncovered a number of deeply buried Late Pleistocene deposits which have been dated to this period. At Deep Foul Sewer (Borehole P4) a basal organic deposit was radiocarbon dated to 12,060–11,800 cal BC (SUERC-28031, 12,020±40 BP). This yielded large numbers of seeds of water sedge (*Carex* cf. *aquatilis*), a species with a northern distribution that extends to alpine and montane habitats, and which correlates with contemporary deposits at Nazeing (Allison *et al.* 1952), where water/stiff sedge

(*Carex aquatilis/Carex bigelowii*) were recorded. This dating has been replicated in two further deposits from boreholes on the Olympic Park site, with dates of 12,110–11,830 cal BC (Beta-218157, 12,080±40 BP, BHCZAi-003) and 12,900–11,890 cal BC (Beta-190632, 12,240±80 BP, VYC/BH2: Corcoran and Swift 2004), with an additional date of 11,210–10,860 cal BC (Beta-216964, 11,130±40 BP) in borehole BHCZ6D-013.

The former Hackney Wick Pit (visible in Pl. 6.3, above) has records of masses of peat dredged from base of the gravel. Warren (1915) noted that this peat was more similar in character to Holocene peats than to the Arctic Beds found elsewhere, although the mammal bone assemblage contained both woolly mammoth (*Mammuthus primigenius*) and woolly rhinoceros (*Coelodonta antiquitatis*). The flowering plants from these peats were typical of an open cool, but not necessarily cold climate. Based upon the available evidence Warren ultimately suggested that this deposit was a later Pleistocene formation rather than Early Holocene in date. However, current evidence suggests woolly mammoths were absent from Britain during GS-3 (Last Glacial Maximum), but had returned by *c.* 13,000 cal BC (GS-2; Stuart *et al.* 2002), with the latest remains found at Condover, Shropshire, dated *c.* 12,920–12,050 cal BC, correlating with the earlier part of GI-1 (Scourse *et al.* 2009). It is therefore possible that the peats from the Hackney Wick Pit are contemporary with the deep deposits found in boreholes elsewhere across the site from GI-1.

There are few occurrences of other possible GI-1 deposits in the Lea Valley, and therefore little is known about the local environment in the area at this time. The return to near-glacial conditions at the onset of GS-1 *c.* 10,950 cal BC was the result of the North Atlantic region cooling, with a weakening of northern hemisphere monsoon strength and a reduction in the oceanic surface water density (Carlson 2010). Several sequences from the Lea Valley show initial sedimentation at this time, with radiocarbon dates from the base of sequences at Temple Mills Depot (10,440–9880 cal BC, KIA-24051, 10,305±50 BP, Bates and Stafford in press), Meridian Point, Glover Drive (10,630–10,130 cal BC, Beta-96080, 10,450±80 BP, Bowsher 1996) and Silvertown BH8 (10,570–9810 cal BC, Beta-101867, 10,310±90 BP, Wilkinson *et al.* 2000) correlating with GS-1 (see Fig. 8.3 for locations). Similar dates have also been obtained from basal deposits found in boreholes from the Olympic Park, for example: BHCZ5C-025 dated to 10,630–10,170 cal BC (Beta-218762, 10,470±70 BP).

At Nazeing extensive marl deposits suggest the development of a lake during GS-1. Calcareous rich deposits have also been found at the base of other sequences in the area, including those rich in the remains of charaphyta (stonewort) oogonia (eg, Deephams Sewage Works, (Hayward 1956), Temple Mills Depot and Silvertown BH8). This may reflect the combined effects of reduced surface run-off (driven by periglacial conditions), water stagnation, and increased groundwater influence to the river valley, with spring-fed calcareous-rich waters (from the underlying chalk aquifers) driving the calcareous deposit formation.

The pollen and plant macrofossils from the sequences at Temple Mills Depot, Meridian Point, Innova Park (Ritchie *et al.* 2008) and Nazeing (Allison *et al.* 1952) generally show an arctic–alpine tundra environment, with extensive local marsh environment dominated by sedges, reed, grasses and aquatic taxa. Typical cold-adapted taxa, often present in the pollen assemblage, include rock rose (*Helianthemum*), Jacob's-ladder (*Polemonium*), mountain avens (*Dryas octopetala*) and saxifrage (*Saxifraga* spp.). Tree taxa are generally sparse, with birch (*Betula*), including dwarf birch (*Betula nana*), willow (*Salix*) and occasionally

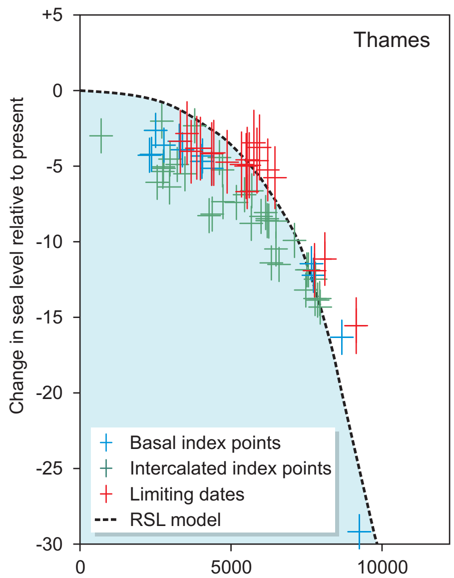


Figure 8.4: Sea-level index points for the Thames Estuary, plotted as calibrated age against change in sea-level relative to present (m), modified from Shennan and Horton (2002)

juniper (*Juniperus*) recorded. Also often present in these samples are occurrences of typical deciduous taxa including oak (*Quercus*), hazel (*Corylus*), alder (*Alnus*) and elm (*Ulmus*). While some of this pollen may be derived from reworked sediment and/or long distance transportation, some may be locally derived.

Corylus avellana-type incorporates pollen derived from bog myrtle (*Myrica gale*), as it is often difficult to separate these two species (Edwards 1981), especially if they are poorly preserved. Traces of *Myrica gale* in the UK have been found in some the Late Pleistocene deposits (Skene *et al.* 2000, 1090), such as in the form of leaves in the GS-1/Early Holocene basal muds at Wareham, Dorset (Seagrief 1959). Within the Lea Valley, seeds of *Myrica gale* have been found in the basal peat deposits at Crown Wharf Ironworks dated *c.* 9000–8000 cal BC (Stephenson 2008; Branch *et al.* 2006).

An early local presence of alder is also supported by macrofossil remains from some contemporary deposits, including individual seeds at Temple Mills Depot (pre 10,200 cal BC; Bates and Stafford in press) and Pannel Bridge, East Sussex (*c.* 9000 cal BC; Waller 1993), with dated wood fragments from Galewood, Northumberland (Passmore *et al.* 2002) dated 12,890–12,000 cal BC (SUERC-9081, 12,280±40 BP) and 11,500–11,300 cal BC (SUERC-9080, 11,490±35 BP). It is not clear which species of alder these macrofossils are derived from (pollen is largely indistinguishable; Blackmore *et al.* 2003), but the more likely species is grey alder (*Alnus incana*), a species found today in cooler areas of Europe, rather than the more common black alder (*Alnus glutinosa*).

Holocene developments

Sea level change

An important contributor to the changes recorded in the Lea Valley is the change in sea-level and estuarine influence throughout the Holocene. Changes in relative sea-level (RSL) are the result of the interplay between the timing and magnitude of eustatic sea-level change, and the spatial variability associated with glacio-isostatic adjustment. The RSL curve and plots of the sea-level index points for the Thames from Shennan and Horton (2002) are shown in Figure 8.4.

Early Holocene basal peats in the outer Thames estuary show an initial rapid RSL rise, whilst during the mid-Holocene RSL rise occurs at a declining rate with further slowing rates of rise in the Late Holocene. This is consistent with trends from other areas bordering the southern North Sea (eg, Denys and Baeteman 1995; Kiden 1995; Long *et al.* 2000; Beets *et al.* 2003). Roman *Londinium* and Saxon *Lundenwic* were located at the tidal head of the Thames (Milne *et al.* 1983; Wheeler 1928). A downstream migration of the tidal head possibly occurred in the early medieval period (Sidell *et al.* 2000), prior to the extensive land-claim of the marshes and the expansion of the city of London, which would have constrained the Thames (and tributary rivers), potentially forcing the tidal head again upstream.

Table 8.3 (right): Radiocarbon dates shown on Figure 8.5

Site	Reference	Trench/ borehole	m OD (unless stated)	Material dated (as stated in original publication)	Code	Date BP	δ13C	Calibrated date
Fort Street, Silvertown	Crockett *et al.* 2002	Profile A	-0.16 to -0.21	Peat (humic acids)	KIA-4410	3250±60	–	1670–1410 cal BC
		Profile A	-1.14 to -1.18	Peat (humic acids)	KIA-4409	4280±50	–	3090–2690 cal BC
Silvertown BH8	Wilkinson *et al.* 2000	BH8	0.89 to 0.95	Peat	Beta-93677	2430±50	–	760–400 cal BC
		BH8	0.38 to 0.42	Peat	Beta-120959	3070±60	–	1490–1130 cal BC
		BH8	-1.00 to -0.96	Wood	Beta-120960	5010±70	–	3960–3660 cal BC
		BH8	-2.26 to -2.20	Organic sediment	Beta-120958	9360±70	–	8810–8340 cal BC
		BH8	-2.43 to -2.40	Organic sediment	Beta-93678	10,010±70	–	9860–9300 cal BC
		BH8	-2.53 to -2.52	Organic sediment	Beta-101867	10,310±90	-34.60	10,570–9810 cal BC
Yabsley Street	Coles *et al.* 2008	Trench 3	-2.00	Peat	KIA-22539	3049±27	-23.50	1610–1440 cal BC
		Trench 3	-2.10	Peat with sand	KIA-22538	3316±33	-25.45	1610–1430 cal BC
		Trench 3	-2.20	Peat	KIA-22540	3233±29	-26.00	1690–1510 cal BC
		Trench 3	-2.33	Peat with twigs	KIA-22541	3248±30	-25.97	1410–1220 cal BC
Victoria Dock Rd.	Barnett 2010	Trench 1	-0.75	Twig	NZA-22395	3040±30	-28.51	1410–1210 cal BC
		Trench 1	-1.65	Twig	NZA-22533	4483±35	-25.81	3350–3020 cal BC
		Trench 2	-4.7 to -4.45	*Alnus glutinosa* twig	NZA-22396	5012±30	-29.73	3950–3700 cal BC
St Luke's Square	Wicks 2008	Trench 3	-0.76 to -0.75	Peat	KIA-37390	3270±25	-25.32	1620–1460 cal BC
		Trench 3	-2.02 to -2.01	Peat	KIA-37389	4870±35	-28.66	3710–3630 cal BC
Crown Wharf	Stephenson 2008; Branch *et al.* 2005	Trench 5	1.20 to 1.23	Peat	Wk-16549	8393±50	-29.40	7570–7340 cal BC
		Trench 5	1.07 to 1.10	Peat	Wk-16548	9066±57	-28.70	8460–8010 cal BC
Omega Works	Spurr 2006	WS03	2.47	Non-woody fibrous plant material	Wk-18595	1864±31	-29.50	cal AD 70–240
		WS02	1.12	Non-woody fibrous plant material	Wk-16737	6238±52	-28.50	5320–5050 cal BC
		WS02	0.52	Non-woody fibrous plant material	Wk-16736	8093±52	-30.50	7300–6820 cal BC
Stratford Box	Barnett *et al.* 2011	Hollow 4271	0.70 to 0.95	4 x *Nuphar lutea* seeds	NZA-32945	1834±35	-30.10	cal AD 80–260
		Hollow 4271	0.19 to 0.21	10 x *Alnus glutinosa* cones	NZA-32946	6822±45	-26.90	5800–5630 cal BC
		Hollow 4271	0.08 to 0.12	10 x *Alnus glutinosa* cones	NZA-32948	7014±40	-27.30	6000–5790 cal BC
		Hollow 4271	0.07	Degraded twig wood	NZA-27376	9099±45	-27.40	8450–8240 cal BC
		Hollow 4271	-0.03	Juvenile *Salix/Populus* wood	NZA-27358	9522±40	-27.90	9140–8730 cal BC
		Hollow 4271	-0.36	Small fragment of woody stem	NZA-27360	9911±40	-28.20	9650–9270 cal BC
Temple Mills Depot	Bates & Stafford in press	Tr4044	2.73	3 outer rings of mature wood	KIA-24588	3650±35	-31.91	2140–1920 cal BC
		Tr4044	2.67	Horizontal root	KIA-24589	3690±35	-26.67	2200–1960 cal BC
		Tr4044	2.39	2 fragments wood	KIA-24590	3980±35	-26.75	2580–2340 cal BC
		Tr4044	2.22	2 fragments wood	KIA-24591	4435±40	-26.15	3340–2920 cal BC
		Tr4042	2.62	*Phragmites australis* stem	KIA-24052	4610±35	-24.57	3520–3130 cal BC
		Tr4042	2.49	Twig fragment	KIA-30301	4589±30	-25.60	3500–3120 cal BC
		Tr4042	2.29	Waterlogged wood	KIA-30332	8865±30	-25.60	8220–7830 cal BC
		Tr4042	1.84	*Phragmites australis* stem	KIA-24051	10,305±50	-28.35	10,440–9880 cal BC
Ikea Site, Glover Drive	Spurr 2007	Trench 3A; Mono 12	7.44	Bulk organic sediment	SUERC-12531	1775±35	-29.80	cal AD 130–350
		Trench 3A; Mono 12	7.07	Bulk organic sediment	SUERC-12530	1835±35	-29.40	cal AD 80–260
		Trench 3A; Mono 13	7.75	Bulk organic sediment	SUERC-12535	2790±35	-28.80	1020–830 cal BC
		Trench 3C; Mono 19	7.34	Bulk organic sediment	SUERC-12557	6130±35	-28.80	5220–4960 cal BC
		Trench 3C; Mono 19	6.95	Bulk organic sediment	SUERC-12536	9835±40	-28.50	9370–9240 cal BC
Meridian Point, Glover Drive	Bowsher 1996	Trench 3	7.04 to 7.15	Organic sediment	Beta-96079	7750±80	–	6820–6430 cal BC
		Trench 3	5.71 to 5.79	Organic sediment	Beta-96080	10,450±80	–	10,630–10,130 cal BC
Millmarsh Lane	Bowsher 1995	Channel	13.05-13.19	Wood	Beta-68680	4420±90	–	3360–2900 cal BC
		Channel	12.83-12.94	Organic sediment	Beta-76891	7140±70	–	6220–5880 cal BC
		Channel	12.60-12.70	Peat	Beta-68581	8240±60	–	7460–7080 cal BC
Enfield Lock	Chambers *et al.* 1996	Column B	0.55 to 0.56 depth	Peat/organic sediment	Beta-68555	8290±80	–	7530–7080 cal BC
		Column B	0.61 to 0.62 depth	Peat/organic sediment	Beta-68556	8200±80	–	7460–7050 cal BC
		Column B	0.84 to 0.86 depth	Peat/organic sediment	Beta-68557	9550±70	–	9220–8720 cal BC
		Column D	Top 0.02	Peat/organic sediment	UB-3349	6620±48	-28.90	5630–5480 cal BC
		Column D	Bottom 0.02	Peat/organic sediment	UB-3350	9546±56	-28.90	9180–8740 cal BC

The start of the tidal influence upon the River Lea is uncertain. The presence of estuarine sediments at Silvertown dated to *c.* 2050 cal BC (Wilkinson *et al.* 2000), extending further west and reaching Westminster by 1050 cal BC (Sidell *et al.* 2000), suggests that the lower reaches of the River Lea would have experienced the onset of tidal conditions by this time. The presence of a number of tidal mills at Stratford shows that the River Lea has been tidally influenced since at least the medieval period, although the extent to which brackish conditions (as opposed to freshwater conditions which were tidally influenced) extended upstream is largely unknown.

Early Holocene vegetation

Further channel incision occurred during the Early Holocene in the Lea Valley, when high energy meltwater discharge occurred as a result of the warming conditions. This is most clearly demonstrated at Nazeing, where a deep channel was scoured through part of the marl sequence and underlying gravel deposits (Allison *et al.* 1952). Subsequently, within these channels, peat formation begins, containing a characteristic pollen flora that includes the main expansion of pine (*Pinus sylvestris*), the disappearance of the previous cold-stage taxa, and a phase of increased meadowsweet (*Filipendula*) abundance.

Expansion of pine across the local area was broadly contemporary, with dates of *c.* 9840 cal BC at Temple Mills Depot (Bates and Stafford in press), *c.* 9300 cal BC at Stratford Box (Barnett *et al.* 2011), 9220–8720 cal BC at Enfield Lock (Beta-68557, 9550±70 BP, Chambers *et al.* 1996) and *c.* 9550 cal BC at Silvertown BH8 (Wilkinson *et al.* 2000).

Sequences from the lower Lea Valley are often poorly dated but it is possible to correlate them using the entrained pollen assemblage. At different stages of the Holocene, most notably the Early Holocene, trees arrive at different times so it is possible to correlate the pollen assemblage with a given time period and hence make an assessment of the associated chronology derived from radiocarbon dating (see below, Table 8.3). At Omega Works, an apparent Early Holocene pollen assemblage, that would appear contemporary with those mentioned above, was associated with a much later radiocarbon date of 7300–6820 cal BC (Wk-16736, 8093±52 BP). However, given that the material dated was unidentified 'non-woody fibrous plant remains' (Spurr 2006), there is the possibility that the material dated contained a high proportion of younger intrusive root material, therefore contributing to the seemingly erroneous younger date (*c.* 2000 years too young). A similar problem was also encountered for the upper radiocarbon dates in the sequences from Temple Mills Depot (Trench 4042) and Enfield Lock.

The accumulation of plant material and formation of peat in several locations investigated along the River Lea indicates a transition from generally open-water flora in the Early Holocene to fen-type vegetation, followed by the transition from sedge and reed communities to the establishment of local willow woodland and then later alder carr upon the floodplain.

Micro-charcoal analysis from Temple Mills Depot (Bates and Stafford in press) and Enfield Lock (Chambers *et al.* 1996) has revealed the occurrence of burning events during the Early Mesolithic, which were also noted in samples from the Ikea site, Glover Drive (Spurr 2007). These may be related to local deliberate burning by people or the result of natural burning events, given the high abundance of suitable fuel (notably *Pinus* woodland and herb communities on the floodplain) and conducive climatic conditions (Holocene Thermal Maximum; Renssen *et al.* 2009). Similar records of burning have been found at other sites in southern Britain (eg, Grant *et al.* 2009; Grant and Waller 2010; Barnett 2009).

Warmer conditions during the Early Mesolithic led to the development of temperate woodland across the area that became London. This woodland was characterised by the expansion of hazel and pine, the latter subsequently being replaced by temperate species, particularly elm (*Ulmus*) and oak. These were later joined by lime (*Tilia*) and alder, to produce the mixed oak-lime forest characteristic of the mid- to Late Mesolithic.

It has been suggested that black alder (*Alnus glutinosa*) spread across Britain during the Early Holocene, before expanding when conditions became locally favourable (Bennett and Birks 1990), occurring largely within the wetland zone. The record from Temple Mills Depot (Bates and Stafford in press) showed successful establishment of alder was hindered by fluctuating water levels. However, the dating of this event is unclear as the uppermost radiocarbon dates from the sequence appeared too young when compared to nearby sequences.

Mid-Holocene vegetation change

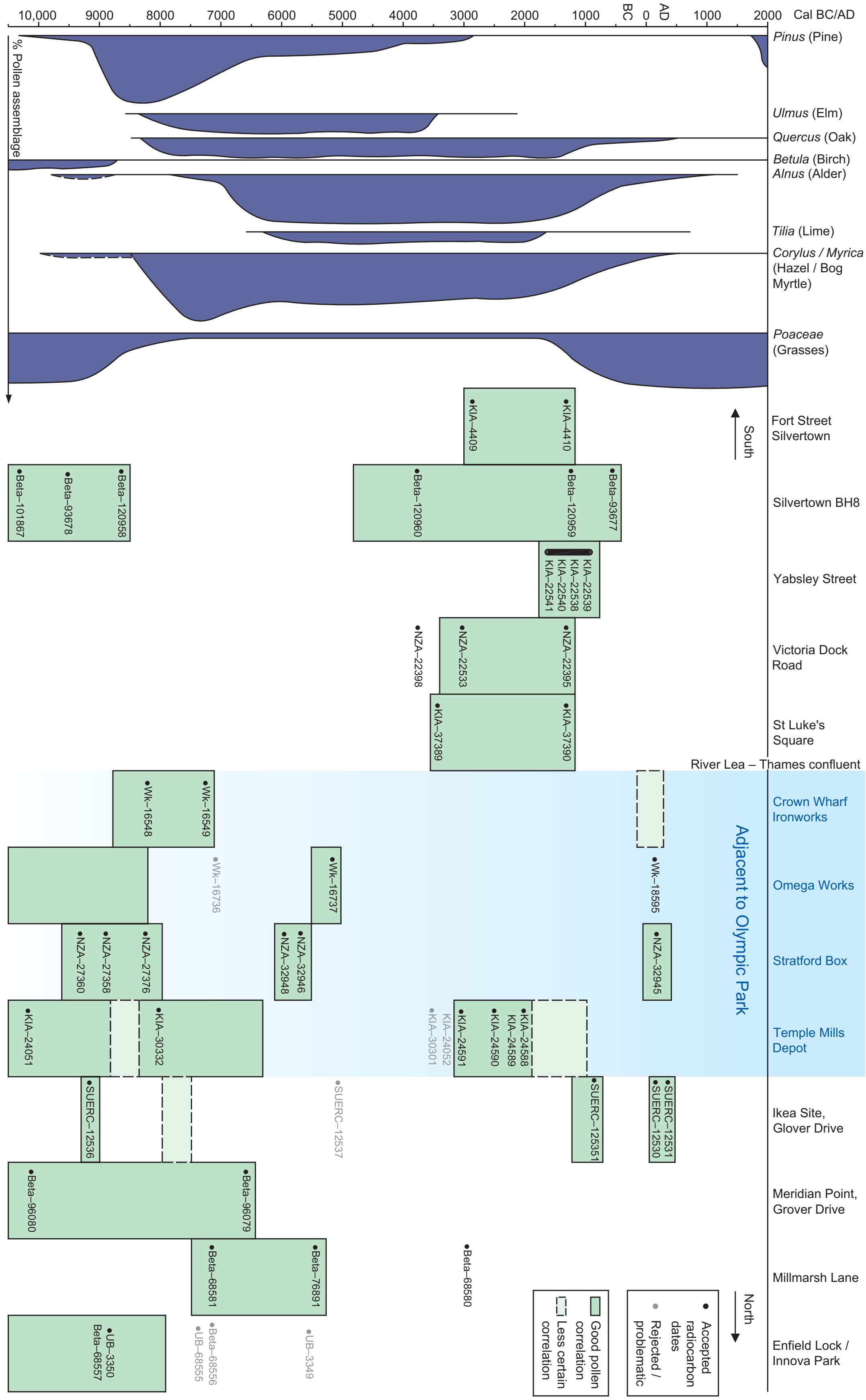
Palaeoecological records from the River Lea start to become patchy and uncertain from *c.* 8000 cal BC (Fig. 8.5), and interpretations based upon sites with only one or two radiocarbon dates should be treated with caution, particularly where bulk radiometric dates are taken on sediments that may potentially include intrusive material. Based upon broadly established vegetation chronologies for southern England and the Lea Valley those dates suspected of being erroneous are highlighted in Figure 8.5. However, a palaeochannel sequence at Millmarsh Lane (Ford 2000) does appear to cover this period briefly. Although the pollen sequence in this study was undated, previous investigation on the site (Bowsher 1995) also uncovered a channel in this same location, containing a similar stratigraphic sequence and comparable radiocarbon dates of 7460–7080 cal BC (Beta-58581, 8240±60 BP) and 6220–5880 cal BC (Beta-76891, 7140±70 BP).

Three sequences appear to best represent the later Mesolithic vegetation of the Lea Valley: Silvertown BH8, Omega Works and Stratford Box. All of these sequences show pollen assemblages dominated by alder, indicating the establishment of floodplain alder carr woodland by this period. In the south of the River Lea, at the confluence with the River Thames, organic sedimentation is generally absent at this time, with peat formation not properly occurring until the Neolithic when changes in sea level and lateral wetland expansion led to expansive peatland along the river floodplain.

A number of dated sequences from the wider area show a notable reduction in the percentage of elm pollen during the Late Mesolithic, eg, Silvertown BH8; Union Street (Sidell *et al.* 2000), Mar Dyke (Scaife 1988) and Bryan Road (Sidell *et al.* 1995), often interpreted as signifying initial impact by Neolithic communities. These changes in the woodland composition have been found at many other sites in Britain (see Parker *et al.* 2002) occurring at a broadly similar date, with causes attributed to human clearance and/or a species specific pathogen similar to Dutch Elm Disease. Away from the floodplain a more pronounced decline in elm is recorded at Hampstead Heath (Girling and Greig 1977), showing the opening up of the local woodland associated with clearance, although the sequence is undated and changes may simply represent a discontinuous sequence (Robinson 2000, 31).

The Neolithic in the Lea Valley is recorded in five sequences, at Silvertown BH8 and Fort Street (Crockett *et al.* 2002), Victoria Dock Road (Barnett *et al.* 2010) and St Luke's Square (Wicks 2008) as part of the extensive Thames III peat deposits, and in the channel deposits from Temple Mills Depot. These all show a continuation of alder domination in the wetland areas with oak, hazel and lime abundant upon the dryland. Also noteworthy are traces of yew (*Taxus baccata*) woodland which is

Figure 8.5: Comparison and correlation of radiocarbon dated pollen sequences from in the lower Lea and Lea/Thames confluence (see Fig. 8.3 for locations). Radiocarbon dates and/or pollen sequences less certain in their correlation are indicated. For example, at Omega Works the basal pollen sequence is clearly of GS-1/Early Holocene date, yet the associated radiocarbon date (Wk-16736) was much later and therefore are plotted apart on the diagram. A generalised pollen diagram is shown on the left of the diagram indicating the abundance (relative percentage) of the main pollen types at different dates within GS-1/Holocene. A full list of radiocarbon dates and sources is given in Table 8.3



associated with wetland areas at the time, recorded in low percentages at Silvertown BH8, though found to be very abundant at many Middle Thames Estuary sites (Carew *et al.* 2009; Meddens and Sidell 1995; Branch *et al.* 2012), and similar contemporary wetland deposits in north-west Europe (Deforce and Bastiaens 2007).

Changes in woodland cover and the nature of sedimentation

Lime was an important constituent of the mid-Holocene woodland cover of lowland England, and decreases in its presence can be observed from many pollen sequences in the lower Thames area and sites along the River Lea (eg, Yabsley Street, Coles *et al.* 2008 and Silvertown BH8, Wilkinson *et al.* 2000). This decline is generally associated with increases in cereal-type pollen and associated ruderal pollen taxa, leading to frequent interpretations of woodland clearance associated with the adoption of arable production. However this interpretation may be incorrect, since Waller and Grant (2012) have shown that large Poaceae pollen grains from two sites in the lower Thames (Rainham and Aveley marshes) were actually derived from wild wetland grasses (eg, *Glyceria*, sweet-grasses) rather than cereals, reflecting an increase in open areas within the wetland.

They also showed that these apparent changes in the pollen assemblage were often located at the top of the thick peat deposits when there was a gradual expansion of estuarine conditions and lateral expansion of the wetland in the middle and inner Thames estuary during the Bronze Age, combined with the local replacement of fen woodland by open wetland communities, leading to the observed reduction in woodland taxa. These major pollen stratigraphic events generally occur in advance of the construction of wooden structures (including many trackways predominantly located along the northern edge of the lower Thames; Meddens 1996), with the archaeological evidence consistent with humans creating access routes across the wetland probably to exploit the open areas available, notably for pastoral activity (eg, Meddens 1996; Carew *et al.* 2009). Although the pollen records from these wetland areas are of limited use for understanding changes occurring on the dryland areas at this time, the archaeological record does show that by the Late Bronze Age the number of sites on the terrace gravels had significantly increased, with arable cultivation likely to have been a component of a mixed-farming economy, resulting in a general reduction of woodland cover (Guttmann and Last 2000; Yates 2001).

Reconstructing the palaeoenvironmental history of the area during the Late Bronze Age/Iron Age is hampered by the end of extensive peat formation in the Thames Estuary (Fig. 8.5) combined with the switch to floodplain/river channel alluvium. By the Middle/Late Iron Age, flooding had begun in some sites, and alluviation began in earnest in the Late Iron Age/Romano-British period. These changes appear to reflect a response to human activity, in addition to climate change and a change in the river drainage gradient due to sea level rise. A reduction of woodland cover accompanied by agricultural activity would have helped raise water tables and increase movement of sediment into water courses. A further, more significant phase of alluviation is recorded across the whole of the country, and spans the entire Romano-British period (Macklin and Needham 1992; Macklin and Lewin 1993).

A series of short dated/phased sequences from the local area, such as Crown Wharf Ironworks, Stratford Box, and the Ikea Site, show a largely open environment by the Romano-British period, with limited woodland cover. To what extent such open landscapes were restricted to lower-lying wetlands is difficult to ascertain. The *Domesday* survey, through the recorded areas of pannage available for swine, indicates a number of surviving woodlands

Figure 8.6:
Location of Trenches and Areas mentioned in the text, and early 19th century river channels

around the Lea Valley in the period prior to AD 1086 (*VCH* 1973), particularly in East Ham, although such woodlands may have been subject to considerable change. For example, a pollen record from Lodge Road, Epping Forest (Grant and Dark 2006) showed a change in the use of woodland dated cal AD 20–220 (OxA 15767, 1903±29 BP) with increased pastoral activity during the Romano-British period leading to a change from lime dominated woodland to wood pasture, with beech (*Fagus sylvatica*) and hornbeam (*Carpinus betulus*) now important components in that area.

Palaeoenvironmental Sampling

The principal aim of the palaeoenvironmental research was to provide an understanding of the origin and development of the Olympic Park site during the Late Quaternary, including the general evolution of the landscape (including site-specific processes), and to provide a framework for investigating the interaction of humans with the changing environment.

Sample selection

The large number of trenches excavated across the site, and the wealth of environmental samples collected (both monoliths and bulk sediment samples), has meant that only those samples with the highest potential were selected for investigation. The available reports and fieldwork archives from the evaluation and excavation stages were assessed, with sequences classified according to likely date, associated archaeology, the nature of sediments, and the degree of preservation of organic material. Sequences were selected to cover as wide a temporal and spatial range possible, and to reflect the different sedimentary environments preserved on the site. This was carried out in conjunction with the results of the deposit model, by which the distribution of palaeochannels, the thickness and nature of the alluvium, and amount of truncation by made ground, helped identify areas of high potential. Samples were considered, therefore, both for their individual sedimentary record and how they contribute to understanding the development of the site as a whole. On this basis, 31 trenches with suitable samples, and accompanying records and radiocarbon dates, were selected for geoarchaeological and palaeoecological investigation (Fig. 8.6).

While trenches were initially selected for further analysis, in part based upon radiocarbon dates obtained during Phases 2 and 3a, it became evident with further targeted dating, comparison of the pollen and plant macrofossil assemblages, and general site-wide comparisons, that the reliability of many of these initial dates needed to be treated with caution (see below).

Techniques applied for each sequence/sample varied depending based upon recommendations made during initial assessment. Following sediment descriptions, each sample was sub-sampled for pollen, diatoms, ostracods, molluscs, waterlogged plant remains, soil micromorphology and/or radiocarbon dating as appropriate. Assessments were made of the content of the processed flot and residue from the bulk samples for subsequent analyses of insects, molluscs and waterlogged plant remains, and radiocarbon dating; if appropriate further samples were processed.

Methods

Sediment description and micromorphology

Where more detailed assessment and/or analysis of the sediments was undertaken, the relevant monoliths samples were described according to Hodgson (1997). Interpretations regarding mode of deposition, formation processes, likely environments represented and potential for palaeoenvironmental analysis were then made, and decisions taken regarding subsampling.

Soil micromorphology was undertaken on samples from Trench 24 to understand the formation process of the soil found there associated with Middle Bronze Age archaeological features. Monolith subsamples were impregnated with a clear polyester resin-acetone mixture prior to curing and slabbing for very rapid 75 x 50 mm size thin section manufacture (Goldberg and Macphail, 2006; Murphy, 1986). The thin sections were described, ascribed soil microfabric types and microfacies types, and counted according to established methods (Bullock *et al.* 1985; Courty 2001; Courty *et al.* 1989; Goldberg and Macphail 2006; Macphail and Cruise 2001; Stoops 2003).

Waterlogged plant remains

Samples of 5 litres were processed by laboratory flotation, with the flots and residues retained on 0.25 mm mesh sieves. Waterlogged plant macrofossils were identified following the nomenclature of Stace (1997), quantified, and the results tabulated. Where absolute counts were not possible within particularly rich samples, a general scale of abundance has been applied. In order to compare assemblages between trenches all counts were turned into a general scale of abundance, then converted to weightings. Species preferences for ecological habitats were then categorised using a simplified system of that given in *PLANTATT* (Hill *et al.* 2004). For each sample, the representation of each habitat type was calculated by adding the weightings given for each species associated with that habitat. Where species were only identified to genera that contained species with varying preferences, the weightings were divided equally amongst those represented habitats. The total values were then added for all the samples within each period and percentages of values for each habitat calculated (Figs 8.27 and 8.33, below).

Insects/beetles

Selected samples were subject to paraffin flotation as outlined in Kenward *et al.* (1980). Insect fragments were identified with reference to modern entomological collections, and the results tabulated. Taxonomy follows that of Lucht (1987).

Molluscs

Five litre waterlogged samples were examined for mollusc remains, following standard methods (Evans 1972). Nomenclature follows Kerney (1999). Results were tabulated and displayed in histograms. Some species were grouped upon the histogram, while *Vallonia pulchella/excentrica* was classified within the marsh species group rather than with the open country species. The ratio of *Bithynia* apices to opercula was also plotted. Ecological preferences follow Evans (1972), Kerney (1999) and Davies (2008).

Pollen

Pollen preparation followed standard methods (Moore *et al.* 1991) with *Lycopodium* tablets (Stockmarr 1971) added to calculate pollen concentration, and silicone oil used as the mounting medium. Pollen and pteridophyte spores were identified using the reference collection held at Wessex Archaeology. Nomenclature follows Bennett (1994) for pollen/spores, whereas Poaceae were classified according to Küster (1988). Plant nomenclature follows Stace (1997). For analysis, a total land pollen (TLP) sum was used based upon a minimum of 400 grains excluding pteridophytes and obligate aquatics. Pollen and spore data are presented using TILIA 1.7.16 (Grimm 2011), with pollen zonation produced using CONISS (Grimm 1987), resulting in a series of local pollen assemblage zones (LPAZ).

Diatoms

Diatom preparation, counting and analysis followed standard techniques (Battarbee *et al.* 2001). Diatom floras and taxonomic publications were consulted to assist with diatom identification; these include Hendey (1964), Werff and Huls (1957–4), Hartley *et al.* (1996) and Krammer and Lange-Bertalot (1986; 1988; 1991a; 1991b). Diatom species' salinity preferences are

OSL Sample	Depth (mOD) [Context]	Grain size (μm)	Moisture content	NaI γ-spectrometry (*in situ*)			γD_r[a] (Gy ka^{-1})	Ge γ-spectrometry (lab based)		
				K (%)	Th (ppm)	U (ppm)		K (%)	Th (ppm)	U (ppm)
GL08007	-0.415 [187]	18–250	0.17±0.04	0.26±0.01	1.49±0.11	0.80±0.07	0.23±0.01	0.31±0.02	1.68±0.30	0.50±0.06
GL08008	-0.33 [187]	125–180	0.23±0.06	0.79±0.02	3.40±0.15	1.92±0.11	0.57±0.02	1.24±0.06	5.37±0.42	1.25±0.08
GL08009	0.015 [193]	125–180	0.21±0.05	0.57±0.02	2.99±0.14	1.72±0.10	0.48±0.02	1.25±0.06	6.10±0.46	1.61±0.09
GL08010	0.82 [247]	125–180	0.22±0.16	0.64±0.02	4.78±0.18	2.31±0.18	0.64±0.03	1.01±0.05	6.95±0.53	1.50±0.09
GL08011	1.085 [219]	125–180	0.16±0.04	0.62±0.02	4.33±0.19	2.10±0.13	0.59±0.02	0.91±0.05	5.34±0.41	1.15±0.08
GL08012	1.585 [219]	125–180	0.35±0.09	0.86±0.02	5.44±0.20	2.20±0.13	0.72±0.03	1.43±0.07	10.77±0.61	1.57±0.09

OSL Sample	βD_r[b] (Gy ka^{-1})	Cosmic D_r[c] (Gy ka^{-1})	Total D_r (Gy ka^{-1})	D_e (Gy)	Age (ka before 2008)	Date (BC; 1σ range; rounded to nearest 10 years)
GL08007	0.25±0.03	0.13±0.01	0.61±0.03	8.3±0.4	13.7±1.0 (0.8)	12,690–10,690
GL08008	0.87±0.10	0.13±0.01	1.57±0.11	21.8±0.8	13.9±1.1 (0.8)	12,990–10,790
GL08009	0.95±0.10	0.14±0.01	1.56±0.11	19.7±0.9	12.6±1.0 (0.8)	11,590–9590
GL08010	0.81±0.09	0.16±0.02	1.62±0.10	5.4±0.2	3.3±0.2 (0.2)	1490–1090
GL08011	0.76±0.07	0.18±0.02	1.54±0.08	5.2±0.4	3.4±0.3 (0.3)	1690–1090
GL08012	0.90±0.14	0.16±0.01	1.77±0.14	10.6±0.5	6.0±0.6 (0.5)[d]	4590–3390

Uncertainties in age are quoted at 1σ confidence, are based on analytical errors and reflect combined systematic and experimental variability and (in parenthesis) experimental variability alone. [a] Calculated from concentrations of U, Th and K determined by *in situ* NaI gamma spectrometry. [b] Calculated from concentrations of U, Th and K determined by neutron activation analysis. [c] Estimates obtained using the method described by Prescott and Hutton (1994). [d] Accept tentatively due to insufficient sample mass for all diagnostics

Table 8.4: D_r, D_e and Age data of OSL samples from Trench 118 (from Toms 2008)

discussed using the classification data in Denys (1992), Vos and de Wolf (1988; 1993) and the halobian groups of Hustedt (1953; 1957).

Ostracods

Sample preparation followed standard techniques. Up to 20 cm^3 of sediment was wet sieved through a 63 μm sieve to extract the coarser fraction. The fine sediment was dried and then sieved through 500 μm, 250 μm, and 125 μm sieves. Foraminifera were also noted and identified. Where possible a minimum of 50 ostracods were counted per sample. Identification and ecological interpretation followed Athersuch *et al.* (1989), Meisch (2000) and Whittaker and Hart (2009).

Quartz Optically-Stimulated Luminescence (OSL) Dating

This was undertaken on samples from a series of sandy contexts in Trench 118 (Toms 2008). In total six samples were collected in daylight from sections by means using opaque plastic tubing (150 x 45 mm) forced into each face. The results of OSL dating are summarised in Table 8.4. Sample GL08012 produced a limited quantity of datable material, restricting the range of diagnostic measurements. Full details of preparation, measurement and evaluation are given in Toms (2008) and Howell and Spurr (2009).

Radiocarbon Dating

Radiocarbon dating undertaken as part of the evaluation and excavation stages (Phases 2a and 3 respectively) used two methods: bulk sample (5–10 g of organic carbon) radiometric beta counting using the liquid scintillation method, and small sample (1 mg) accelerator mass spectrometry (AMS). Both can produce comparable age estimates but the use of AMS has the distinct advantage of directly dating individual organic remains (eg, seeds or bone) (Walker *et al.* 2001; Lowe and Walker 2000; Bayliss *et al.* 2008). However, in many situations (such as river valley sequences) it is often not possible to obtain sufficient identified organic remains to date, either due to the rapid breakdown of organic material or the high minerogenic composition of the alluvium. In these instances dating the sediments directly may be the only option.

The whole sediment sample method requires the dating of an extracted chemical fraction, humins and humic acids (Cook *et al.* 1998) to provide robust results. Humic acids are insoluble in water under acidic conditions, but are soluble at higher pH values, making them mobile in neutral/alkaline conditions and able to leach downwards (or translocate upwards) in percolating ground-waters (see Nilsson *et al.* 2001; Turetsky *et al.* 2004). The humin fraction is often taken as being more representative of a true sediment age as it is water, acid- and alkali-insoluble and therefore immobile when water levels fluctuate. However, it should be noted that both fractions originate from the decomposition of plant matter, which may include intrusive younger root material (Brock *et al.* 2011), or older in-washed/reworked carbon (eg, Dugmore *et al.* 1995; Waller *et al.* 2006), particularly if the sediments have been subject to any turbulent movement after initial formation/deposition (Xu and Zheng 2003). Therefore even if a chemical fraction is used, there is no guarantee that it will provide a meaningful date for sediment deposition. Root material producing artificially young dates when using bulk sediment samples are clear and well understood (Walker *et al.* 2001; Lowe and Walker 2000; Bayliss *et al.* 2008), with roots having been observed to penetrate up to 2 m in certain environments (Saarinen 1996). Howard *et al.* (2009) and Bayliss *et al.* (2008) have highlighted the problems of dating sediments from floodplain environments and the need for careful selection of the material used for radiocarbon dating. Most important is that decisions are based upon an understanding of the sample taphonomy and origin, the site context and geomorphology, and the reason for undertaking the dating in the first place.

Phases 2 and 3a radiocarbon dates

An initial round of dates provided a basic chronological framework for the targeting of suitable sample locations for the site-wide geoarchaeological/environmental and the post-excavation assessments (Table 8.5). All but three of the dates were obtained from bulk sediment samples (Beta-204033 and Beta-210489 from fibrous root material, and Beta-210488 from indeterminate charred material). In addition, recommendations were made during the evaluation of Trench 43 for the AMS dating of roots so that the results could be compared with pottery spot dates (Bull and Spurr 2009, 44). Furthermore, Spurr and Corcoran (2010, 33) state that some of the radiocarbon dating had been undertaken prior to advice to them and the excavators, with the result that the dates may be imprecise. For these reasons some results are treated with caution.

Further AMS dates were sought on sequences to clarify the original dating, with the majority of these being obtained from stratified discrete short-lived plant remains. In most cases the new samples returned different results from the original dates, although no consistent pattern was observed (younger or older).

For example, in Trench 21 (context 14) a radiometric date on bulk sediments provided a result of cal AD 770–1030 (Beta-213551, 1110±60 BP), while an AMS date on seeds provided a result of cal AD 1290–1420 (SUERC-24956, 580±30 BP) (Fig. 8.7). A similar discrepancy problem was noted in Trench 118 between a date on sediment (in context 210) of 1440–1220 cal BC (Beta-250600, 3080±40 BP) and one on seeds of cal AD 20–220 (SUERC-34954, 1900±35 BP). Context 210 was the upper fill of a clearly defined channel cut (600), seen in both sides of the trench. Here the later of the two results is confirmed by five further dates from material within the same channel fill (SUERC-36576–8, 34944 and 34939).

In Trench 56 a possibly wattle-lined pit was found capped by alluvial deposits (Fig. 8.8). Dating of bulk sediments from the overlying alluvium provided two dates in stratigraphic and chronological order: context

Table 8.5: Summary of the radiocarbon dating undertaken during the different phases of archaeological work on the Olympic Park

Project phase	Radiometric		AMS						Unknown method: Sediment
	Sediment	Unident. plant material	Sediment	Bone	Charred material	Timber	Identified plant material	Unident. plant material	
2 (Boreholes)	8	–	6	–	–	–	–	–	9
2 (Trenches)	6	1	4	–	1	–	–	1	–
3A	–	–	46	–	–	–	–	2	1
3B	–	–	11	–	1	–	39	–	–
5	–	–	2	15	26	15	30	1	–

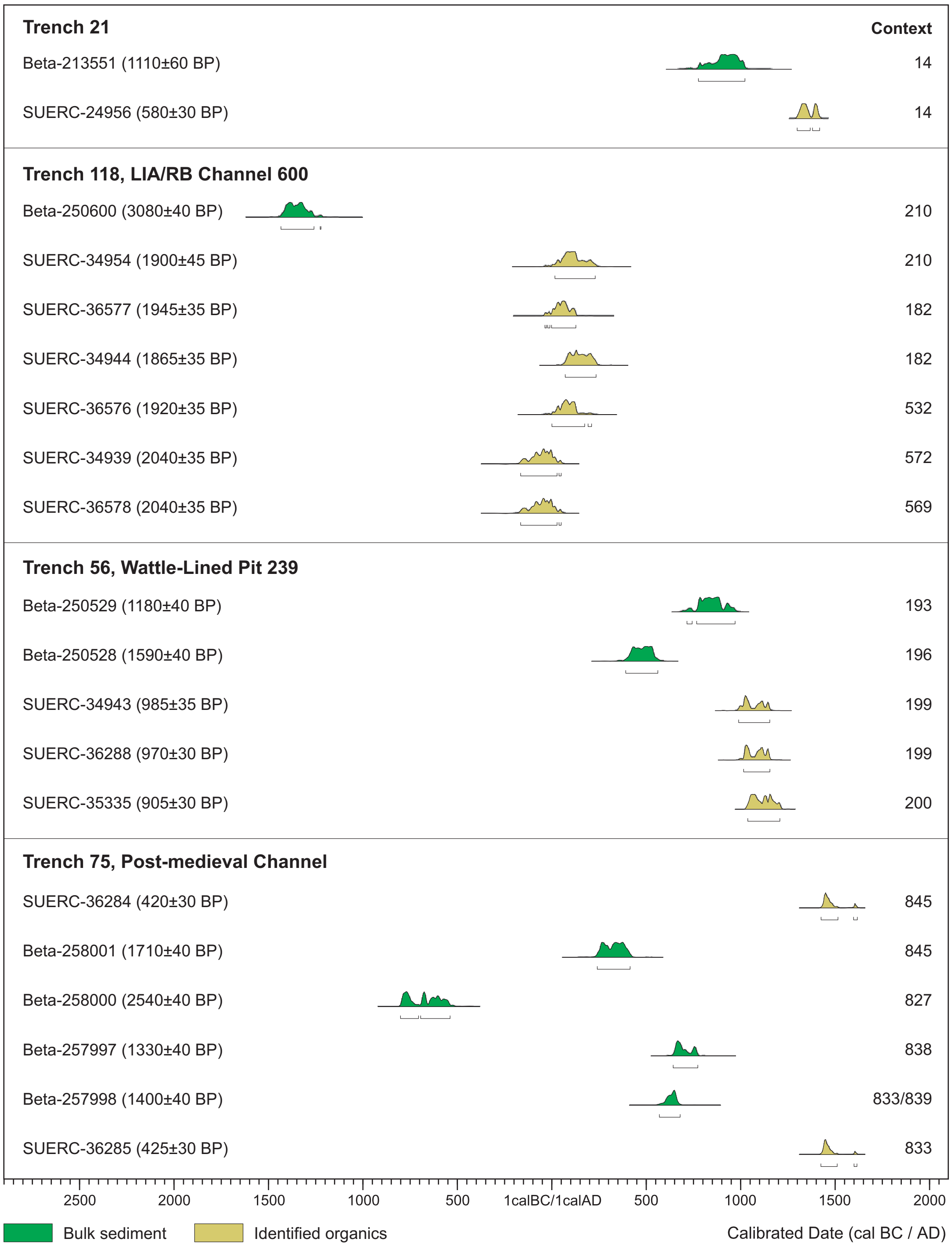
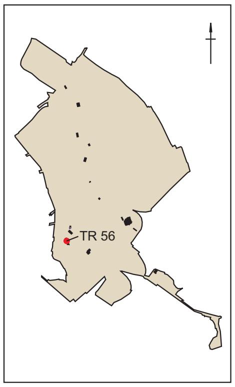


Figure 8.7: Comparison of selected radiocarbon dates derived from bulk sediments and identified plant remains from comparable features/ contexts/stratified sequences within four trenches. See text for descriptions and Fig. 8.8 for stratigraphic relationship between dates of Pit 239 and overlying alluvium from Trench 56



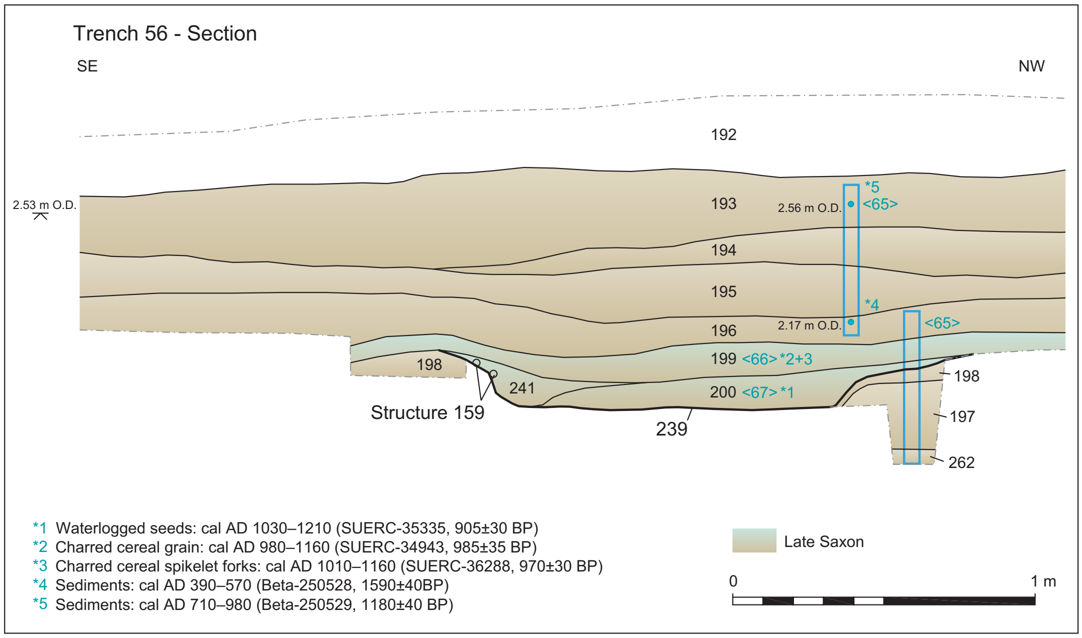


Figure 8.8: Example of problems encountered with radiocarbon dates from this study: comparison of dates from the wattle-lined pit and dates from the overlying alluvium within Trench 56

196 was dated cal AD 390–570 (Beta-250528, 1590±40 BP), and was overlain by context 193, dated cal AD 710–980 (Beta-250529, 1180±40 BP). This would suggest the pit was Romano-British or earlier in origin. However, dating of seeds in the base of the pit (context 200) gave a date of cal AD 1030–1210 (SUERC-35335, 905±30 BP) overlain by two dates upon cereal grains and spikelet forks of cal AD 980–1160 (SUERC-34943, 985±35 BP) and cal AD 1010–1160 (SUERC-36288, 970±30 BP), implying the pit is much later and of Late Saxon/early medieval date. Given the context of the pit in relation to the overlying alluvium, and the cereals came from a botanically rich assemblage, it would support the conclusion that the material dated is *in situ* and not intrusive. Similar discrepancies can be noted from other trenches when a comparison is made between dates derived from bulk sediments and identified plant remains, such as the post-medieval channel cut in Trench 75 (Fig. 8.7). Given these problems, it has been necessary to question the reliability of the dates derived from bulk sediments. Due to their low organic content, and the fact that sediments are transported within the river catchment and eroded from elsewhere, the most likely explanation for the apparently older dates is simply the inclusion of old carbon within younger depositional sequences. When the problem of younger dates from root intrusion is also introduced, it shows that the dates on sediments can be both too young or too old, resulting in the need for considerable caution if any of these are used.

Further problems may exist when dating the Late Pleistocene/Early Holocene sediments on the site. It is very probable that some of the older dates obtained from bulk sediment samples can be related to hard water error. This is especially likely given the widespread presence of stonewort (*Chara* sp.), which along with other species of sub-aquatics, is known to absorb calcium bicarbonate (originating from the calcareous geology) in order to extract the carbon dioxide it needs, and in turn precipitate calcium carbonate (Pitty 1971). The problem of erroneous results is further highlighted in Figure 8.5, where some of the radiocarbon dates appear incompatible with the stratigraphy and pollen assemblage (see also Table 8.5).

Phases 3b and 5 radiocarbon dates

During phases 3b and 5 geoarchaeological/environmental and archaeological analyses, identified plant macrofossils were targeted as radiocarbon samples for dating sequences. Such material as seeds (and in the case of *Alnus*: cones and seeds) has an unambiguous above-ground origin and where possible was selected from rich assemblages using the most common taxa present (non-submerged aquatics). In cases where only small assemblages were available, the possibility that such material may be reworked was considered. Similarly, the presence of worm cocoons and/or signs of soil formation within sediments were taken as indicators that intrusive material was more likely.

Other material dated included cremation deposits, bone, charcoal and worked wood, although in some instances sediment dates were obtained where no other material was available for dating. Some of the radiocarbon dates on bone material should also be treated cautiously. In a number of instances (notably Trench 9) the carbon-nitrogen (C:N) ratio was found to be highly variable between samples. This ratio is one of the primary indicators of the degree of preservation of bone protein (collagen) and/or contamination by soil organic substances. Recommended values for the C:N content ranges between 2.9-3.5. When higher than 3.5, the $\delta^{13}C$ value (often more negative than -24‰) may point towards extensive diagenesis or a high proportion of exogenous carbon, such as non-callogenous proteins or contamination from mobile humic acids in the soil (Stafford *et al.* 1987; Hedges and van Klinken 1992).

Calibration and results presentation

Conventional radiocarbon dates are reported in terms of years before present (BP) and are calibrated using the recommended curve for terrestrial samples, IntCal09 Northern Hemisphere (Reimer *et al.* 2009). Radiocarbon dates are quoted using the program OxCal 4.1 (Bronk Ramsey 1995; 2001) as years AD/BC, using the 2σ confidence range (95.4%) with the end points rounded outwards to 10 years (Mook 1986). Dates older than 15,000 BP are rounded to the nearest 50 years following the data spacing of the IntCal09 dataset (Reimer *et al.* 2009). All radiocarbon dates are presented in Appendix 5, and commented on accordingly where concerns (as highlighted above) may exist over the reliability of a date. All radiocarbon dates produced during previous phases of site investigation have been cross-checked against the original laboratory reports and are quoted correctly.

Deposit Model

by Michael J. Grant and David Norcott

As archaeological evaluation of deeply stratified sedimentary sequences from lowland river valleys can be problematic (eg, excessive depth of the deposits, associated high water table level and ground instability), an alternative strategy for understanding the nature of the buried landscape, and determining the placement of the archaeological excavations, is to model subsurface stratigraphy through deposit modelling.

Deposit modelling within the lower River Lea Valley has a long history (eg, Thompson 1930; Hayward 1955; 1956). At its most elemental form, deposit modelling can simply be the grouping together of individual sedimentary or lithological units with similar characteristics within a particular borehole. These are then correlated with similar units in adjacent boreholes to provide a rudimentary sedimentary transect across a study area, resulting in a series of site-wide facies which can be considered to be representative of different depositional environments. This approach to understanding the buried deposits (and thus their archaeological potential) continues to

Project	No. of data points
Archaeological/geoarchaeological excavations	35
British Geological Survey (GeoIndex)	872
CrossRail (Pudding Mill Lane)	65
High Speed 1 (Temple Mills Depot and Stratford Box)	125
Olympic Park (Olympic Delivery Authority)	3235
Westfield Stratford City/Olympic and Paralympic Village	740

Table 8.6: Data points used in the Olympic Park deposit model (Fig. 8.9c)

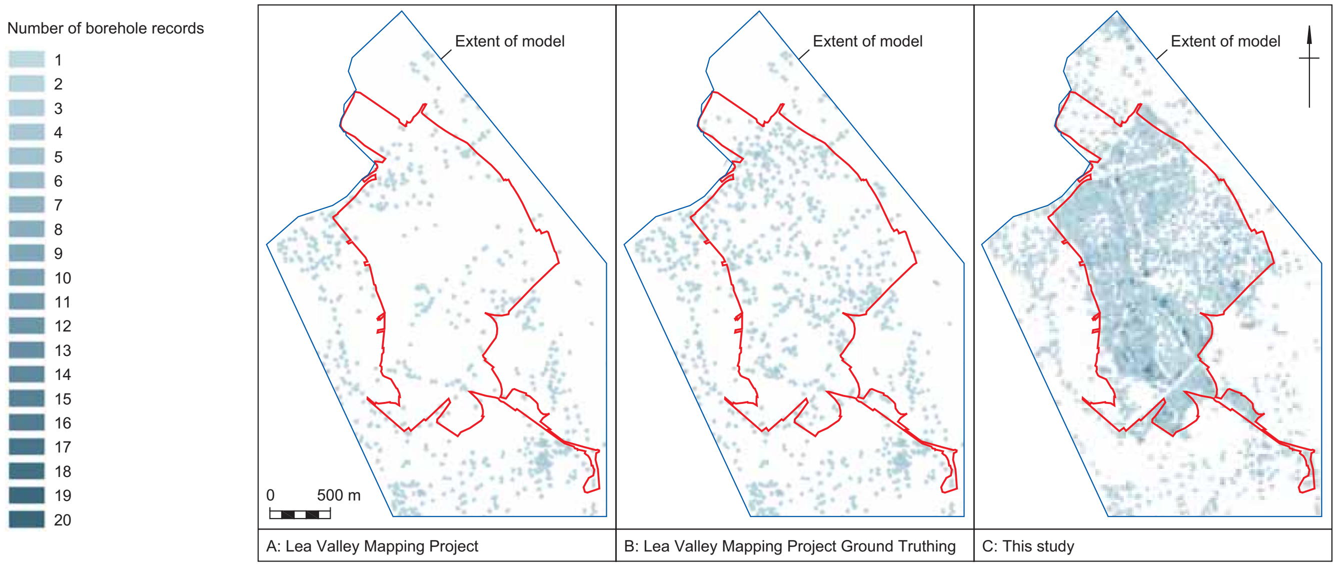


Figure 8.9: Comparison of the data point coverage within the three main deposit models for the site and adjacent area: a) Lea Valley Mapping Project (Corcoran et al. *2011); b) Lea Valley Mapping Project Ground Truthing (Corcoran* et al. *2011, chapter 14); c) this study*

be widespread in commercial archaeology (eg, Bates and Stafford in press; Stafford in press), with several sites often subject to multiple phases of similar investigation to help improve the understanding of the buried sequence: eg, Deephams Sewage Works (Hayward 1956; Champness 2010). However, such transects can be potentially misleading as it is rare that a borehole transect across an area is ever in a perfectly straight line, as they will usually undertake some path deviations to join available data points, leading to the creation of artificial features. Furthermore the interpretation of transects will tend to assume that the features of interest, such as palaeochannels, will be intersected perpendicularly, whereas often they will be intersected at an oblique angle and thus their dimensions and profile distorted. For this reason it is important to visualise these different stratigraphic units within a three-dimensional framework, such as a series of intersecting transects, or preferably a three-dimensional deposit model. These allow the spatial variation in deposits and buried features to be explored in greater detail than is possible simply by studying single borehole transects. More sophisticated models can now be achieved with the availability of increased computing power combined with software designed specifically for visualising and interrogating geotechnical data (Royse *et al.* 2006; 2012). However, in many cases these models are still limited by their spatial constraints, so it was not possible to trace the origin of features such as palaeochannels beyond the development footprint.

The first deposit model for the area covering a large spatial area was that of the Lea Valley Mapping Project (LVMP; Corcoran *et al.* 2011). This utilised *c.* 3000 datapoints from the lower Lea Valley south of the M25 covering an area of 30.5 km^2. This project provided the first overall indication of the general nature of the deposits beneath the modern floodplain, and formed the basis of the initial deposit model dealing with the Olympic Park development itself (ODA 2007e, chapter 13.4; Corcoran and Swift 2004). However, as can be seen from Figure 8.9a, only irregular and sparse data point coverage was available for the Olympic Park site in the initial stage of the LVMP, so that initial predictions based upon the LVMP were at a fairly coarse scale, with extrapolation between widely spaced data points providing a poor estimation of the actual nature of the buried deposits. Subsequently around 600 geotechnical boreholes were monitored during site investigation works, increasing the number of data points for the area to *c.* 1300 (Fig. 8.9b; Corcoran *et al.* 2011, fig. 131).

In 2009 Phase 3b (geoarchaeological assessment and analysis) was initiated. An updated deposit model was necessary to take account of the additional geotechnical work that had been undertaken on the site, and to allow integration and interpretation of the results of large-scale geoarchaeological and palaeoenvironmental analysis being undertaken. Further, as the data from the previous deposit model dataset (LVMP) was not available, it was necessary to construct a new independent deposit model for the site and surrounding area. This new deposit model combined a number of different datasets derived from recent and ongoing developments on the site and in the adjacent area (Table 8.6). The resultant revised deposit model contained over 5000 data points and shows a very dense coverage across the Olympic Park compared to the previous models (Fig. 8.9c), although beyond the Park boundary data coverage is similar as these data points are predominantly derived from the same BGS dataset.

Methods

Integrating data from separate studies into a single dataset presented considerable challenges. All datasets were checked for basic accuracies (eg, the precision and inclusion of location and datum information), and conversion was made, where necessary, to a consistent coordinate system (OSGB36). Every record was checked against the original geotechnical report. The precision of the location data was found to be variable between different datasets, and was most noticeable in the BGS data for the surrounding area where most records only had an accuracy of *c.*10 m. For the area within the Olympic Park boundary, where data point density was highest, it was decided that only data with a location precision of 0 1 m would be included. For data points outside this area the threshold for inclusion was set at 0 10 m as spatial precision (given the lower data point density) was less critical. Data also included were those derived from visual inspection of the sediments themselves (eg, trenches or boreholes). Results from purely geophysical measurements (such as Dynamic Cone Penetrometer; DCP) were omitted, as the interpretation of results from techniques such as DCP are limited in their ability to fully classify the lithological properties of the sediments and must be calibrated by correlations with neighbouring visual records (eg, window sampling). Given the high coverage of data points for the site, the use of this type of imperfect data was deemed unnecessary. Sparse and irregular data coverage from the valley to the north-west of the Olympic Park (Hackney Marsh) has meant that this has been omitted from the modelling results to prevent the displaying of misleading interpolated results.

All datasets were then checked by modelling the stratigraphic units (see below) and any apparently erroneous records (eg, spikes or stratigraphic boundaries at markedly different datum heights to the general trend of the surface) were interrogated further.

The lithology was recorded using a system of 24 defined lithological units, similar to those from the LVMP, closely conforming to standard sedimentary descriptions provided during geotechnical investigations. However, the detail of sedimentary descriptions was found to be highly variable, for example, the term alluvium was sometimes applied to all deposits overlying the basal gravels. A similar problem was encountered during the LVMP, which concluded that 'variability [in borehole descriptions] is likely to have created differences between similar deposits and made quite different deposits appear the same' (Corcoran *et al.* 2011, 27), making a model based upon variations in the lithology or attempts to reconstruct detailed facies across the site unreliable and impracticable. It was decided to take a more geomorphological approach, with lithostratigraphical units assigned to the following broader stratigraphic units.

Made ground: This occurs immediately below the ground surface over most of the Olympic Park, although its depth and composition is highly variable. Ground investigations show that much of it consists of brick and concrete rubble, ash and other industrial wastes associated with historical land uses (see Chapter 6);

Alluvium: The lithology of Holocene alluvium is variable, ranging from organic peats to clays, sands or gravel deposits;

Gravel deposits: Essentially Pleistocene in date, these gravels typically consist of flint gravel with occasional flint or sandstone cobbles with variable amounts of medium to coarse sand;

Tertiary geology: Underlying the gravel deposits are Tertiary geology deposits, predominantly London Clay and Lambeth Group (Reading and Woolwich Formations).

By assigning the lithological units into the above stratigraphic units, it was possible to model the site-wide stratigraphy for the area within the program *Rockworks* 2006, using the interpolation method of Inverse Distance Weighting. The model was able to identify the nature of the topography and thickness of each stratigraphic unit across the entire site, and to identify a number of features (and how they are spatially related), including the main channels imprinted in the gravel topography, areas of raised ground which might have been suitable for occupation, and areas that had been subject to considerable made ground deposition. Subsequently, it was then possible to interrogate the recorded lithological units from specific areas in order to gauge palaeoenvironmental potential or the specific localised depositional environment, such as peat deposits or possible sand bars. The results of the latter are not specifically illustrated here.

Additional information included in the geotechnical reports provided a general understanding of the spatial variability, composition, phases of deposition or origin of the made ground deposits. These analyses showed some spatial trends, such as brick and cement being common components across the entire site, whereas inclusions of pot are spatially constrained to the northern part of the site, coinciding with areas where large volumes of bomb damaged rubble had been deposited (Saunders 2005) and the location of areas used for land fill. Concentrations of contamination were also investigated to identify spatial patterns in the distribution of certain key elemental contaminants (including arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium and zinc), which were correlated with known industries within the area of Olympic Park.

Downcutting During the Late Pleistocene

The topography of the underlying Tertiary geology provides an indication of the nature of river flow and incision during the Late Pleistocene, when the current form of the Lea Valley was shaped (Fig. 8.10). This shows deep channel incision *c.* 100–200 m wide on the western side of the modern floodplain, within a wider topographic depression (below -3 mOD) *c.* 700–800 m wide. Due to the sparse and uneven coverage of suitable data points on Hackney Marsh, this area was omitted from the deposit model results shown in Figures 8.10–8.13. A number of tributary watercourses are also recognisable in the geological topography.

Proto-River Lea Channel (RL)

The main river channel (Fig. 8.10) appears to enter the Olympic Park area in the centre of the valley before moving to the western edge of the current floodplain close to the small outcrops of Kempton Park Gravel and more extensive Taplow Gravel Terraces (Fig. 8.1). This implies that much of the Kempton Park Gravel terrace on this side of the floodplain was scoured out by the latest phase of incision, with little remaining below the modern floodplain. Conversely, the much gentler gradient in the geological topography on the eastern margin of the floodplain suggests less erosion and therefore a great probability of preservation of the Kempton Park Gravels beneath the site. This is supported by more extensive deposits shown on the geology map of the area and OSL dating of deposits from the western edge of the Olympic and Paralympic Village of *c.* 76,000–64,000 BC (GL08006, 1σ range; Corcoran *et al.* 2011, 195).

Proto-Hackney Brook Channel (HB)

In the north-west a channel enters the site to the north of an outcrop of tertiary deposits, after which it heads south to join the proto-River Lea Channel. Its course corresponds broadly to that of the historic Hackney Brook and is clearly demonstrated by an incision through the Taplow Gravel running west from the floodplain and exposing London Clay (Fig. 8.1).

Proto-Dagenham Brook (DB) and Phillibrook Stream Channels (PS)

Two possible tributary channels also exist in the north-east of the site. The northern of these, corresponding roughly to the historic Dagenham Brook, appears to drain the adjacent terrace, cutting across the area of the Temple Mills Depot, then heading south-west to join the proto-River Lea Channel. Although not shown on recent BGS maps (Fig. 8.1), a small exposure of London Clay, similar in nature to that shown for the other tributary channels in the area, is recognisable on the Stanford's Geological Map (1878) south of Marsh Road in Leyton. A valley shown on Milne's 1800 *Land Use Map* may indicate the source of this palaeochannel.

The southern channel, corresponding roughly to the historic Phillibrook Stream (the 'PS Channel'), enters the valley slightly further south than the proto-Dagenham Brook Channel, then turns south-west before meeting the floodplain (near the historic Bully Point on Waterworks River). This channel is clearly seen on the geology map cutting through the Hackney and Taplow Gravels (Fig. 8.1), exposing the underlying London Clay and Lambeth Group geologies. As its general course also coincides with the two known finds of Arctic Bed deposits in the area – Temple Mills Pit (Warren 1915) and the dated sequence from borehole VYA/BH3 (Corcoran and Swift 2004) – it is possible that these deposits relate to this tributary rather than River Lea itself. This channel has previously been referred to as the Leyton River (Corcoran *et al.* 2011, 74).

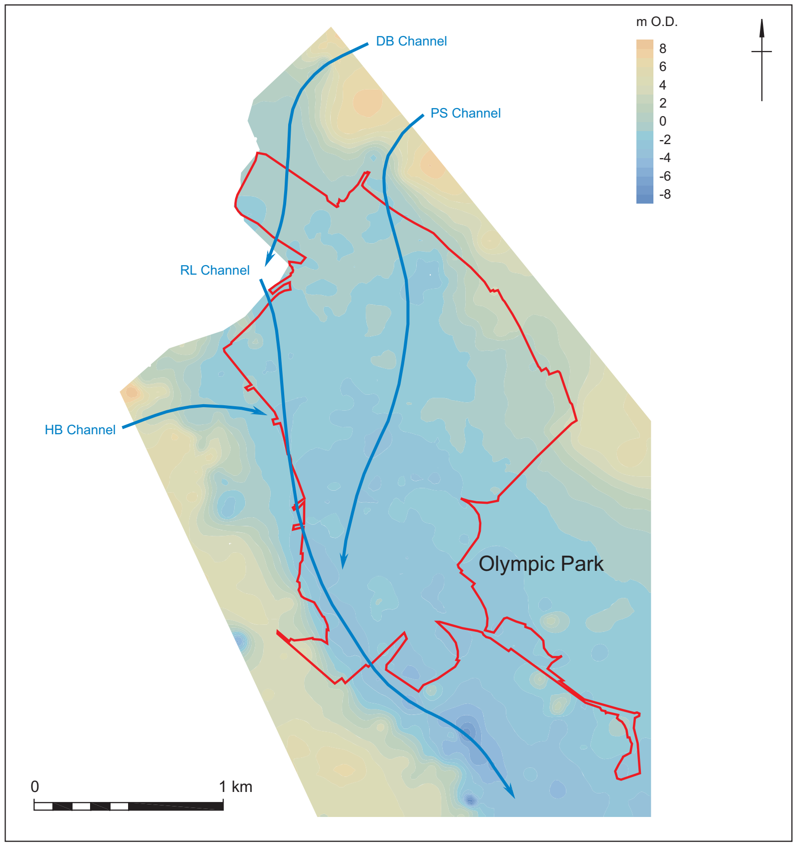


Figure 8.10: Topography of the underlying Tertiary geology deposits, showing the channel incision and erosion during the Late Pleistocene prior to gravel aggradation. Directions of possible watercourses referred to in the text are shown

Deposition of the Holocene Floodplain Gravels

The deposition of (predominantly) gravel deposits during the Late Pleistocene occurred as flood frequency and magnitude decreased and temperatures began warming. OSL dating of channel sand bar deposits (overlying the gravels) from Trench 118 provided dates of *c.* 12,690–10,690 BC (GL08007, 1σ range) and 12,990–10,790 BC (GL08008, 1σ range).

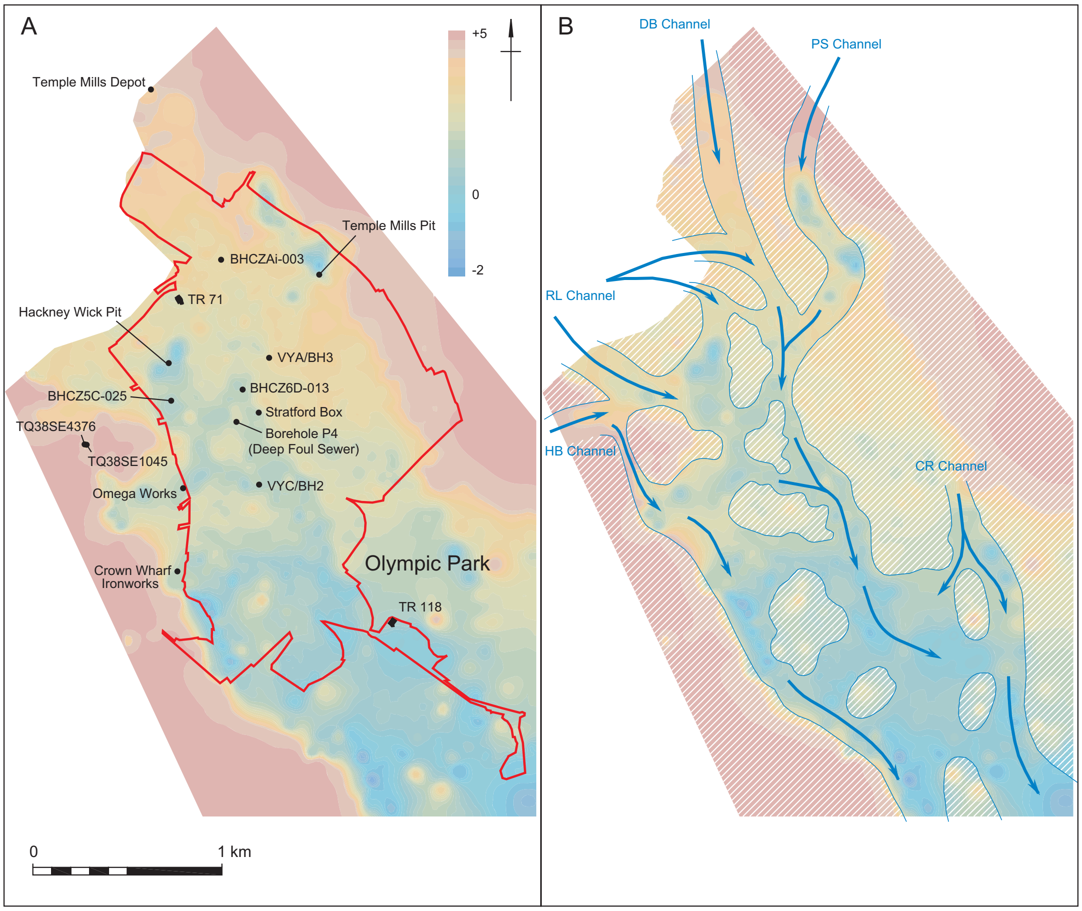


Figure 8.11:
a) Topography of the underlying gravel deposits, showing channel areas which were existent by the Late Pleistocene/ Early Holocene. Also shown are the locations of boreholes and trenches mentioned in the text
b) Annotation of the gravel topography model, identifying the main channel areas referred to in the text

It can therefore be assumed that the surface topography of the gravel deposits can be equated with the Late Pleistocene/Early Holocene floodplain landscape (Fig. 8.11), which shows a braided (anastomosing) river system separated longitudinally by elongated gravel 'eyots' (islands).

Within an earlier Holocene context, the courses of this relict river system (Fig. 8.11) should be seen as channel areas, rather than representative of single individual channels, within which there would also have been abandoned/cut off channels filling with organic and calcareous deposits, forming localised marsh and fen vegetation environments. The banks of these channel areas would have represented areas of drier ground suitable for exploitation and habitation, with easy access to riverine resources.

This pattern generally continued until later in the Holocene, when the deposition of substantial thicknesses of fine minerogenic alluvium overtopped the constraining gravel highs and enabled active channels to meander more freely across the floodplain. This sedimentation was essentially linked to the rate of sea level rise, which was sufficient to reduce the flow gradient of the River Lea and thus raise water levels. This, combined with an increase of transported fine sediments from higher up in the catchment, led to increased sediment deposition and overbank flooding.

Although some of the gravels would have been reworked during the Holocene, (eg, Corcoran *et al.* 2011, 201), or truncated by quarrying (eg, Temple Mills and Hackney Wick Pits) and construction activity, re-running the deposit model using only data points where there is alluvium recorded overlying these gravel shows no significant difference to the topography of the original buried landscape.

Proto-River Lea Channel (RL)

Evidence from data points in the Clapton Park area, to the north of the site, suggests that the RL Channel entered the study area on the western side of the floodplain close to its confluence with the proto-Hackney Brook, although two additional entry points to the east join the Dagenham Brook. These multiple channel areas reflect the generally anastomosed channel morphology (Fig. 8.11). All these channels converge on a main channel area in the centre of the site which appears to have lasted for a substantial period of time, supporting a series of Bronze Age and Iron Age settlements along its periphery (see Chapter 3 and below). Further south the river appears split into two main channel areas on the east and west of the floodplain, separated by a series of islands, although that on the west may be an earlier channel associated with the proto-Hackney Brook.

Proto-Hackney Brook (HB)

The main course of the channel enters the floodplain on the west of the site and heads east to join that of the proto-River Lea. A second channel was found to run south between the floodplain edge and a large gravel island just south of where the proto-Hackney Brook joins the floodplain. This channel is poorly represented on the deposit model, but a series of boreholes indicate a narrow channel running south, along the present route of the A12. Boreholes TQ38SE4376 and TQ38SE1045 both show the presence of organic calcareous silty clays at *c.* 0.1 m OD overlain by thick sandy clay with organic lenses. The description of the basal sediments appear to be similar to deposits found at Temple Mills Depot and Silvertown BH8, and may therefore indicate that this channel became marginalised during the late GS-1/Early Holocene. A similar pattern of early sediments is found further south at Omega Works (Spurr 2006) and Crown Wharf Ironworks (Stephenson 2008). The apparent area of raised gravels between these two sites may therefore be simply due to interpolation of dispersed datapoints, as there are none from this intersecting gravel ridge. The presence of a deep narrow channel further north and the presence of similar deposits either side of this apparent topographic high, suggest that an early channel of the Hackney Brook–River Lea extended south along the western floodplain margins, although its flow rates would have been limited during the Early Holocene, as development of fen/marsh vegetation would have occurred early in the Holocene, followed by later development of alder carr.

Proto-Dagenham Brook (DB)

This watercourse has been associated with two channels (at least one being *c.* 60 m wide) revealed in excavations at Temple Mills Depot. One was found to have filled with organic deposits during the Early Holocene, while the other may have remained active prior to marginalisation and infilling with sediments during the Middle Neolithic (Bates and Stafford in press). The deposit model shows it flowing south to join the proto-River Lea (in the vicinity of the present Quarter Mile Lane). The source of this channel may have been the same drainage feature identified in the underlying geology topography originating south of Marsh Lane. Later the Dagenham Brook is mapped by Chapman & André (1777) as following a similar course, so that name is adopted here.

Proto-Phillibrook Stream (PS)

This channel was shown to exist in the underlying geology topography and is found to follow a similar course to that of today, running south to where it enters the floodplain in the vicinity of the present Ruckholt Lane. The deposit model implies the presence of a deep channel, although this coincides with the approximate location of the Temple Mills Pit (Warren 1915; Pl. 6.3). While some of this apparent deepening is accounted for by 19th and 20th century aggregates extraction, borehole data from the Temple Mills area

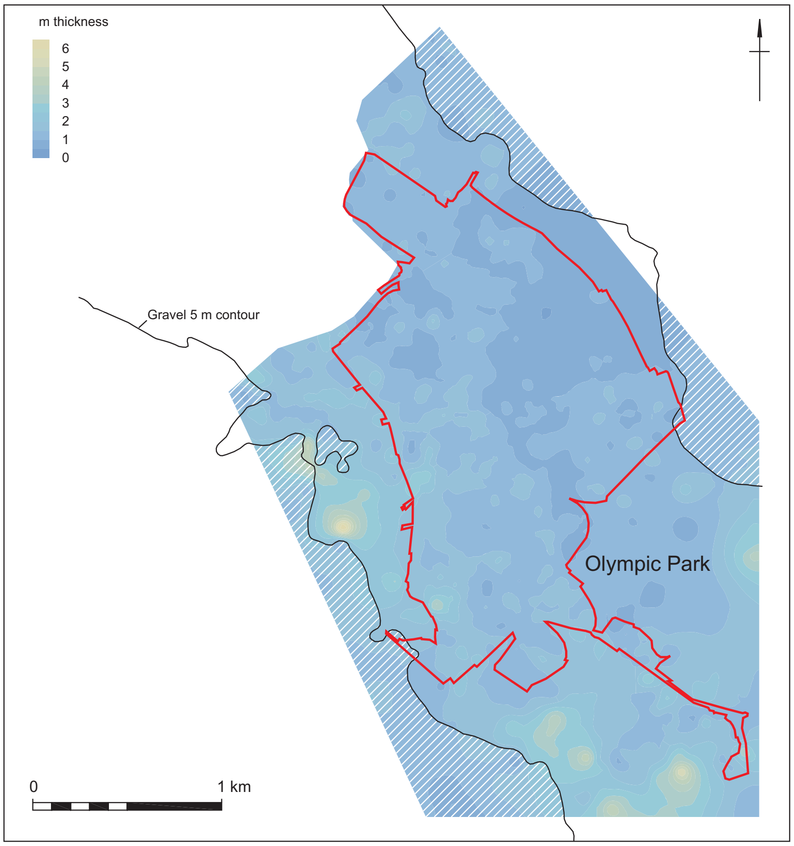


Figure 8.12: Thickness of alluvium deposits, bounded by the 5 m contour in the underlying gravel topography. Truncation and compaction by thick made ground deposits and/or minerogenic will have affected local thicknesses

(and visual recordings by Warren (1915, 70)) show that *in situ* alluvial deposits overly the gravels at this reduced elevation, implying that a natural channel runs through this area. From this point, the channel appears to turn south-west to join the proto-River Lea.

Proto-Channelsea River (CR)

Further south on the eastern side of the floodplain, several depressions in the east of the Olympic Park suggest that a south-flowing channel drained the low terrace. Although the available borehole data in the area suggest that these depressions are not related to 19th/20th century quarrying, there is a strong possibility, given the shallow nature of this gravel area that these relate to erosion by the later Channelsea River that flows along this course. Furthermore, this low gravel terrace appears to be at a higher altitude than the RL Channel to the west, so it is unlikely that these channels were connected at the start of the Holocene. However, a clear, deeper channel area can be identified flowing further to the south, again along a similar alignment to the modern Channelsea River. This appears to divide at an island in the area of Stratford Market Depot (although there is sparse data point coverage in this area), one channel passing to the east along the line of the modern Channelsea River, the other possibly flowing west towards the location of Trench 118.

Alluvium

During the Holocene, the deposition of substantial thicknesses of fine minerogenic alluvium overtopped the constraining gravel highs of the earlier topography and enabled active channels to meander more freely across the floodplain. This sedimentation was essentially linked to the rate of sea level rise, which was sufficient to reduce the flow gradient of the River Lea and thus raise water levels. This, combined with an increase of transported fine sediments from higher up in the catchment, led to increased sediment deposition, channel margin levee development and overbank flooding.

Truncation of the alluvium and compaction by the overlying made ground makes correlation of the altitude and thickness of deposits, and identification of clear channel deposits, difficult (Fig. 8.12). However, some very broad trends can be determined. The alluvial deposits generally thin towards the east, reflecting the general shallowing of the underlying gravel topography. Moreover, the distribution of organic deposits within the alluvium show a general association with the channel areas mapped in the underlying gravel topography. Organic deposits recorded overlying some of the raised areas of gravel have been found to be post-Iron Age in date, indicating that although alluviation was largely restricted to the channel areas in prehistory, during the historic period sedimentation was more widespread across the valley and had surmounted the constraints of the gravel topography.

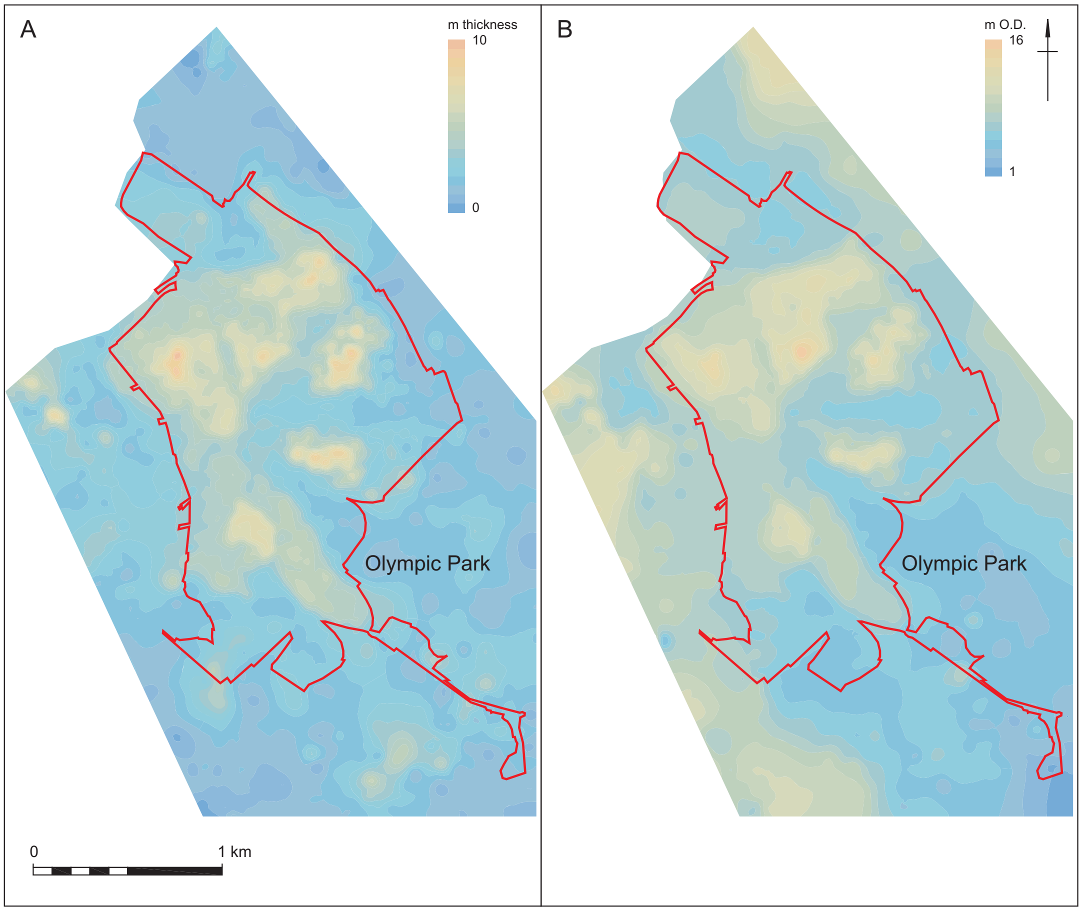
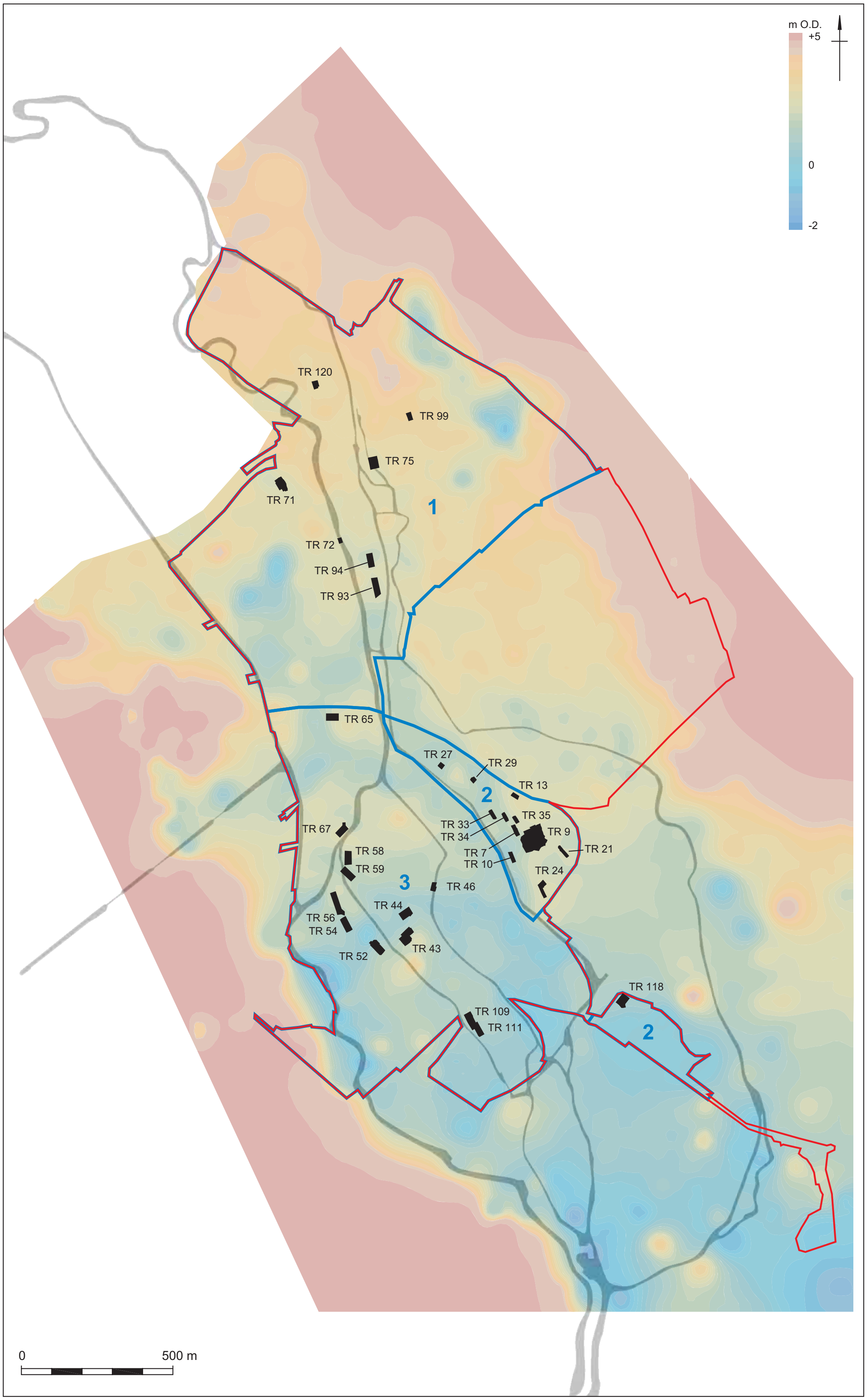


Figure 8.13:
a) Thickness and
b) surface topography of the made ground across the site

Made Ground

Modelling of the made ground deposits (prior to ground works associated with the development of the Olympic Park) shows considerable variation in thickness and topography across the area, with some deposits up to 10 m thick and reaching 16 m OD (Fig. 8.13). The deposition of the made ground would have been for a variety of purposes, such as the elevating of railway embankments above the marshes in the 19th century or for the disposal of rubble as a result of bomb damage after the World War II (Saunders 2005), or land fill. A number of clear spatial trends are apparent. The thickest deposits are generally found in the northern half of the site, situated beneath the former Eastway Cycle Circuit and Hackney Arena, the latter over the site of the former Hackney Wick Pit (Warren 1915). Thick deposits situated between the Waterworks and City Mills Rivers follow the alignment of the former railway sidings. The thin band of made ground running between the Olympic and Paralympic Village and Westfield Stratford City developments marks the alignment of the High Speed 1 development at Stratford Box, in part probably reflecting data point collection after initial ground level reduction for construction. To the south and north of the Olympic Park thinner deposits (less than 3 m thickness) of made ground are generally found, again in part probably reflecting data point collection after initial ground level reduction for construction.

Figure 8.14: Locations of the three study Areas, and trenches with analysed environmental sequences mentioned in the text, shown overlying the gravel topography and historic waterways



Results

by Chris J. Stevens, Michael J. Grant, Sarah F. Wyles, David Norcott, David Smith, John Russell, Nigel Cameron, Nicola Mulhall and Richard I. Macphail

To provide an overview of the geoarchaeological and palaeoecological results from the Olympic Park, the site has been divided into three Areas based on the spatial and temporal distribution of the sequences investigated, and the nature of the sediments (and depositional environment) they contained (Fig. 8.14). The results from each technique used have been integrated into a single narrative for each trench, and grouped together by archaeological period (see Tables 8.7-8.10). This section is a summary of the main findings, and full results (on a trench by trench basis) will be deposited with the Archaeological Data Service (ADS).

Area 1: Northern (between Temple Mills and Hackney Wick)

Material ranging from the Late Pleistocene to the post-medieval period was examined from seven trenches in this area, which lies between Temple Mills to the east and Hackney Marsh/Hackney Wick on the west (Fig. 8.14; Table 8.7). The deposit model shows it contains the confluences of four of the ancient watercourses discussed above – from west to east, the proto-Hackney Brook, proto-River Lea, proto-Dagenham Brook and proto-Phillibrook Stream.

Greenland Interstadial 1 (GI-1), Early Holocene and Mesolithic

Deposits relating to the Late Pleistocene and Early Holocene are known to be present throughout the Lea Valley (Fig. 8.5, see above), and have been found along the margins of the Olympic Park on all sides to the north at Temple Mills Depot (Bates and Stafford in press), the south-east at Stratford Box (Barnett *et al.* 2011), and the south-west at Omega Works (Spurr 2006) and Crown Wharf Ironworks (Stephenson 2008).

Trench 75

A yellow silty sand (830) at the base of the trench (see Fig. 4.13) provided a radiocarbon date of 11,180–10,780 cal BC (Beta-257999, 11,080±60 BP), although the accompanying pollen assemblage was inconclusive and poorly preserved (Scaife 2009b, 119), so the date should be treated with caution.

Trench 71

The lowest deposits (21) returned a date 10,430–9880 cal BC (SUERC-35336, 10,285±35 BP), indicating that they began to accumulate during GS-1. However, the chronology of higher up this sequence is uncertain due to apparent reversals in some of the radiocarbon dates (SUERC-35337 and SUERC-24530), although the latter, dated to 8300–8230 cal BC (SUERC-24530, 9050±35 BP) is most likely to be reliable. Dates from the top of the pollen sequence (Fig. 8.15)

Table 8.7: Summary for Area 1 (Northern Area) showing representation of material type by period and trench

Tr.	GS-1/EH	Mesolithic E	Mesolithic L	Neolithic E	Neolithic M	Neolithic L	Bronze Age E	Bronze Age M	Bronze Age L	Iron Age E	Iron Age M	Iron Age L	R–British E	R–British L	Saxon E	Saxon M	Saxon L	Medieval E	Medieval L	Post–med. E	Post–med. L
71	[diatoms] [pollen] [insects] [waterlogged plant remains]	[molluscs] [pollen] [diatoms] [insects] [waterlogged plant remains]	–	–	–	–	–	–	–	–	?	[ostracods] [molluscs] [pollen] [diatoms] [insects] [waterlogged plant remains]	[ostracods] [molluscs] [pollen] [diatoms] [insects] [waterlogged plant remains]	?	–	–	–	?	[molluscs] [waterlogged plant remains]	?	–
72	–	–	–	[pollen] [waterlogged plant remains]	[pollen] [waterlogged plant remains]	[pollen] [waterlogged plant remains]	–	–	–	–	–	–	[pollen] [waterlogged plant remains]	–	–	–	–	–	–	–	–
75	–	–	–	–	–	–	[pollen] [insects] [waterlogged plant remains]	?	–	–	–	–	–	–	–	–	–	–	–	[molluscs] [pollen] [insects] [waterlogged plant remains]	–
93	–	–	–	–	–	–	[pollen] [molluscs] [waterlogged plant remains]	?	–	–	–	–	[pollen] [molluscs] [waterlogged plant remains]	?	–	–	–	–	–	–	–
94	[pollen] [waterlogged plant remains]	[pollen] [waterlogged plant remains] ?	[pollen]	–	–	–	–	–	–	–	–	–	horse bones	–	–	–	–	–	–	–	–
99	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	[waterlogged plant remains]	[waterlogged plant remains]
120	–	–	–	[waterlogged plant remains]	[waterlogged plant remains]	[waterlogged plant remains] [insects]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

Key: diatoms; insects; molluscs; ostracods; pollen; waterlogged plant remains;
? date of sequence is uncertain and environmental material of this period may be represented; GS-1=Greenland Stadial 1; EH=Early Holocene.

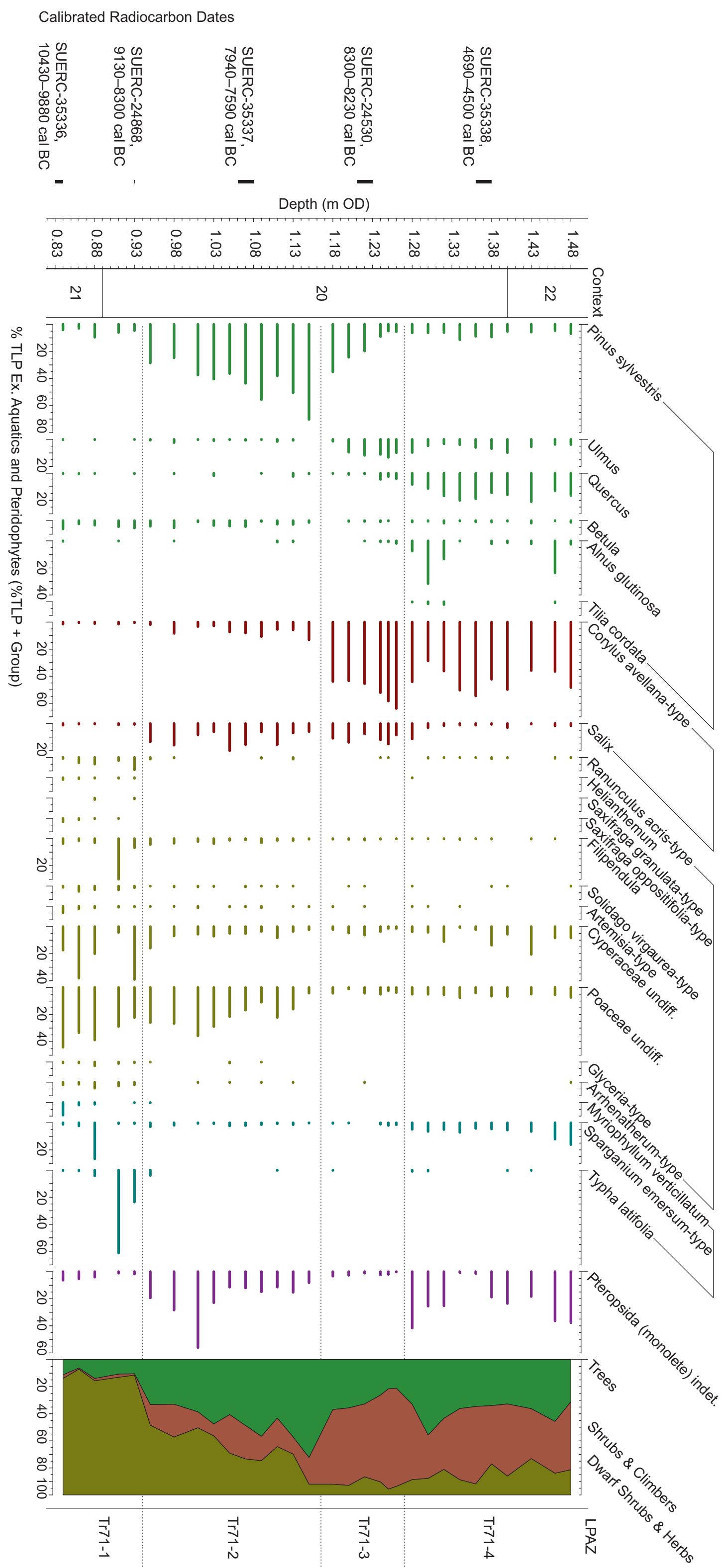


Figure 8.15: Summary pollen diagram from Trench 71, monolith 14, east-facing section

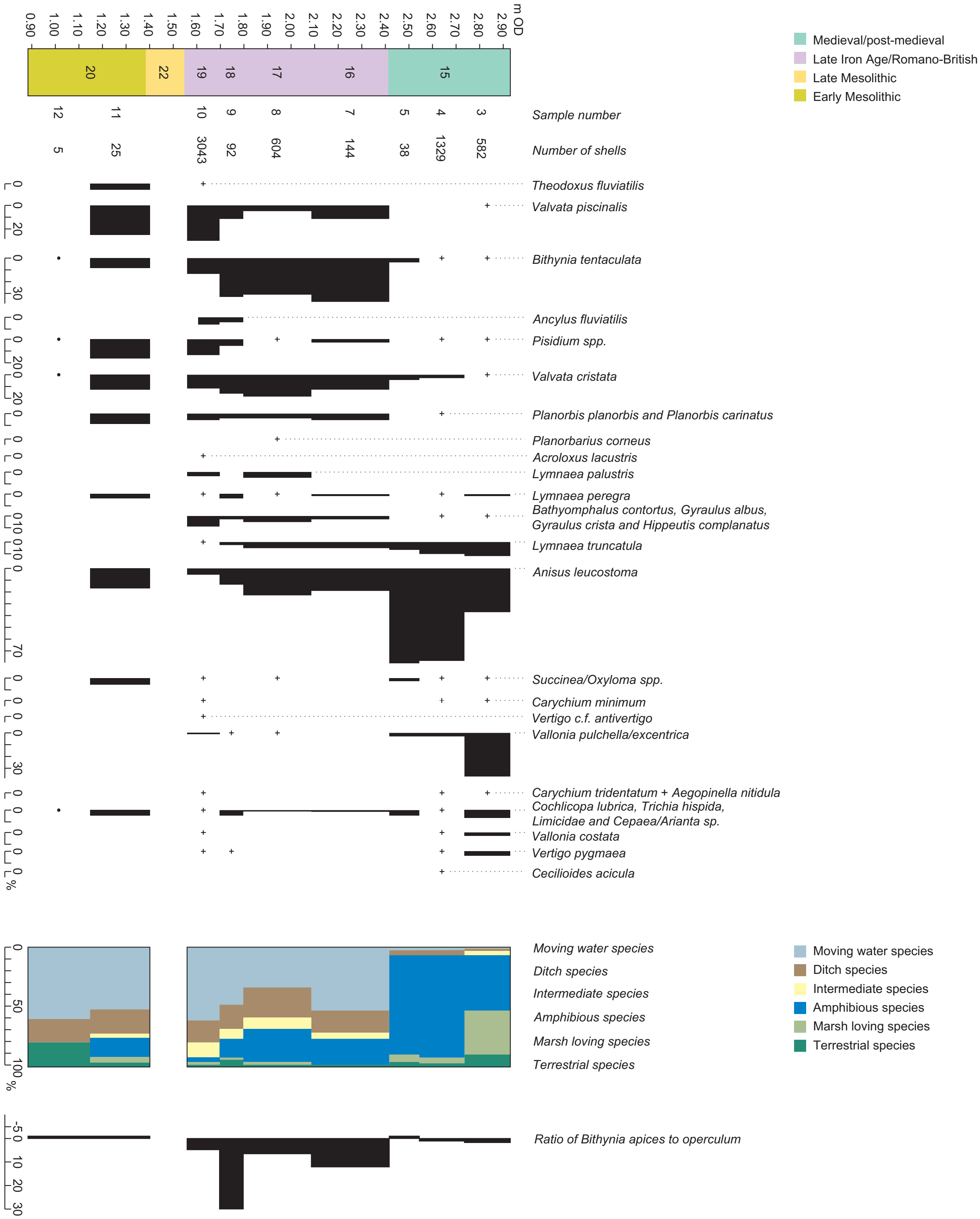
(SUERC-35328 and SUERC-35338) are also problematic, the former being clearly too young, and the latter must be intrusive, as what originally appeared to be woody twig fragments may in fact be root material. The absence of sufficient datable plant macrofossils in this sequence may be related to the drying out of the sediments at some point in the past. Based on correlations with other dated sequences in the area, the pollen assemblage suggests that the top of the sequence (context 22, LPAZ Tr 71–4) may be *c.* 7000 cal BC.

Channel

The earliest deposits (21) comprised a humic-loamy sand in a generally active channel. Despite the small amount of environmental data relating to the channel itself, it appears that it was fast-flowing and relatively unvegetated. However, as the channel became isolated from the main water flow, a range of submerged and semi-submerged aquatic species became established, including pondweed (*Potamogeton* sp.), water-crowfoot (*Ranunculus* subgenus *Batrachium*) and stonewort, along with bulrush (*Typha latifolia*), branched bur-reed (*Sparganium erectum*), water-milfoil (*Myriophyllum verticillatum*), and common club-rush (*Schoenoplectus lacustris*). The latter species is most common in very open, unshaded situations where water stands for much of the year, in cut-off chutes, or the shallows adjacent to rivers, and is less common in flowing water.

By the start of the Mesolithic the channel appears to have become isolated and increasingly vegetated, with the onset of peat formation (20) dated to around 9130–8300 cal BC (SUERC-24868, 9365±110 BP). The cut-off channel still held water, with horned-pondweed (*Zannichellia palustris*), water-crowfoot and duckweed (*Lemna* sp.) recorded. An open wet marsh environment is indicated by the presence of many sedge seeds, probably of common sedge (*Carex nigra*), and the pollen (LPAZ Tr 71–1) of common club-rush and bulrush (Fig. 8.15). Mollusc numbers are low, but suggest there was still occasional water flow through the fen, such as a small stream (Fig. 8.16).

The upper part of the sequence shows an absence of plant macrofossils, with low numbers of diatoms and ostracods indicating that the channel had dried up sometime in the Middle to Late Mesolithic, with only intermittent periods of standing water. The establishment of alder (*Alnus glutinosa*) is uneven, with the



pollen showing abundance varying through time (LPAZ Tr 71–4), possibly due to fluctuating water levels. This is supported by changes in the proportions of sedges (Cyperaceae), ferns (Pteropsida monolete indet.) and bur-reeds (*S. emersum*-type) also likely to be reflecting localised water-level fluctuations. Molluscs present, such as *Theodoxus fluviatilis* and *Valvata piscinalis,* suggest some with moving water.

Figure 8.16: Mollusc diagram from Trench 71

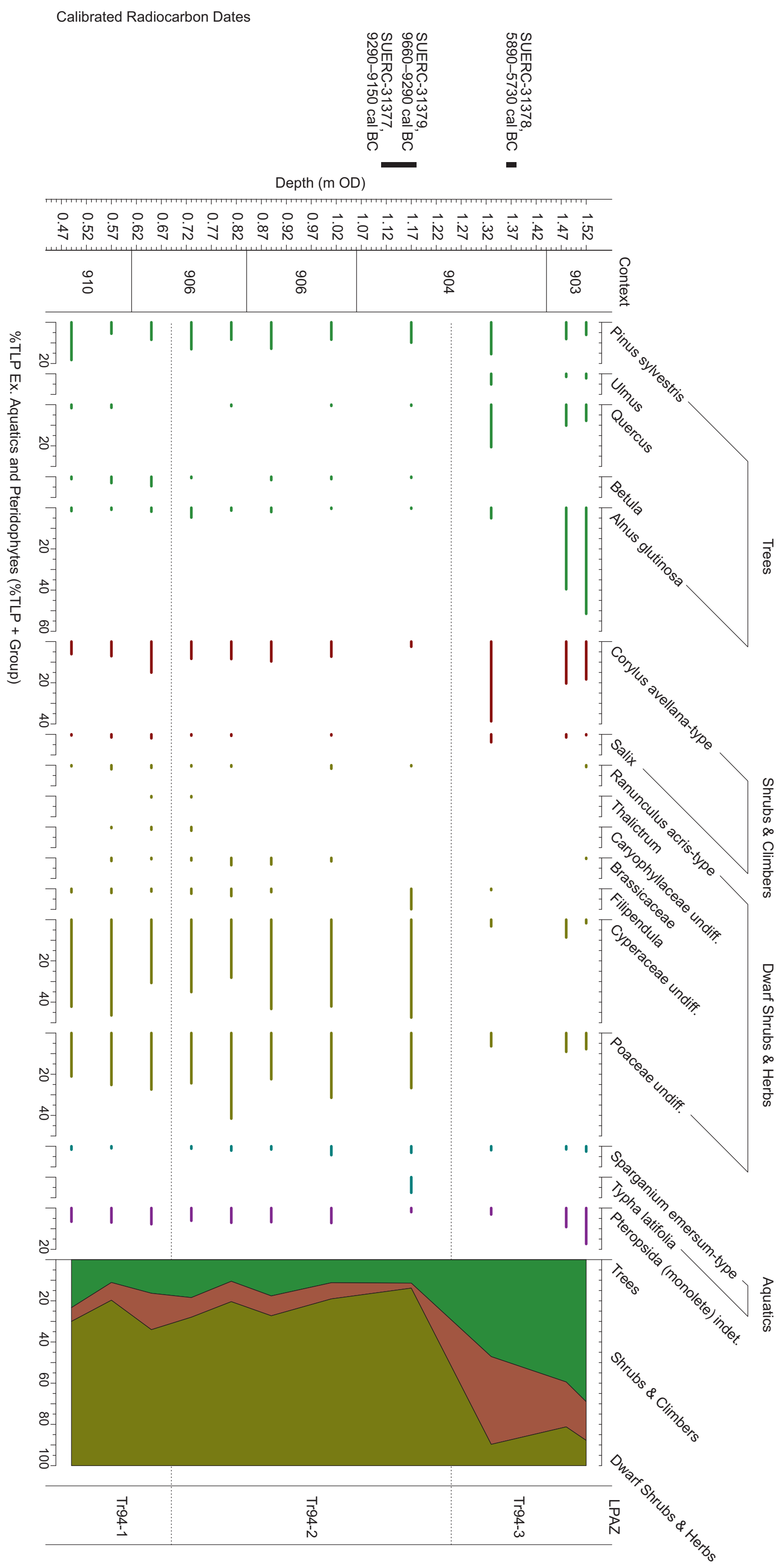


Figure 8.17:
Summary pollen diagram from Trench 94, monoliths 1, 2 and 3, east-facing section

Vegetation

At the GS-1/Early Holocene transition the environment appears to have been very open marshland (Fig. 8.15) with grasses, sedges and meadowsweet (*Filipendula ulmaria*), along with species typical of the period, such as the low growing shrubs juniper (*Juniperus communis*) and willow (*Salix*), as well as rock-rose (*Helianthemum*), purple saxifrage (*Saxifraga oppositifolia*-type) and mugwort (*Artemisia*-type). There is evidence for small stands of pine (*Pinus*) and birch (*Betula*), with dwarf birch (*Betula nana*) also probably present (LPAZ Tr 71–1). Insect remains indicate probable areas of disturbance and the grazing by large herbivores. The weevil *Notaris* characteristic of sweet-grass (*Glyceria*), coincides with abundant *Glyceria* -type pollen at the base of the sequence (LPAZ Tr 71–1).

The expansion of pine can clearly be seen dating to just after 9130–8300 cal BC (SUERC-24868, 9365±110 BP), although there is still evidence at this time for birch, with increased willow and hazel (*Corylus avellana*-type) type pollen (LPAZ Tr 71–2); there was probably still also extensive grassland, especially on the floodplain, though meadowsweet was declining.

At the end of the Early Mesolithic, 8500–7500 cal BC, there is an increase in elm (*Ulmus*) and hazel, with a reduction in pine and grassland (LPAZ Tr 71–3), although pine may have remained for a while relatively abundant on the drier margins. The channel sides became dominated by hazel and aspen (*Populus tremula*), with dogwood (*Cornus*), a common component of drier patches of former humic peaty soils, at the woodland edge. Further changes in the woodland composition occur with an increase in oak (*Quercus*), along with the initial expansions of alder, and the first record for lime (*Tilia*) (LPAZ Tr 71–4).

Trench 94

The basal dates from this trench spanned the Early Holocene to the Mesolithic, and at least part of the sequence is probably broadly contemporary with that from Trench 71. While the earliest material from context 906 yielded a date of 9660–9290 cal BC (SUERC-31379, 9945±36 BP), the underlying sediments (910) may also date from GS-1 or earlier. These sediments probably dried out, and some soil formation may have taken place, before the onset of peat formation

(904) in the Early Mesolithic, 9290–9150 cal BC (SUERC-31377, 9735±35 BP). The final date suggests peat formation may have continued until the Late Mesolithic, 5890–5730 cal BC (SUERC-31378, 6935±30 BP), although this date, obtained from bulk sediment, may be problematic as the sequence shows significant bioturbation *c.* 0.2 m below its level, perhaps associated with further drying of the deposit.

Channel

A sequence of calcareous fine sediments, dated to the Early Holocene, were interpreted as representing channel edge deposits, later overlain by mud and showing signs of wetting and drying. There are few plant macrofossils from these lowest deposits, but it is possible that the *Corylus avellana*-type pollen recorded (Fig. 8.17; LPAZ Tr 94–1 and –2), rather than being intrusive, may indicate bog myrtle (*Myrica gale*), a plant characteristic of boggy habits subjected to drying or peaty soils. Similarly, the alder pollen may indicate grey alder (*Alnus incana*).

These deposits were overlain by Early Holocene peat, probably associated with a reed bed. The channel appears to have been relatively well vegetated with ample evidence for water-crowfoot, common club-rush and water-plantain (*Alisma*). The absence of plant material from the upper levels, and the presence of worm cocoons, imply that after a truncation/hiatus, the deposit also dried out, potentially as late as the Late Mesolithic. However, the pollen indicates that localised wetland vegetation persisted, with evidence for sedges, and bur-reeds along with willow and alder. The peat was overlain by alluvium, which, if of Late Mesolithic date, represents the end of peat formation at this time.

Vegetation

In the Early Holocene there was open sedge-grassland beyond the channel, with some open pine and birch woodland (LPAZ Tr 94–1). Unlike in Trench 71 (above), there was less evidence for taxa typical of the colder conditions suggesting that the sediments in this trench began to form at a slightly later date, in keeping with the radiocarbon dates. However, subsequent changes just above the base of the sequence (LPAZ Tr 94–2), such as reductions in birch and willow and increases in meadowsweet, willow and buttercup (*Ranunculus*) are more comparable with Trench 71. These were accompanied by increases in seeds of thistles (*Carduus*), and water-edge fen species, such as gypsywort (*Lycopus europaeus*) and mint (probably *Mentha aquatica*).

The presence of charred material, albeit in limited quantities, in particular of stems and seeds of Cyperaceae, may indicate natural or deliberate burning; similar charred remains have been noted in Early Mesolithic sequences at Uxbridge (Wessex Archaeology 2006; Lewis and Rackham 2011). Pollen from the top of the sequence (LPAZ Tr 94–3) indicates that hazel, oak and elm had all become established, with alder also expanding in the local area.

Neolithic

Trench 72

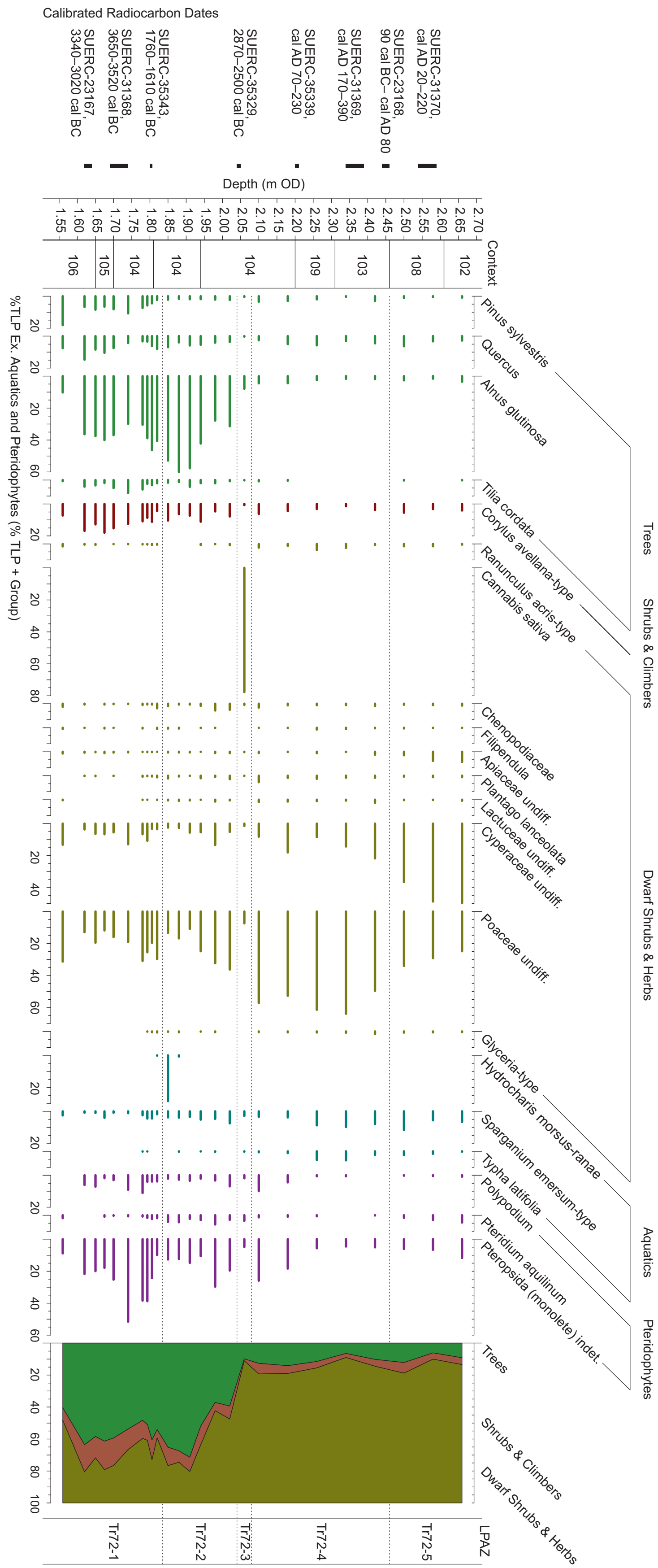
The basal sediments, dated to the Early–Late Neolithic, were followed by a hiatus which saw some drying out of the sediments.

Channel

The sediments overlying the basal gravels indicate an active channel, with an organic mud probably related to a period of lower energy conditions. The pollen (Fig. 8.18; LPAZ Tr 72-1 and -2) indicates wetland sedge-grass flora, along with bur-reeds, the latter increasing towards the end of the Neolithic, perhaps associated with increased wetness. Despite the absence of waterlogged plant macrofossils and molluscs in the lower part of the sequence, it seems likely that the deposit dried out sometime between the Early Bronze Age and Romano-British period.

Vegetation

Pollen evidence shows the dominance of alder carr on the floodplain during the Neolithic, although with a significant grass-sedge community and evidence for ferns, particularly at the beginning of the sequence. At the start of the sequence there is evidence for dry land taxa such as lime, oak, elm, hazel and low amounts of pine (LPAZ Tr 72–1), with seeds of elder (*Sambucus nigra*) attesting to woodland edge scrub. This pattern continued into the Late Neolithic, although the wetland vegetation saw increases in taxa indicative of open marsh condition, particularly sedge-grassland, due to changes in local hydrology.



Trench 120

A number of intercutting tree-throw holes of possible Neolithic to Bronze Age date were identified, bulk samples from two of which contained large amounts of organic material. Alder cones and elder seeds from tree-throw hole 25 were dated 3630–3190 cal BC (NZA-32944, 4628±40 BP), while whole hazelnuts from the tree-throw hole 21 were dated 2580–2340 cal BC (NZA-32943, 3960±35 BP). Baked clay (daub) was also found in tree-throw hole 21, along with undated struck flint (Pooley *et al.* 2008). No samples from this trench were suitable for pollen analysis.

Channel

The deposit model suggests that the proto-Dagenham Brook flowed close to this trench. The presence of tree-throw holes, filled, and sealed by, an organic alluvium, suggests that woodland at first grew on relatively dry stable river banks, possibly even away from the channel, but that by the Middle–Late Neolithic the channel had become more active with increased flooding and alluviation. Comparatively few aquatic species (water-plantain and water-crowfoot) occurred in the Late Neolithic tree-throw hole.

Vegetation

Both samples produced ample evidence for local alder woodland with little evidence for open terrestrial or indeed open channel conditions. Species associated with woodland edge, scrub and rough sedge-grassland were present, including bramble (*Rubus* sp.), greater stitchwort (*Stellaria holostea*), bugle (*Ajuga reptans*), buttercup and sedge suggest more open vegetation lining the channel edge. The more open elements were most common in the Early–Middle Neolithic, including common nettle (*Urtica dioica*), and elements indicative of marshy wet grassland such as marsh-marigold (*Caltha palustris*) and buttercup, and woodland edge such as common hemp-nettle (*Galeopsis* cf. *tetrahit*). The Late Neolithic sample had more indicators of wooded scrub, such as three-nerved sandwort (*Moehringia trinervia*), elder and wood sorrel (*Oxalis acetosella*), although gypsywort and ragged-robin (*Lychnis flos-cuculi*) would grow in the herb layer at the edge of alder carr.

Figure 8.18 (left): Summary pollen diagram from Trench 72, monoliths 1,2 and 3, west-facing section

Bronze Age

Trench 93

Two radiocarbon dates, on alder cones, catkins and seeds in the base of this trench indicate their formation in the Early Bronze Age, around 1920–1740 cal BC (SUERC-31371, 3495±30 BP) and 1900–1740 cal BC (SUERC-31376, 3510±30 BP).

Channel

The bottom of the sequence formed in an active channel, with sands and occasional organic lenses indicating periods of slower flow with flooding events indicated by strand line deposits. The mollusc assemblage, including *Valvata piscinalis*, *Bithynia tentaculata*, *Pisidium* spp., *Theodoxus fluviatilis* and *Ancylus fluviatilis*, also suggests moving water. Concurrent with the accumulation of a detrital lens in the monolith there was a decrease in the percentages of *Pisidium* spp., *Bathyomphalus contortus*, *Gyraulus albus* and *G. crista* and a rise in *Valvata cristata*, indicative of a vegetated, still-water environment. The vegetation during this period included water-plantain, arrowhead (*Sagittaria sagittifolia*), pondweeds, common club-rush, water-crowfoots, and bulrush, with some increases in bur-reeds, more typical of slower-flowing to deeper, still water.

It is probable that channel migration resulted in a cut-off with a deep, still to slow-moving water environment, in which alluvial mud was deposited. Mollusc numbers decrease at this time, with light levels increasing as local alder decreases and there is an increase in pondweeds, bulrush and bur-reeds in the pollen assemblage in the upper part of the profile, possibly in the Middle to Late Bronze Age. A hiatus is present in the top of the sequence, prior to a transition to highly organic, almost peat-like, sediments that formed in the Romano-British period.

Vegetation

In the earliest phase alder is dominant, with evidence for hazel, oak, and lime, along with ivy (*Hedera helix*), willow, elder, sloe (*Prunus spinosa*) and bramble, indicating local woodland with open patches of scrub and long sedge-grassland, including rushes and meadowsweet, probably along the channel banks. Shortly after the channel was cut off, there appears to have been an opening up of the floodplain vegetation, with an expansion of long sedge-grassland, along with nettles, buttercups, ribwort plantain (*Plantago lanceolata*), thistles and, to a limited extent, chenopods, all of which are indicative of increased disturbance, possibly relating to the use of the floodplain for pasture.

Trench 75

A peaty-clay (837) was initially dated to the Late Neolithic, 2410–2150 cal BC (Beta-257995, 3850±40 BP), although subsequent dating of alder cones from the underlying basal context (842) provided a later date of 1750–1530 cal BC (SUERC-36286, 3360±35 BP), indicating a more likely Early–Middle Bronze Age date for this sequence.

Channel

The mollusc assemblage indicates a well oxygenated, well vegetated, slowly flowing channel, possibly with marshy and damp sedge-grassland at its edges (Fig. 8.19). The waterlogged plants showed a relatively vegetated channel, with yellow water-lily, and branched bur-reed. This is supported by the insect fauna, which indicate the presence of yellow or white water-lily and duckweed (the food plants of *Donacia crassipes* and *Tanysphyrus lemnae*), along with common club-rush, sedges, and sweet-grass.

Vegetation

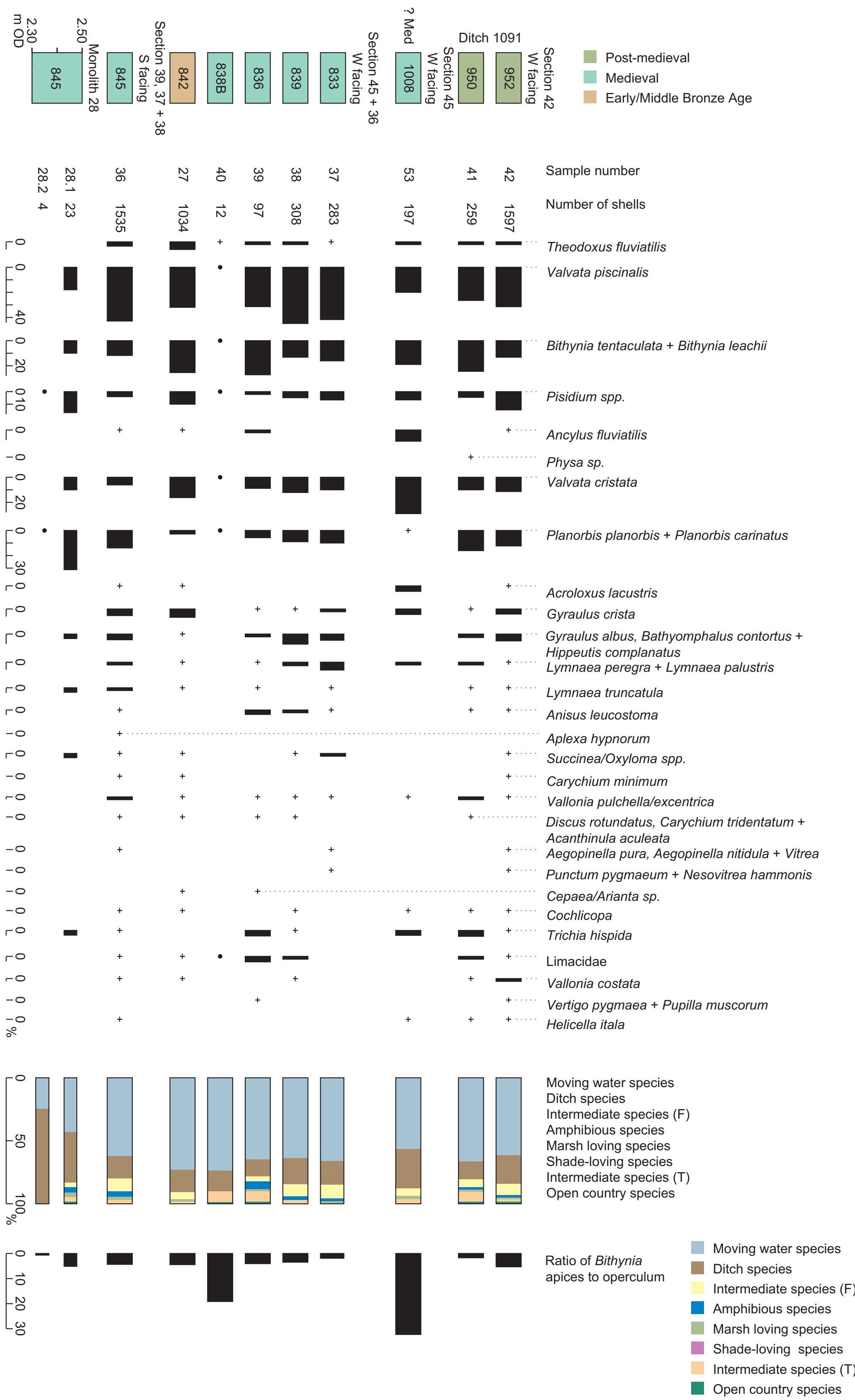
The plant macrofossils signify relatively open alder carr with areas of wet grassland, showing clear indications of disturbance, with dock, thistles, sow-thistle and hawkbit all present. The insect fauna (Fig. 8.20) demonstrates a similar environment, with *Agelastica alni* associated with alder, while *Chilocorus renipustulatus* and *Rhamphus pulicarius* are more characteristically found with willow (*Salix* spp.). Also of note was the presence of the 'bark beetle' *Dryocoetes villosus* associated with oak (*Quercus* spp.), while species such as the woodworm, *Anobium punctatum,* and the eucnemid, *Melasis buprestoides,* are indicative of deadwood.

Iron Age and Romano-British

Trench 71

A Middle Iron Age date on sediment, 400–200 cal BC (SUERC-24526, 2245±30 BP), from the upper part of this sequence, coincides with layers containing large numbers of stonewort. It is therefore

Figure 8.19: Mollusc diagram from Trench 75, showing samples from ditch 1091 and the west- and south-facing sections through the channel



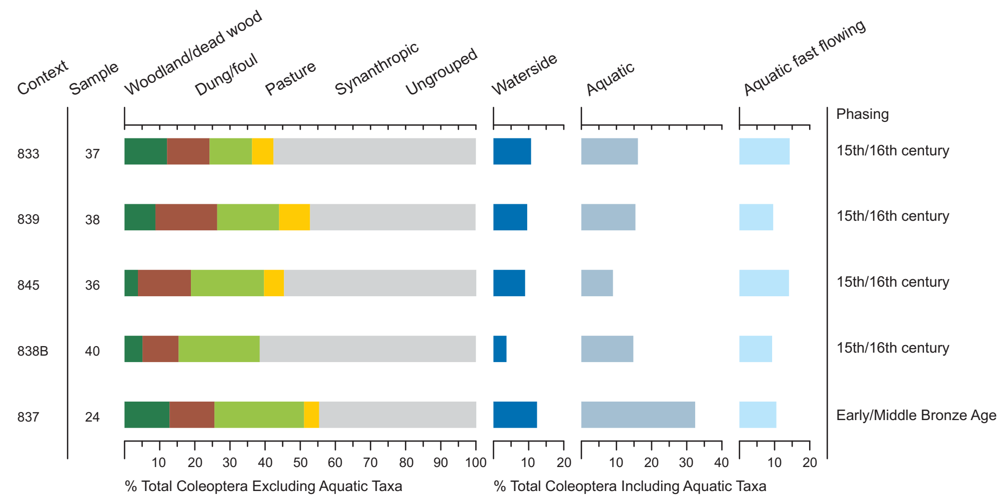


Figure 8.20: Summary of beetle fauna communities from Trench 75

possible that the date may be slightly too early, and when compared to other sequences, the sequence may be better placed in the Romano-British period.

Channel

This channel may have eroded some of the upper sediments from the top of the underlying Mesolithic sequence (see above), depositing an alluvial sand (19). A rich mollusc assemblage indicates a fast flowing riverine environment, notably through the presence of *Valvata piscinalis*, *Pisidium* cf. *amnicum*, *Ancylus fluviatilis* and *Theodoxus fluviatilis*, together with the ratio of 1:4.9 opercula to each *Bithynia* apex (Fig. 8.16).

The aquatic vegetation component was extremely rich, with many gametes of stonewort, seeds of water-crowfoot, yellow water-lily (*Nuphar lutea*), water-cress (*Rorippa nasturtium-aquaticum*), spiked water-milfoil, arrowhead, pondweed, horned pondweed, bur-reed, pollen of bulrush and large numbers of seeds of common club-rush, all indicating a probable shallow, slow-moving marginal channel environment.

This pattern broadly continued in the overlying context (18), although the molluscs suggest it formed in the shallow channel edge. The high ratio of opercula of *Bithynia* to shells suggests that the shells were allochthonous (eg, derived from more active areas of the channel). In the diatom assemblage there was a significant proportion of opportunistic taxa, such as *Fragilaria pinnata*, *Fragilaria brevistriata*, *Fragilaria construens* var. *venter*, all reflecting a shallow water habitat subject to episodes of drying out.

Vegetation

A wet sedge-grassland, with low alder values, indicate an open channel environment, with only scattered stands of woodland and isolated trees. Evidence for grazing of local grassland is suggested by pollen of sheep's sorrel (*Rumex acetosella*), ribwort plantain, Chenopodiaceae and bracken, seeds of nettle, orache (*Atriplex*), docks (*Rumex*), buttercup and thistles, and insect remains of *Sitona*, *Apion* and the dung beetle *Aphodius*.

Trench 72

Channel

Initially this sequence shows shallow water alluvium with associated vegetation, which became increasingly vegetated, probably comprising mainly common reed (*Sparganium erectum*), and led to the development of the overlying peat deposits as flow conditions subside. This marks some of the latest dated evidence for peat formation from this study, with radiocarbon dates suggesting a Romano-British date for its formation. Increased overbank flooding led to the development of an accretional floodplain soil, fed by seasonal flooding depositing fine silt and clay. Aquatic species present included fairly high numbers of seeds of horned pondweed, along with gametes of stonewort. The pollen (Fig. 8.18; LPAZ Tr 72–4 and –5) and waterlogged plant macrofossils included arrowhead, water plantain, common club-rush, water-crowfoot, bur-reed, whorled water-milfoil and bulrush, together suggest flowing water, although seeds may have been deposited during flooding events. Worm cocoons were present throughout this part of the sequence, which is in keeping with the development of the floodplain soil, and some homogenising of the deposit is likely to have occurred.

Vegetation

The overlying peat deposit formed in a very open landscape, with the high levels of grass pollen, perhaps related to the dominance of common reed (LPAZ Tr 72–4 and –5). Indications of disturbance and pasture elements, including docks, goosefoots and buttercup, probably indicate grazing. Notable throughout this part of the pollen sequence there is the constant presence of sweet-grass (*Glyceria*-type), although in many other studies from the Thames area these large Poaceae grains, often found associated with a decline in lime pollen (Grant *et al.* 2011; Waller and Grant 2012), have been classified as cereal-types and interpreted as evidence of localised arable agriculture after woodland clearance. At 2.06 m OD, dating probably to the Romano-British period, the pollen assemblage was dominated by pollen of hemp (*Cannabis sativa*). However, while it is likely it was grown in the general catchment area, the high number of pollen grains strongly suggest it derives from retting rather than being a locally grown crop (see Wyles *et al.* Chapter 7).

There was a slight increase in woodland taxa alongside the development of the floodplain soils, but this may be related to changes in the pollen source area. Sedges also increase, which again can be related to the change towards a grassland-sedge environment. Overgrown scrub elements are also present, including bramble, nettle and elder, possibly derived from vegetation growing at the edge of this marshland. Such vegetation may have quickly colonised during the formation of floodplain soils, becoming incorporated into the peat through pedological processes.

Trench 93

Channel

The sediments that formed in the top of the channel were highly organic (similar to Trench 72), and again overlain by an accretional floodplain soil. Molluscs were better preserved in this assemblage and the high numbers of *Bithynia opercula* can be related to overbank flooding.

The channel vegetation includes material from a range of sources. Seeds of sweet-grass and sedge indicate the floodplain dominance of sedge-grassland but, unlike Trench 72, no remains of common reed were seen. Seeds of water-cress were common in these assemblages, especially during the development of the floodplain soils, the species being characteristic of wet-mud and shallows at the channel edge, as is river water-droplet (*Oenanthe fluviatilis*). Club-rush and bur-reed would also have grown in such environments, the former being more common in the permanent shallows at the channel edge than on the floodplain itself. Seeds of yellow water-lily and arrowhead are more likely to have been brought in with flood events from the channel itself.

Vegetation

The very open vegetation of the early Romano-British period is similar to that in Trench 72 (Fig. 8.18). There are typical grassland or pasture weeds, including buttercups, docks and self-heal (*Prunella*), as well as fen species such as mint and gypsywort. Alder, oak and birch are still present, although they are likely to have grown in small surviving stands of woodland or as isolated trees.

Medieval and post-medieval

There was no evidence either for Saxon archaeology or environmental sequences in this area, and while there are likely to have been many sequences (or at least upper parts of sequences) associated with the medieval and post-medieval periods, the nature of the on-site sampling and problems of dating such sediments (many of which are fine-grained alluvium resulting from flooding) have resulted in the small number of the sequences discussed below.

Trench 71

Although undated it is probable that the upper samples from this trench date to the medieval (or post-medieval) period. The mollusc assemblages appear to indicate lightly grazed pasture, with areas of standing water or seasonal flooding. The plant assemblages were generally very poor due to soil formation and the drying out of the sediments, with aquatics generally absent. Most of the species, such as bramble, nettle, orache, and thistle are typical of drier, disturbed wasteland soils, and are complemented by seeds of either strawberry (*Fragaria vesca*) or barren strawberry (*Potentilla sterilis*), along with fig and a grain of free-threshing wheat (*Triticum turgidum/aestivum*).

Trench 75

Channel 846 (Fig. 4.13, above) cut through Bronze Age and Late Pleistocene/ Early Holocene sediments (see above) recorded in a north-facing section. It was filled with deposits 833 and 845 (in north- and south-facing sections, respectively), from which botanical material was dated to the 15th to 16th centuries, cal AD 1420–1620 (SUERC-36284, 420±30 BP and SUERC-36285, 425±30 BP). The botanical material included grape pips, fig seeds, possible strawberry seeds and plum stones (see Wyles *et al.* Chapter 7).

Previous dates from sediments, which clearly lie within a single channel cut, were found to be unreliable (Fig. 8.7), providing a variety of dates: contexts 829 (originally 827) and 845 (in the south-facing section) yielded dates of 810–530 cal BC (Beta-258000, 2540±40 BP), and cal AD 240–420 (Beta-258001, 1710±40 BP), respectively, while contexts 833/839 and 838 (in the north-facing section) returned dates of cal AD 570–680 (Beta-257998, 1400±40 BP), and cal AD 640–780 (Beta-257997, 1330±40 BP). It is possible that an early medieval date of cal AD 1030–1220 (Beta-257996, 910±40 BP) from context 822, through which this channel cuts, may also be incorrect.

Channel

Molluscs from the basal channel deposits suggest it contained well oxygenated, slowly flowing-water, with areas of marsh and damp grassland in the vicinity, with some fluctuations in the rate of water-flow. Waterlogged seeds included those of rigid hornwort, pondweed, common club-rush and branched bur-reed. These channel fills had large number of water-beetles, as well as species associated with sedges, and the vegetation comprised of stonewort, arrowhead, water-plantain and pondweed. The construction cut (1091) for the late 17th–mid-18th century timber-lined water channel associated with Building 2 (see Chapter 5) is likely to have been permanently wet with well oxygenated, well vegetated, slow to very slowly moving water in it. The molluscs also suggest that patches of long grass probably lined its edge.

Vegetation

The environment was drier than previously, with some woody scrub and marshy grassland, within which rushes, buttercup, and self-heal also grew. Indicators of scrub and disturbed, probably nitrogen enriched, soils include willow, hedge-parsley (*Torilis*), knotgrass, nettle, orache, stitchwort, hawkbit and sow-thistle (*Sonchus*). The pollen also indicates open environment, with sedge-grassland, including buttercup, and species associated with disturbance, such as knotgrass (*Polygonum*), docks, ribwort plantain, thistles, cornflower (*Centaurea cyanus*) and knapweed (*Centaurea*). The cereal pollen grains present probably derived from local domestic use, or processing at the adjacent Temple Mills. The insect fauna *Loricera pilicornis*, *Clivina fossor*, *Harpalus* spp., *Platynus dorsalis* and *Amara* spp. are also characteristic of open grassland and disturbed ground.

Area 2: South-East (East of Waterworks River)

The deposit model shows that most of the trenches from which sequences were examined straddle the interface between the main channel area of the proto-River Lea and gravel ridge that defines its eastern edge (Figs 3.3, 8.14; Table 8.8). The gravel ridge, which had evidence of Bronze Age and Iron Age settlement at several locations, is likely to have received only intermittent flooding or alluviation prior to the Early to Middle Iron Age, when increased overbank flooding and fine sediment deposition changed it from a predominantly dry marginal area to wet meadow and marsh. A further trench (118), to the south, lay just to the east of the main channel area, but close to a possible course of the proto-Channelsea River (see Fig. 8.11).

Tr.	GS-1/EH	Mesolithic		Neolithic			Bronze Age			Iron Age			R–British		Saxon			Medieval		Post–med.	
		E	L	E	M	L	E	M	L	E	M	L	E	L	E	M	L	E	L	E	L
7	–	–	–	–	–	–	–	–	–	–	–	–	–	–	ostracods; pollen; diatoms; insects; waterlogged plant remains	–	–	–	–	–	–
9	–	–	–	–	–	–	–	–	–	–	ostracods; pollen; insects; waterlogged plant remains	–	–	–	–	–	–	–	–	–	–
10	–	–	–	–	–	–	–	–	–	waterlogged plant remains	waterlogged plant remains	–	–	–	–	–	–	–	–	–	–
13	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	molluscs	molluscs
21	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	pollen; molluscs; waterlogged plant remains	pollen; molluscs; waterlogged plant remains	–	ostracods; pollen; diatoms; molluscs; waterlogged plant remains	–	–
24	–	–	–	–	–	–	–	molluscs	–	–	–	–	–	–	–	–	?	?	?	waterlogged plant remains; molluscs ?	waterlogged plant remains; molluscs
27	–	–	–	–	–	–	–	–	–	–	–	–	–	–	waterlogged plant remains	waterlogged plant remains	–	–	–	–	–
29	–	–	–	–	–	–	–	–	–	–	–	–	diatoms; pollen; waterlogged plant remains	diatoms; pollen; waterlogged plant remains	–	–	–	–	–	–	waterlogged plant remains
33	–	–	diatoms; molluscs; waterlogged plant remains	–	–	–	–	–	–	–	pollen; molluscs; waterlogged plant remains	–	–	–	–	–	–	–	–	–	–
34	–	–	–	–	–	–	–	–	–	?	pollen; molluscs; waterlogged plant remains	?	?	–	–	–	–	–	–	–	–
35	–	–	–	–	–	–	–	–	–	–	pollen; molluscs; waterlogged plant remains	?	?	–	–	–	–	–	–	–	–
118	ostracods; molluscs; pollen; insects; waterlogged plant remains	–	–	pollen; molluscs; waterlogged plant remains	pollen; waterlogged plant remains	pollen; waterlogged plant remains	–	ostracods; molluscs; pollen; diatoms; insects; waterlogged plant remains	ostracods; molluscs; pollen; diatoms; insects; waterlogged plant remains	–	pollen; waterlogged plant remains ?	?	molluscs; pollen; diatoms; insects; waterlogged plant remains	?	–	–	–	–	pollen; waterlogged plant remains	pollen; waterlogged plant remains	–

Key: diatoms; insects; molluscs; ostracods; pollen; waterlogged plant remains;
? date of sequence is uncertain and environmental material of this period may be represented; GS-1=Greenland Stadial 1; EH=Early Holocene.

Table 8.8: Summary for Area 2 (South-east Area) showing representation of material type by period and trench

Late Pleistocene to Mesolithic

Trench 118

A combination of two radiocarbon dates, OSL dates (Table 8.4) on channel sandbars, pollen assemblages from three sequences, and stratigraphic evidence, all indicate the survival of Late Pleistocene to Early Holocene deposits. These deposits, associated with at least two channels, appear to cover (though not continuously) an extended period of notable climatic fluctuations, from GI-1, *c.* 12,750 BC, through GS-1, 10,950–9700 BC, and into the Early Holocene, 9700–9300 BC.

Channel

The basal deposits show evidence for channel activity in the Late Pleistocene. There appear to be two channel cuts (62 and 602) directly overlying the gravel topography, but because of difficulties in establishing stratigraphic relationships across the trench it is unclear whether one or two separate phases of channel activity exist.

Deposits relating to the older of these two channels (62; Fig. 8.21) were found across the centre of the trench (contexts 601, 223, 506, 196, 197 and 198). A radiocarbon date of 3990–3790 cal BC (Beta-250294, 5110±40 BP) from context 223, obtained during the excavation phase, is clearly erroneous, as this deposit was found during later analysis to contain no organic material suitable for dating, but had significant root penetration from overlying contexts (the likely cause of the young date). In contrast, the overlying sand bar deposits (187) provided two OSL dates of 12,690–10,690 BC (GLO8007, 1σ range) and 12,990–10,790 BC (GLO8008, 1σ range) (Toms 2008). The 1σ range (68.2%) of the age estimate from the OSL dating implies channel activity during GI-1/GS-1, although if a wider 2σ (95.4%) confidence range was used, this could suggest the dates were closer in age (GS-1) to those radiocarbon dated from channel (602) (see below). Additionally, given that the spectral exposure history of the dated deposits is uncertain (nature of deposition of the sand bar and riverine conditions), the absence of an increase in natural equivalent dose (De) does not necessarily testify to the absence of partial bleaching of the grains (Toms 2008). This could mean that the OSL dates for the sand bar deposit are overestimating the burial age. Conversely, gradual migration of the channel southwards could have led to the deposition of the sands as point-bars on the inner side of the channel over a prolonged time.

The second channel (602) cut through context 506 on a similar alignment to channel 62 (albeit further south) and is therefore younger. A radiocarbon date from its

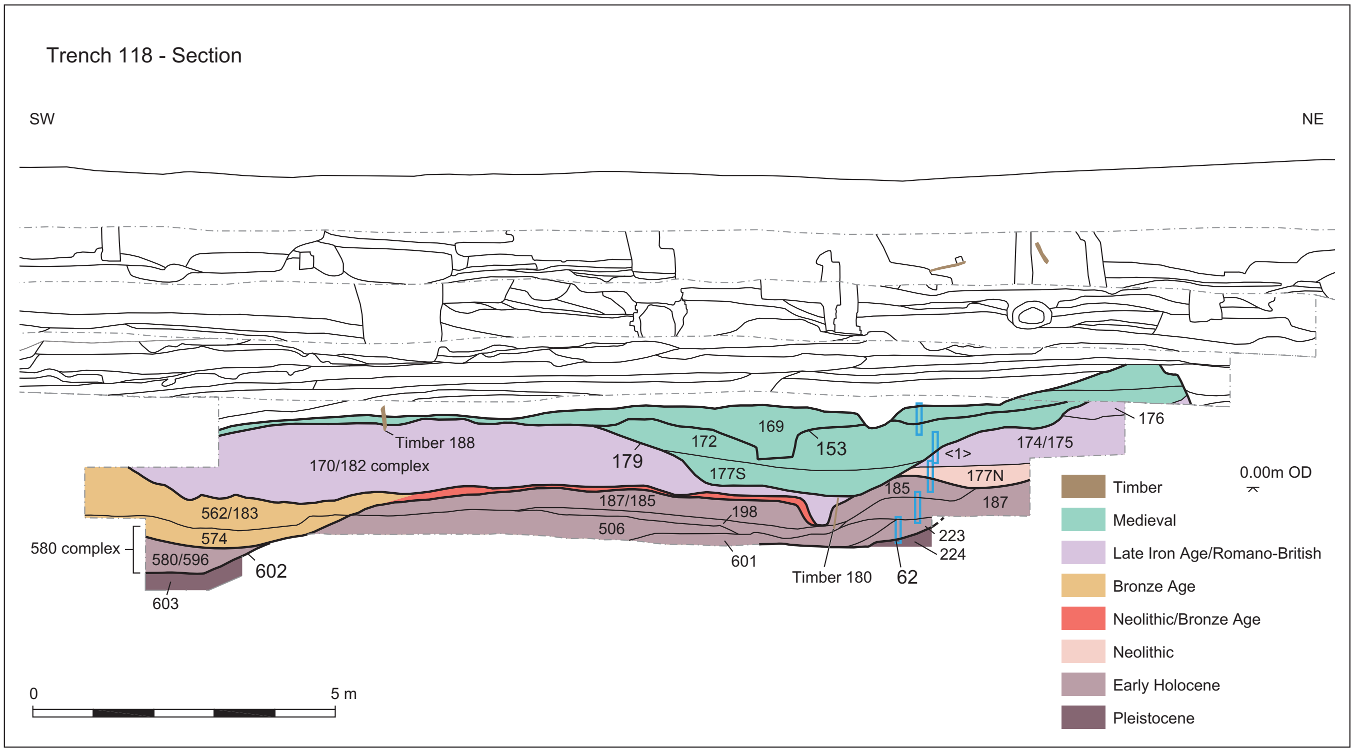


Figure 8.21: South-east facing section from Trench 118, showing location of pollen sequence 1 (note that monolith sequences 9 and 122, shown in Fig. 8.23, come from the north-east-facing section not shown)

base, in the complex of contexts recorded under 580 (580-complex), provided a date of 10,440–10,040 cal BC (SUERC-34949, 10,325±40 BP), placing it in GS-1. This channel could be the result of downward incision through the earlier channel deposits as a response to high water discharge during GS-1. Samples from both channels contained a typical Late Pleistocene pollen assemblages (Fig. 8.23; LPAZ Tr 118 M122–1, Tr118 M11–1 and Tr118 M9–1), confirming their general dating. Plant macrofossils indicated the presence of stonewort, bulrush, water-plantain and pondweeds, while the sporadic pollen evidence indicated pondweed, bulrush and spiked water-milfoil (*Myriophyllum spicatum*), along with sedges (Cyperaceae).

Overlying the 580-complex is a peat deposit (596), radiocarbon dated to 9750–9330 cal BC (SUERC-36287, 10,000±35 BP), and it appears that channel 602 became cut off in the Early Holocene, with the peat forming in highly vegetated environment with little to no water-flow (similar to Trench 71 in Area 1, above). Many of the insect remains present are from species found in slow-flowing to still water, eg, *Agabus* spp., *Ochthebius minutus*, *Limnebius* spp., *Coelostoma orbiculare*, *Cercyon sternalis*, *Laccobius* spp. and *Chaetarthria seminulum* (Fig. 8.22), while the molluscs, comprising predominately *Bithynia* opercula, with some fragments of *Theodoxus fluviatilis*, suggest material brought in from a nearby fast-flowing channel (Fig. 8.24). Waterlogged plant remains include club-rush,

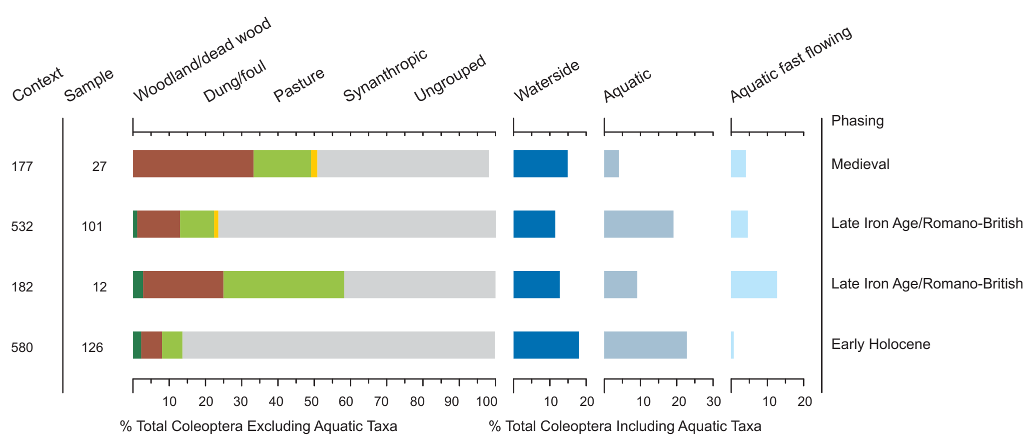
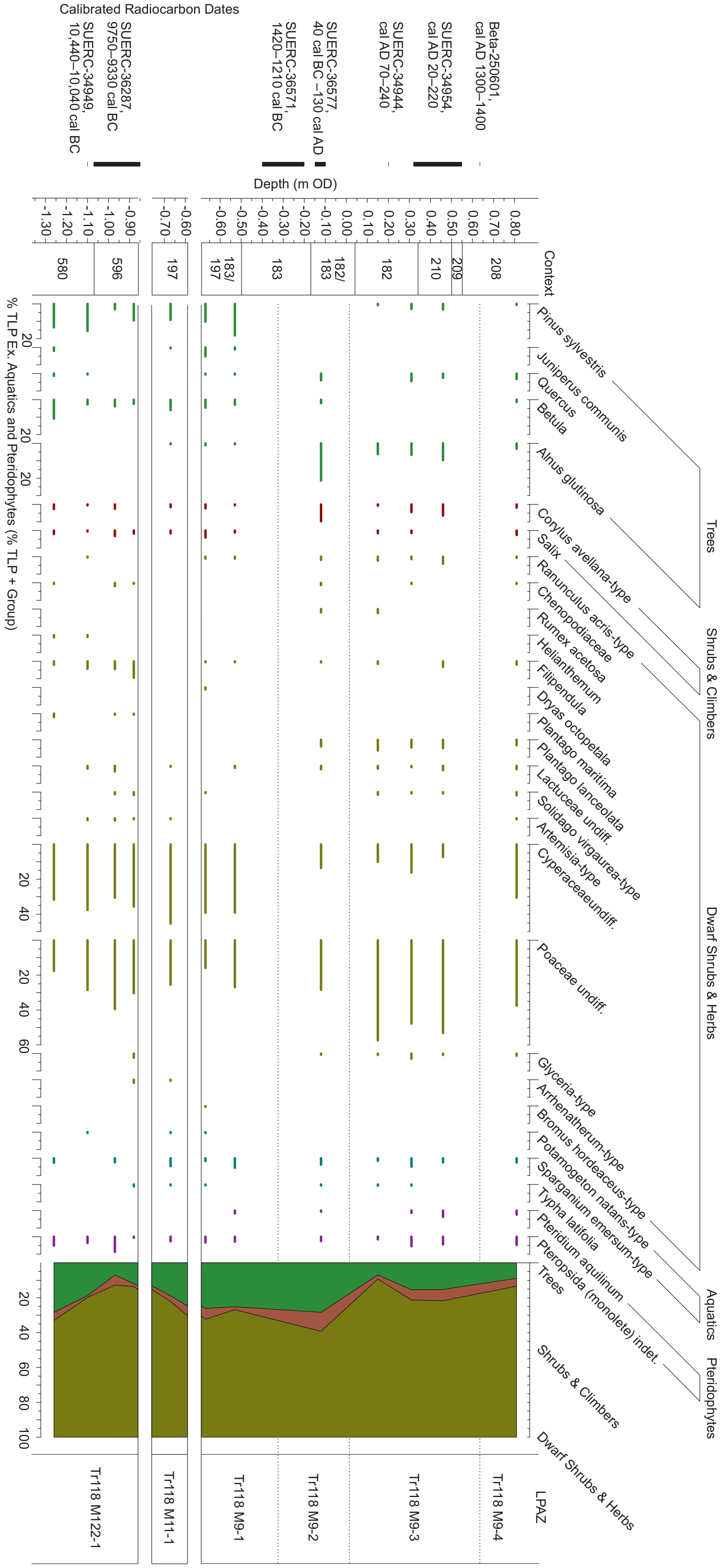


Figure 8.22: Summary of beetle fauna communities from Trench 118



stonewort, water-crowfoot, water-plantain, mare's-tail (*Hippuris vulgaris*) and pondweed present, while the pollen also indicates bulrush and bur-reed. A number of water beetles, such as *Donacia impressa*, *Plateumaris sericea* and *Limobaris pillistriatus*, are all associated with common club-rush, sedge and rushes.

Vegetation

Although the three sequences examined were broadly similar, there were some differences between the earlier two. The general environment was open marshland, dominated by grasses, possibly including reeds, rushes and sedges, and low levels of meadowsweet. In the earlier channel (62) there is also some indication of juniper in context 198, which would have been present as a low-growing shrub. This sequence also had a few plants characteristic of colder conditions, such as field gentian (*Gentianella campestris*) and, in context 223, purple saxifrage and mountain avens (*Dryas octopetala*), along with meadow saxifrage (*Saxifraga/granulata*-type). Pine was certainly present locally, along with birch, probably all growing in scattered stands.

Some of the species associated with colder conditions were still present in the 580-complex, including, juniper and saxifrage, as well as rock-rose and mugwort. With the exception of mugwort, this pollen was generally more common in the lower, GS-1 part of the sequence, with juniper absent from all but the lowest sample.

A significant difference between the two channel sequences is that pollen and waterlogged seeds of meadowsweet were found in much higher proportions in channel 602, peaking towards the top of the sequence in peat 596. Seeds and pollen of several other grassland plants were also recovered from both the 580-complex and peat 596, including buttercups, meadowsweet, cinquefoils/tormentils (*Potentilla* sp.), thistles (*Carduus/Cirsium* sp.), docks, silverweed (*Potentilla anserina*) and self-heal. Significantly, the peat also contained seeds and pollen of fat-hen (*Chenopodium album*), hemp-nettle, nettle, and many-seeded goosefoot, suggesting areas of disturbance, possibly associated with nitrogen enriched soils, and it is notable that some dung-beetles (*Aphodius*) were recorded from this same context indicating the presence of large herbivores (Fig. 8.22).

Figure 8.23 (far left): Summary pollen diagram from Trench 118, showing pollen from channel 602 (monolith 122) and sequence in north-east-facing section (monoliths 9 and 11)

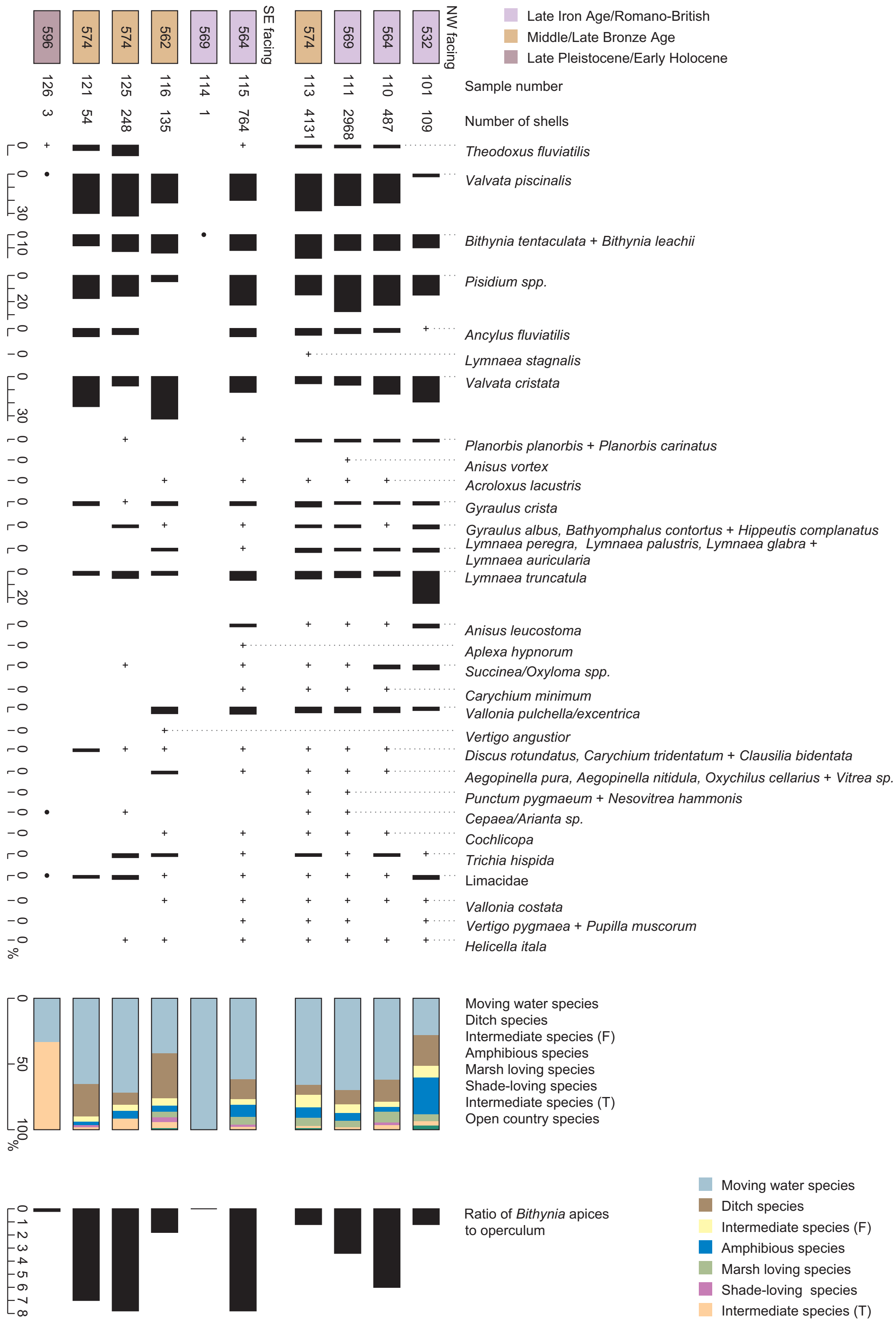


Figure 8.24: Composite mollusc diagram for channel deposits from the north-west- and south-east-facing sections of Trench 118, taken through the Middle/Late Bronze Age and Late Iron Age/ Romano-British channels

Figure 8.25 (right): Mollusc sequences through Late Pleistocene/ Early Holocene, Early Neolithic, Middle/Late Bronze Age and Late Iron age/Romano-British deposits in the north-east-facing evaluation section (except context 570 which is located nearby) of Trench 118

Trench 33

This trench produced one of the few dated instances of Late Mesolithic deposits, with a date of 5310–5070 cal BC (SUERC-31388, 6240±30 BP) obtained on two alder cones from the base of the sequence (83). However, the similarity of the lowest samples with the overlying Middle Iron Age samples (see below) raises the possibility of mixing between these deposits.

Channel

The base of this sequence contained fluvial sands and redeposited tufaceous material, all formed under an active channel containing bars and sandbanks. The diatom *Ellerbeckia arenaria*, which is associated more with sandy substrates, was only present in the lowest two samples. This basal sample was particularly rich in molluscan remains of species associated with moving water, such as *Valvata piscinalis*, *Bithynia tentaculata* and *Theodoxus fluviatilis*, and the frequent remains of stonewort, water-plantain, pondweed, club-rush and yellow water-lily, along with branched bur-reed, point to dense vegetation in, and along the edge of, the channel.

Vegetation

Remains of alder, along with dogwood, bramble, elder and hazelnut, show alder carr and woodland scrub growing along the channel edge. Other vegetation communities are represented for the local area, including species associated with stretches of low-growing scrub; nettle, and winter-cress, those more common in wet grassland; buttercup, common meadow-rue (*Thalictrum flavum*), silverweed, thistle and willowherb, and those of marshland/river edges; bogbean (*Menyanthes trifoliata*), gypsywort and mint. Along with nettle there were also several other species associated with disturbance, such as goosefoots and orache.

Neolithic to Early Bronze Age

Trench 118

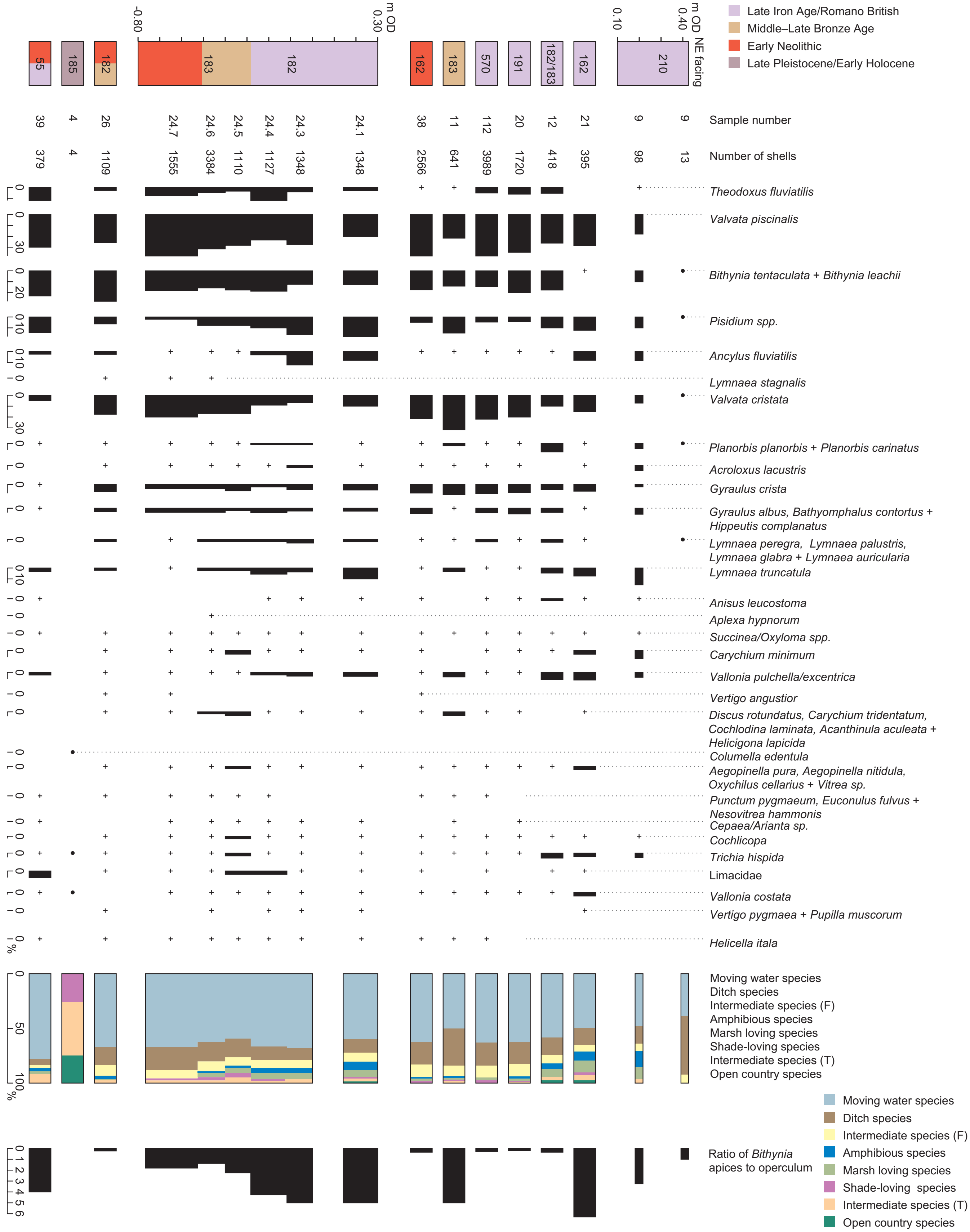
The extent of the Neolithic deposits is not known and it is possible they were relatively thin and only present directly overlying the Early Holocene sediments (above) (Fig. 8.21).

Early Neolithic dates were obtained from alder cones recovered from similar channel-edge deposits in different parts of the trench. The dates are 3520–3360 cal BC (SUERC-34951, 4650±35 BP) from context 162 towards the base of the trench, and 3630–3360 cal BC (SUERC-36575, 4680±35 BP) from the base of context 183 at a similar level at the base of the north-east-facing evaluation section.

Both deposits overlay the Late Pleistocene to Early Holocene channel fills and it is probable that they form the remnants of a channel fill that was largely removed by later channel activity. They probably extended south-west across channel 602, and were subsequently recorded as part of the 580-complex, although it is quite possible that they might have formed part of context 574 (in the trench's north-east-facing section).

Middle to Late Neolithic deposits were also identified from context 177N in a channel (not numbered), visible in the trench's south-east-facing section (Fig. 8.21), which cut the Late Pleistocene sand bar. The earlier date from this bulk sample, 3510–3130 cal BC (SUERC-33682, 4605±30 BP), was obtained from hazelnut shells, while the later date, 2870–2570 cal BC (SUERC-36226, 4120±30 BP), was on a stratigraphically lower sediment sample. These two results are not in chronological order, and although the hazelnut may be reworked, it is more likely, given the amount of penetrating roots in this context, that the roots have contributed to the younger sediment date.

Of particular importance is the possibility that some of these deposits are closely associated with Early to Middle Neolithic finds from the trench, including three stakes (timbers 577, 578 and 581), an axe associated with 580-complex and possibly also with the base of context 183, and fragments of Plain Bowl pottery probably associated most with context 162. In addition, some deer antlers from 580-complex


Late Iron Age/Romano British
Middle–Late Bronze Age
Early Neolithic
Late Pleistocene/Early Holocene
m OD
-0.80
0.30
0.10
0.40
NE facing
55
185
182
183
182
162
183
570
191
182/183
162
210
Sample number
39
4
26
24.7
24.6
24.5
24.4
24.3
24.1
38
11
112
20
12
21
9
9
Number of shells
379
4
1109
1555
3384
1110
1127
1348
1348
2566
641
3989
1720
418
395
98
13
Theodoxus fluviatilis
Valvata piscinalis
Bithynia tentaculata + Bithynia leachii
Pisidium spp.
Ancylus fluviatilis
Lymnaea stagnalis
Valvata cristata
Planorbis planorbis + Planorbis carinatus
Acroloxus lacustris
Gyraulus crista
Gyraulus albus, Bathyomphalus contortus + Hippeutis complanatus
Lymnaea peregra, Lymnaea palustris, Lymnaea glabra + Lymnaea auricularia
Lymnaea truncatula
Anisus leucostoma
Aplexa hypnorum
Succinea/Oxyloma spp.
Carychium minimum
Vallonia pulchella/excentrica
Vertigo angustior
Discus rotundatus, Carychium tridentatum, Cochlodina laminata, Acanthinula aculeata + Helicigona lapicida
Columella edentula
Aegopinella pura, Aegopinella nitidula, Oxychilus cellarius + Vitrea sp.
Punctum pygmaeum, Euconulus fulvus + Nesovitrea hammonis
Cepaea/Arianta sp.
Cochlicopa
Trichia hispida
Limacidae
Vallonia costata
Vertigo pygmaea + Pupilla muscorum
Helicella itala
%
0
50
100
%
Moving water species
Ditch species
Intermediate species (F)
Amphibious species
Marsh loving species
Shade-loving species
Intermediate species (T)
Open country species
Ratio of Bithynia apices to operculum
0
1
2
3
4
5
6

were radiocarbon dated to the Late Neolithic, 2480–2290 cal BC (SUERC-36293, 3910±30 BP) and 2570–2290 cal BC (SUERC-36289, 3935±35 BP), although these may be reworked (see Chapter 2).

Channel

The assemblages and sediments from context 162 and the base of 183, which are broadly contemporary with the three stakes, indicate a slow-flowing, well vegetated channel margin, with both *Valvata piscinalis* and *Bithynia* present in reasonably high amounts (Fig. 8.25). The vegetation in the channel was relatively diverse, with common club-rush dominating the assemblage, suggesting a wide, shallow and relatively slowly flowing channel. The aquatics included yellow water-lily, water-cress and pondweeds.

The Middle–Late Neolithic channel containing fill 177N probably flowed broadly north–south, albeit seemingly at a much higher elevation than either earlier or later channels (Fig. 8.21). The assemblages in 177N were relatively poor and the channel may have been subjected to periods of drying during, or shortly after, the deposition of the material. Aquatics were rare, comprising a few seeds of common club-rush.

Vegetation

The assemblages from contexts 162 and 177N indicate alder woodland extending up to the channel edge. Woody scrub components, including elder, hawthorn, willow, sloe and bramble, were common, while winter-cress and nettle are indicative of lower growing herbaceous communities growing on the edge of the scrub. Seeds of three-nerved sandwort are characteristic of peaty-mull soils in woodland or areas of relict woodland. The pollen indicates the presence of oak and occasional elm. Grassland is also present, with buttercup, dock, tormentil (*Potentilla erecta*), self-heal, cinquefoil and thistle, giving way to fen-marsh grassland, with numerous seeds of club-rush, along with water-droplet, mint and gypsywort, and bogbean. There are also some elements indicating disturbance.

The marshy environment is also indicated by *Vertigo* cf. *antivertigo*, a generally rare species only recorded in the dated Neolithic samples from contexts 162 and the basal 183 (and one other sample from 183 of uncertain date).

Middle to Late Bronze Age

No Early Bronze Age deposits were recorded from this area, and while Middle Bronze Age features were uncovered in Trench 9 and 24, no contemporary water-logged material or organic deposits was recovered from the area with the exception of Trench 118.

Trench 24

A buried land surface (4) was associated with Middle Bronze Age settlement features. Two radiocarbon dates were obtained, one of 1390–1050 cal BC (Beta-210488, 2990±40 BP) on charcoal (indet.) from post-hole 7 and the other of 1420–1260 cal BC (SUERC-35325, 3075±30 BP) on sloe (*Prunus spinosa*) charcoal from the adjacent curvilinear gully (23). The land surface was sealed by alluvium (3).

Soil micromorphology suggests, despite the hydromorphic and slaking effects of freshwater inundation, a history of pedogenesis in an upward-fining stone-free loam soil, and the development by the Bronze Age of a grassland mull topsoil. Occupation may have led to trampling and an accumulation of muddy soil associated with intermittent flooding. Given the development of the soil, the few waterlogged seeds recovered from it were certainly intrusive, confirmed by radiocarbon dating of both the seeds and alluvium (see below).

Trench 118

Channel fills dating to the Middle to Late Bronze Age were recorded in the south-west of the trench (Fig. 8.21), including (in approximate chronological order) 574, 562 and 183, the latter two potentially part of the same context. It is notable that context 183, which was also dated to Neolithic at the base, is also recorded in the trenches north-east-facing section identifiable with 562, but on context descriptions might be more readily equated with 574.

Radiocarbon dates, from the trench's north-east-facing section, of 1420–1210 cal BC

(SUERC-36571, 3055±35 BP) from 183, and 1320–1050 cal BC (SUERC-34953, 2970±35 BP) from 182/183 (the interface with the overlying channel) showed context 183 to be of Middle to Late Bronze Age date. Alder seeds and a cone from context 574 produced a date of 1270–1020 cal BC (SUERC-34950, 2935±35 BP), while alder fruits and other seeds supposedly from the underlying context (596) produced a date of 1380–1120 cal BC (SUERC-33681, 3005±30 BP). However, examination of section drawings showed that the latter sample is more likely to come from the base of 574, and this is supported by analogous molluscan and waterlogged plant assemblages for both contexts. All four radiocarbon results are statistically consistent (χ2-Test: df=3 T=6.5 (5% 7.8)) indicating a similar date.

The edges of the Bronze Age channel were not clearly visible. In the north-east of the trench the fill appears to have been deposited in either a shallow channel or a hollow. The channel profile shows a gentle slope cutting into the earlier sand bars, with organic silts deposited on its inside edge, consistent with the outside bend of a channel. Given the Neolithic date from the base of context 183, it is possible that this part of the channel dates entirely to the Early Neolithic, with the Middle to Late Bronze Age channel confined to the south-west end of the trench. Deposited tree stumps, broken tree trunks and a tufaceous deposit (570/191) may also date to the Middle–Late Bronze Age, but the tufa appears to have been redeposited in the base of the Late Iron Age/Romano-British channel straddling the upper Bronze Age contexts.

Channel

The initial fill of the Bronze Age channel (574) formed under high energy conditions, as seen in the mollusc assemblages which are dominated by shells of moving water species, in particular *Valvata piscinalis* (Fig. 8.24). The channel was relatively well vegetated, with plant macrofossils of stonewort, water-crowfoot, marsh yellow cress, mare's tail, water-plantain, pondweed, horned-pondweed, bur-reed and common club-rush.

The overlying alluvial silty clays (562) and (183) were probably laid down at the channel edge during a period of slower flow, also indicated in the mollusc assemblages (Figs 8.24-5). These deposits may have originally extended further north-east, but were removed by later channel activity. There was some variation seen in the waterlogged plant remains in the two layers. The lower samples from 183 had very few aquatics, while the upper samples showed an assemblage closer to that from context 574, with the addition of water-lily, water-starwort (*Callitriche* sp.), and arrowhead, but the absence of mare's-tail. The sample from 562 had a slightly different array of aquatics, although marsh yellow-cress, lesser water-plantain (*Baldellia ranunculoides*), water-plantain and duckweeds were all present. The mollusc assemblage associated with the tufaceous deposit (570/191) showed a slow moving, well vegetated water environment, probably on the channel edge (Fig. 8.25).

Vegetation

The Middle to Late Bronze Age floodplain was probably less wooded than in the Neolithic, although woodland was still prevalent. Shade-loving molluscs were found in context 183 including a single shell of *Helicigona lapicida* which in this context can be associated with woodland.

The pollen assemblage from the 182/183 interface shows the dominance of alder, with some hazel and willow. The plant macrofossils from contexts 182/183, 562 and 574 can all also be associated with alder carr, while buds and nut fragments indicate the local presence of willow and hazel, along with occasional acorns indicate oak on this part of the floodplain, although only low amounts of oak pollen were seen. There are also scrub elements, including elder, sloe, hawthorn, and bramble.

Bugle, which is often found in grassy areas bordering fen carr, was present, along with water-pepper (*Persicaria hydropiper*) which is often found in more shaded places. Several other elements were associated with wet grassland pasture, including seeds and pollen of buttercup, marsh-marigold, ragged-robin, ribwort plantain, hoary plantain (*Plantago media*), docks, selfheal, with some also indicative of more marshy fen sedge-grassland, eg, fairly high numbers of sedge, marsh valerian (*Valeriana dioica*), mint and gypsywort. These species, along with others associated with

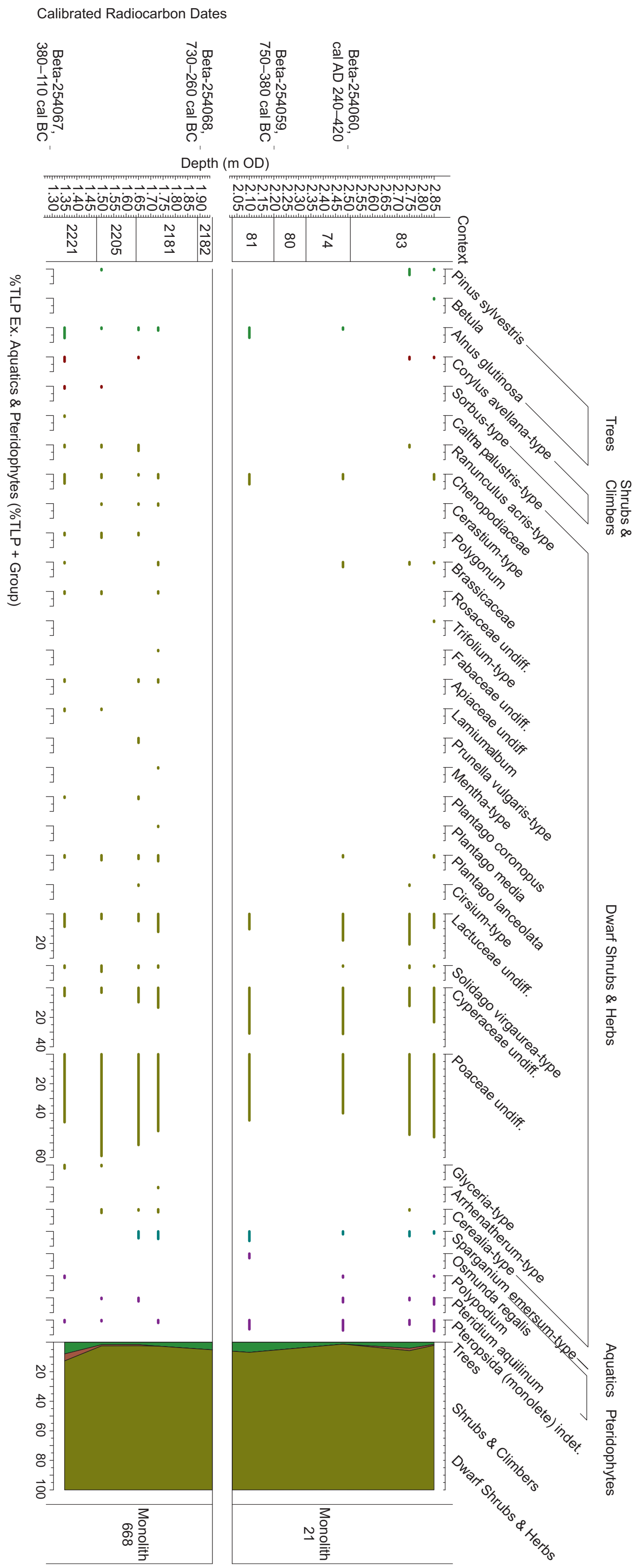


Figure 8.26: Summary pollen diagram from ditch segment 2222 (Fig. 3.7) (monolith 668) and through alluvium 80 (monolith 21) from Trench 9

disturbance, such as seeds and pollen of Polygonaceae, goosefoots, in particular fat-hen, and orache, are all indicative of pasture and grazing. They were more common in the upper fills of the Bronze Age channel, than in context 574.

The mollusc assemblage from context interface 182/183 indicates marsh and damp grassland near the channel, while *Clausilia bidentata*, 'common in woods, on rocks, walls and in established hedges' and *Cochlodina laminata*, 'largely confined to woodland and well shaded scrub' (Davies 2008, 178), indicate some woodland close by (Fig. 8.25). The insect faunas from contexts 183 and 574, which include a few remains of dung-beetle (*Aphodius* sp.), indicated relatively open, probably grazed pasture.

Iron Age

The Iron Age was well represented in this area with samples and sequences coming both from archaeological features associated with Middle Iron Age settlement, and from several other trench profiles.

Trench 9

Almost all the samples from Trench 9 came from fills in the Middle Iron Age enclosure ditches, but there were a few from pit fills. Pollen sequences were examined from ditch segment 2222, and through layers of alluvium (81, 80, 74 and 83) recorded during the evaluation (Fig. 8.26). Context 80 was radiocarbon dated on bulk sediments to the Early Iron Age, but the date of this alluvium is potentially problematic, as it was possibly cut by a Middle Bronze Age ditch (see Chapter 3). It should be noted, however, that this relationship is very unclear, and the ditch may be entirely overlain by the alluvium. For this reason, and combined with the general evidence for the date of alluviation of this type on these gravels, this sequence of alluvium (80) has been treated as broadly Iron Age to Romano-British in date.

Channel environments: ditch fills and alluvium

A sequence of alluvial events was recorded on the site. It seems likely that the earliest significant period of alluviation probably occurred in the Early Iron Age as many of the Middle Iron Age features cut through a thin layer of alluvium. A reduction in flooding during the Middle Iron Age (potentially recorded in nearby trenches, see below) seems to have allowed the re-settlement of this part of the gravel ridge. A number of waterlogged samples from Middle Iron Age ditch fills (in sections 1705 and 1929 (ditch 1213), 1660 (ditch 1384), 1668 (ditch 1385), 1679 (ditch 1923) and 2120 (ditch 2298)) were examined for insect and waterlogged plant remains, although no molluscs were preserved.

The insect assemblage indicates slow-flowing to stagnant/still water, although species associated with reeds, rushes, sedges, sweet-grass or duckweed and other typical ditch vegetation are relatively rare. This was also the case with plant macrofossils, with seeds of aquatics, or species associated with permanent standing water such as water-crowfoot, water-plantain, common club-rush and branched bur-reed being fairly rare. However, plant species associated with shallow water bodies that are prone to drying out, such as fool's-water-cress, were more common. The diatom assemblage, in particular *Hantzschia amphioxys*, *Pinnularia brebissonii* and *Navicula cincta*, from the basal fills (2201 and 2205) of ditch segment 2222, indicated a shallow water environment that may have dried out intermittently. *Gomphonema parvulum* is characteristic of high nutrient concentrations and eutrophication, possibly associated with animal waste and general settlement debris entering the ditch.

In contrast, fill 1696 in (Phase 2) enclosure ditch 1679 (1923) had evidence for standing water, and quite dense vegetation in the ditch. This context also had many statoblasts of the bryozoa *Lophopus crystallinus*, which form small colonies on floating plant debris, as well as aquatic plants. It might be noted, however, that seeds of both rush and sedge were relatively common in all the ditch samples, although these might have been growing adjacent to the ditches rather than in them.

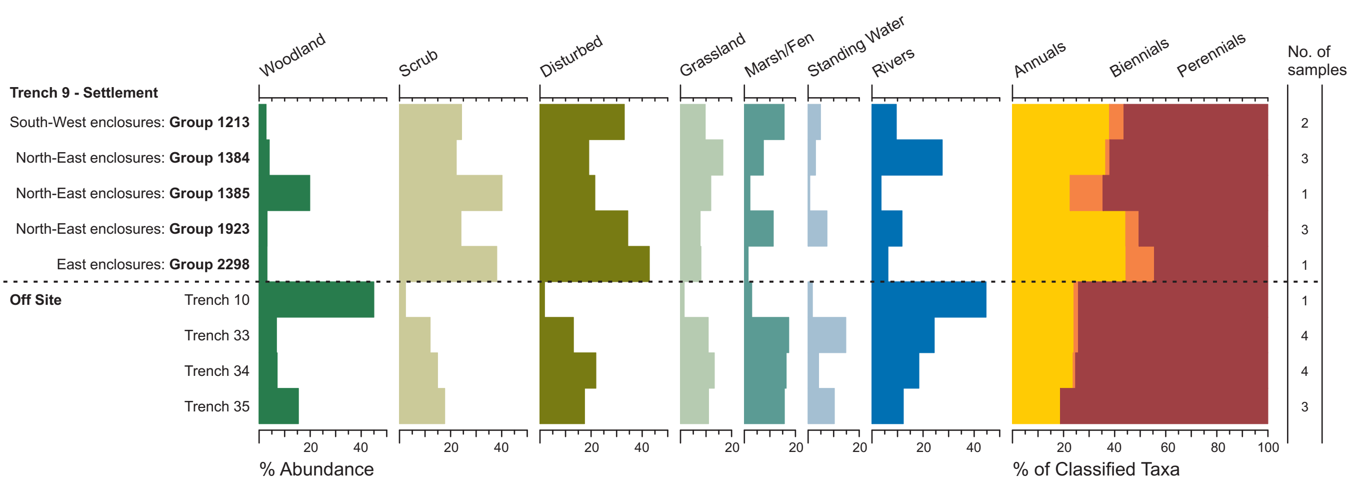
Increased flooding in the Late Iron Age led to the abandonment of the settlement, following which many of the features were sealed under a layer of alluvium, with the scouring effect of such alluviation events apparently removing any overlying topsoil.

A pollen sequence was examined both from this period of overbank alluviation (74 and 83), and from an early phase (80 and 81), although the latter was based on a bulk sediment dated 750–380 cal BC (Beta-254059, 2380±40 BP), and may therefore be over-estimating the date of sediment deposition. Aquatics are generally rare in the pollen, but bur-reed is present.

Vegetation

The vegetation was dominated by species associated with nitrogen-rich disturbed soils, with annuals, for example, accounting for 30-35% of the waterlogged plant macrofossil assemblage, compared to 10-25% at other trenches in this area (Fig. 8.27). This was largely the case with species of general disturbance, arable and wasteland conditions, which were more prevalent on the settlement site than elsewhere. They included henbane (*Hyoscyamus niger*), fumitory (*Fumaria* sp.), fig-leaved goosefoots (*Chenopodium ficifolium*), orache, stitchwort (*Stellaria* sp.), knotgrass (*Polygonum aviculare*), black-bindweed (*Fallopia convolvulus)* and fat-hen. Many of these species, especially those of Chenopodiaceae and *Polygonum*, are also well represented in the pollen assemblage (Fig. 8.26), particularly from ditch segment 2222.

Figure 8.27: Histogram showing the percentage of species abundance, derived from waterlogged plant remains assemblages, associated with each habitat type for each ditch group in Trench 9 (see Fig. 3.7) and for the off-site Iron Age sequences in Trenches 10, 33, 34 and 35. For each sample the abundances of species associated with that habitat were totalled. Where seeds etc. were identified only to family or genus level and more than one habitat was represented the abundances were equally divided between each habitat. The abundances from every sample were then totalled for each ditch group/trench and the percentage representation of each broad habitat then calculated and plotted



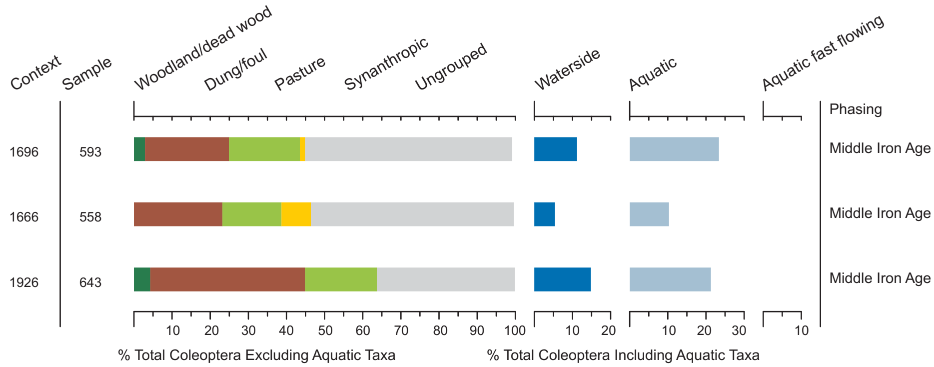


Figure 8.28: Summary of beetle fauna communities from Trench 9

The high numbers of nettles in these samples were notable, both in terms of seeds and commonly associated insect species, such as *Brachypterus urticae*, *Apion urticarium*, *Ceutorhynchus pollinarius* and *Cidnorhinus quadrimaculatus*. Together these indicate nitrogen and phosphate enriched soils caused by animals, manure heaps and general settlement middens. Charred cereal remains and cereal pollen were also recovered from ditch segment 2222, although whether this indicates nearby cultivation is unclear. Charred seeds of spike-rush (*Eleocharis palustris*) and blinks (*Montia fontana* subsp. *chondrosperma*), which might be taken as indicative of the cultivation of local wetter soils, were only recovered from Late Bronze Age assemblages.

The extent to which the enclosure ditches were associated with scrub or even hedges is debatable, although macrofossil remains of oak, alder, willow and hazel, albeit in relatively small quantities, indicate some scrub and trees around the ditch sides. Rose/bramble thorns and fruits of bramble, along with thorns and fruit stones of both sloe and hawthorn, and seeds of elder, all indicate possible hedges around the enclosure, with thorny species being especially useful for corralling animals. In contrast, the pollen from ditch segment 2222 points to an open landscape with little to no woodland, although many of the aforementioned species are represented (or potentially represented) in this assemblage.

The wider landscape appears to have been one of grassland pasture, with evidence for herbivore dung indicated by the 'dor beetle' *Geotrupes* and the 'dung beetles' *Onthophagus* spp., *Aphodius rufipes*, *A. sphacelatus*, *A. prodromus*, *A. ater* and *A. granarius* (Fig. 8.28), all of which are more commonly associated with dung in the field rather than manure heaps or animal pens. The palaeonevironmental evidence points to open, rough, disturbed, and poorly managed pastures, wastelands and possibly even arable land, containing thistle and dock, and more typical grassland pasture species, such as clover, ribwort plantain, selfheal and buttercup.

Trench 33

A sequence covering the Early–Middle Iron Age, came from the upper deposits in this trench, with two radiocarbon dates 410–210 cal BC (SUERC-31556, 2285±30 BP) and 400–200 cal BC (SUERC-35334, 2270±30 BP) indicating broad contemporaneity with the settlement in Trench 9 just 150 m to the south-east, and enabling investigation of the wider environment during the period of the occupation.

Channel

The upper part of the sequence may have formed in a ridge and swale topography, probably being laid down on the inner edge of a migrating channel. The general indication is of a shallow water environment, with evidence of periods of drying before wetter conditions resumed.

The molluscan evidence from the earliest part of the Iron Age sequence shows an active channel, with slow to fast flowing water, soon changing to slow and still/stagnant water probably associated with marshland, meadows or damp pasture. Mollusc shells are absent during the period in which the sediments indicate some drying out. At the same, species associated with standing or flowing water, such as water-crowfoot, stonewort, bur-reed and common club-rush, are all much reduced, while seeds of water-starwort, associated with wet-muddy environments, become much commoner. However, since that the pollen evidence shows less change, such developments are likely to have been localised.

Vegetation

Despite macro-botanical remains of alder being very evident, pollen values were sporadic, perhaps indicating only localised stands. However, during the drying of the sediments the evidence for alder is very much reduced with more scrub species (mainly bramble, sloe and few wetland indicators). The pollen also indicated the limited presence in the wider landscape of oak, elm, lime, willow and hazel. With the return of wetter conditions probably in the Middle–Late Iron Age, the environment appears more open, with few remains of alder, although elder is slightly more common.

During this period seeds of buttercup and celery-leaved buttercup (*Ranunculus sceleratus*), as well as nettle, were common, as were seeds of species associated with disturbed trampled soils, pastures and perhaps even agriculture, such as greater plantain (*Plantago major*), fumitory, goosefoot, orache, stitchwort, knotgrass, docks, thistles, and goldenrods/ragwort type (*Solidago virgaurea/Senecio* sp.).

Trench 34

The only reliable date from deposits in this trench (*c.* 30 m east of Trench 33), 490–230 cal BC (SUERC-31557, 2325±30 BP) from context 88, suggests a broadly contemporary sequence.

Channel

The sediments and section profile suggest these deposits were also associated with a ridge and swale topography, with drier grassy hummocks and sedge-dominated hollows, subject to intermittent periods of drying (resulting in the poor organic preservation in the lower part of sequence). The deposits contained few aquatic species or seeds associated with wetland, and were dominated by resistant pollen types.

By contrast, the overlying deposit (88) associated with the swale, provided evidence for shallow water and wet marshy conditions, with thick swathes of vegetation, comprising rushes, sedges, bur-reed, and aquatics, stonewort, rigid hornwort (*Ceratophyllum demersum*), water-crowfoot and lesser water-plantain. The molluscan assemblage was also richer, indicating a much greater channel influence, including perhaps flooding events, with species present associated with permanent water, *Bithynia tentaculata*, *Valvata cristata* and *Planorbis planorbis*. Other species, such as *Lymnaea truncatula* and *Anisus leucostoma*, might still indicate localised hollows and swales where seasonal desiccation occurred.

Alder and scrub vegetation appear to have extended up to the water's edge, perhaps inhabiting the ridges adjacent to the swales. Seeds of winter-cress and water-pepper, both associated with shaded woodland edges of ditches and ponds, were relatively common.

Vegetation

Although less well represented than within Trench 33, the dated deposit (88) from the swale has pollen and macrofossil remains, particularly in the upper part of the sequence, that attest to the local presence of alder, along with elder, hazel and the occasional oak. Greater stitchwort, bramble and bittersweet (*Solanum dulcamara*) also suggest patches of wooded fen or scrub, rather than individual trees.

As with Trench 33, there is evidence for wet pasture, meadow and/or long fen-grassland. Seeds and pollen of species indicative of disturbance, including goosefoot, thistle, stitchwort, goldenrods and ragwort and ribwort plantain may relate to trampling by grazing animals, given that such swales may have served as temporary waterholes (when water levels/flooding was sufficient). Nettles, goosefoots and orache would then quickly colonise when these features became dry during summer months.

Growing in this grassland, seen from both pollen and plant macrofossils, were buttercup, common meadow-rue, meadowsweet, campion, selfheal, dock, willow herb, hemp-agrimony (*Eupatorium cannabinum*) and mint. Taken together with some of the terrestrial molluscs, these generally imply that grazing of this grassland-marsh was not particularly intensive.

Trenches 10 and Trench 35

Two further sequences were examined from trenches located on the gravel ridge 100 m to the south-west (Trench 10) and north-east (Trench 35) of the Trench 9 settlement site. Deposits overlying the gravels produced very similar radiocarbon dates in the Early Iron Age for the beginning of the sequences.

Channel

The single sampled context from Trench 10 (context 134) suggests it was peripheral to channel activity, with few aquatic species other than water-crowfoot. A much wider range of aquatics was found in the similar sequence in Trench 35, including pondweed, water-plantain and common club-rush, pointing to the proximity of the channel, although the seeds of these species are all very under-represented, in comparison to other sequences from the area. The pollen had larger amounts of grasses and sedges, again with less evidence for aquatics, although bur-reed pollen, which would only grow in still or slowly flowing water, is reasonably well represented.

The upper parts of the deposits in both trenches comprise silty-clay alluvium indicative of increased channel activity and influence of uncertain date, but possibly Middle–Late Iron Age or later.

Vegetation

Context 134 in Trench 10 was a rich organic deposit with frequent remains of wood and twig, which appeared to relate to a nearby, relatively dense stand of alder during the Early–Middle Iron Age, 780–410 cal BC (NZA-32947, 2484±35 BP). There was very little evidence for channel influence, except occasional seeds of water crowfoot and sedge. Given the presence of remains of oak, it is possible this woodland stand was located in a slightly drier part of the valley, away from the immediate influence of the channel.

A broadly contemporary sample (from context 94 in Trench 35) was dated on alder cones and hawthorn to 760–410 cal BC (NZA-32949, 2462±35 BP). This deposit was associated with a possibly butchered horse bone, radiocarbon dated to 750–400 cal BC (SUERC-36296, 2425±30 BP). Occasional charred cereal remains of emmer/spelt and weed seeds were also present, suggesting nearby settlement. The pollen and plant macrofossils showed a more open environment, although alder, elder, hawthorn, hazel and bramble were still fairly pronounced. However, grasses, reeds, rushes and sedges were also quite common, especially in the pollen record, and it may be that the woodland stands were quite localised.

Romano-British

Trench 118

A Late Iron Age/early Romano-British channel (600) was identified at the south-west end of the trench cutting the earlier Middle–Late Bronze Age channel fills. The full extent of the channel was difficult to establish given that it was heavily truncated by the later medieval channel running across the centre of the trench.

As with the Bronze Age channel, it is clear that the sandbars (187) continued to define the north-west edge of this channel. A number of broadly contemporary timbers (180, 69, 504) radiocarbon dated to the early Romano-British period, were driven into the underlying Early Holocene deposits (185, 196, 223 and 506), one of which (180) was driven in against sandbar 187 (Fig. 4.7, above). If this marks the northern edge of the channel then it suggests that the channel was *c.* 12 m wide at its base and 18 m at its highest point. There is evidence to suggest that sandbar 187 was on an outer bend, with the channel changing direction from south-east to south-west (see Chapter 4).

While not all the fills of this channel could be directly correlated, their broad sequence is as follows: the basal fills comprised contexts 569, the lower to middle part of 182, and lowest part of 572; the middle fills comprised contexts 572, 182 and 564; and the upper fills comprised contexts 532, the upper part of 564, 210, and probably 533, 208 and 170.

The channel is likely to have been cut during the Late Iron Age, with identical dates of 170 cal BC–cal AD 50 obtained from alder cones from context 572 (SUERC-34939, 2040±35 BP), and from a cattle bone from context 569 (SUERC-36578, 2040±35 BP). The channel was infilled during the early Romano-British period, with dates of AD 1–220 (SUERC-36576, 1920±35 BP) and AD 20–220 (SUERC-34954, 1900±35 BP) on seeds from contexts 532 and 210, respectively.

Channel

The basal fill, a dark silty clay loam with sand lenses, points to alternating low and high energy events during the Late Iron Age, followed by more humic channel edge deposits and slow to still-water environments. These fluctuating water levels are reflected in both the diatom and the mollusc assemblages, with the river-limpet *Ancylus fluviatilis*, characteristic of quick-flowing, clean, stony channels, being particularly common in the basal samples. These layers also contained frequent fragments of drift wood, including a tree stump (566) and a large broken trunk of silver/downy birch (*Betula pendula/pubescens*) (573), most probably brought in with higher energy events. It is likely that the rolled tufaceous deposits (570 and 191), possibly of Bronze Age date (see above), were also redeposited during the formation of this channel. Of the aquatic species, remains of stonewort, pondweed, horned pondweed, water-lily and water plantain, along with water-droplet, were common in the lower samples, but absent from the uppermost channel fills. Water-crowfoots, arrowhead and common club-rush were present in all samples, but mare's-tail was only recorded in the uppermost context (210).

Vegetation

The pollen indicates a generally open environment, with the evidence for alder, oak and hazel probably reflecting scattered individual, or small stands of trees on the floodplain. Alder, however, is still frequent in the lowest channel fills, as demonstrated by the presence of seeds and catkins/cones, most of them well preserved, and confirmed by cones dated from context 572 (above).

One noticeable difference with earlier assemblages from the trench was the much greater number of buds of willow/poplar (*Salix/Populus*) which, with the alder, suggests mixed riparian woodland. Seeds and stones of elder, hawthorn, sloe and bramble, along with winter-cress, probably reflect the margins of such vegetation. Water-pepper, tasteless water-pepper (*Persicaria mitis*), small water-pepper (*P. minor*) and water-mint (*Mentha aquatica*) are also all associated with such shaded, water-edge environments.

Species associated with grassland pasture/meadow are also frequent in plant assemblages, including buttercup, common meadow-rue, ragged-robin, dock, silverweed and tormentil, and in the pollen with meadowsweet and ribwort plantain. There were also seeds of marshy fen-grassland, including bogbean and gypsywort, as well as high numbers of sedge, along with common club-rush. In the mollusc assemblage, *Lymnaea truncatula* also favours marshy grassland and swampy pools subject to seasonal desiccation.

There were a number of seeds of plants indicating disturbed, often nitrogen-enriched, ground found in both arable fields and trampled areas of grazed pasture, including fumitory, nettle, goosefoots, stitchwort, knotgrass and thistles, although these were less common in the pollen record. Celery-leaved buttercup, which is characteristic of low-lying, nitrogen enriched pastures in wetter areas, especially around estuaries was common, particularly in the later fills.

Trench 29

Although bulk sediments were originally dated from the base of the sequence to the Early–Middle Bronze Age (1740–1450 cal BC, Beta-204034, 3310±60 BP), with a Late Bronze Age date (980–800 cal BC, Beta-220049, 2720±40 BP) from the top, subsequent dating of plant macrofossils showed this sequence to span the Romano-British period. A date of cal AD 80–240 (SUERC-26953, 1855±30 BP) was obtained mainly on buttercup seeds from the base, and another of cal AD 240–400 (SUERC-26954, 1720±30 BP) on seeds of iris (*Iris pseudacorus*) from the top. The high abundance of calcareous material in these deposits, including abundant stonewort, is a likely to be contributor to the original older dates.

Channel

The lowest deposits comprised a 1 m thick layer of organic fine calcareous silty clay loam, with inwashes of sand, especially at the base. These sediments probably represent a channel-edge or backwater environment that became progressively less influenced by channel flow conditions.

The channel appears to have been highly vegetated with large numbers of gametes of stonewort, along with seeds of horned pondweed, water-crowfoot, water-cress, pondweeds, club-rush and water-dropwort. The plant macrofossils and pollen suggest slow-moving water in a channel clogged with bulrushes and branched bur-reed. Diatoms and ostracods also indicate a shallow-water environment, with areas of still or possibly even stagnant water, over a muddy substrate.

Vegetation

The environment was generally marshy grassland with some disturbed ground. Particularly common were seeds and pollen of buttercup, common nettle, dock, hawkbits (*Leontodon* sp.), ragworts, sow-thistles and ribwort plantain, suggesting rough, poorly managed, probably seasonally grazed pasture with trampling, indicated by goosefoot, orache, stitchwort and knotgrass. The pollen and seeds suggest that this wet grassland extended into areas dominated by more wetland fen-marsh elements, such as meadowsweet, marsh-marigold, gypsywort, mint, rushes, sedges and sweet-grass.

Unusually, there were both pinnules and spores of bracken (*Pteridium aquilinum*) or *Polypodium* fern recorded within the sequence. The persistence of scrub woodland is indicated by fragments of alder catkins, catkins of willow/poplar type and fragments of hazelnuts, although the pollen does suggest that these were from individual trees or small isolated stands on the floodplain. Such elements were less common in the upper bulk samples, although there was no discernible change in the pollen sequence.

Saxon

Trench 7

A highly organic alluvium, 0.7–1.0 m thick, was rapidly deposited in a probable oxbow/abandoned channel during this period and has been radiocarbon dated broadly to the Early Saxon period.

Channel

The plant macrofossil evidence from Trench 7, including the large numbers of seeds from water-crowfoot, water-dropwort, sedges, wild celery (*Apium graveolens*), branch bur-reed and common club-rush, demonstrate that the channel contained tall stands of thick, lush vegetation. Along with the pollen evidence, this points to a slow-moving to still-water environment, probably in a cut-off channel or oxbow. Although fine-leaved (*Oenanthe aquatica*) and river water-droplets are frequently associated with a flowing river, they are also recorded by Clapham *et al.* (1987) as common in still water and, in the case of fine-leaved water-droplets, in slow-flowing to stagnant water.

The ostracod evidence similarly shows a marshy still water environment for much of this deposit's formation, and together with the diatom assemblage, are dominated by freshwater taxa, suggesting a shallow-water environment with variable flow conditions. A number of halophilous diatoms (*Gomphonema olivaceum* and *Melosira varians*) in the middle of this sequence coincide with an increase in sand inwash layers, implying transportation and deposition during one or more flooding events. These halophilous diatoms may have originated in brackish water areas further south in the lower Lea and River Thames, but were transported upstream, possibly on a storm surge.

Vegetation

Open rough, marsh-grassland is indicated by seeds and pollen of meadow-rue, iris, meadowsweet, buttercup, selfheal, sedges, rushes and hemp-agrimony, with some evidence of grazing seen through species associated more with disturbance; nettle, fat-hen, dock, ribwort-plantain, hoary plantain, sow-thistle and thistles. A similar environment, with some evidence for grazing animals, was reflected in the insect fauna.

The lowest part of the profile, before the accumulation of the alluvium, provided evidence for small localised stands of alder that may have persisted into the Saxon period. Within the alluvium, occasional finds of elder, bramble, hazelnut and willow, along with several fragments of wood and twigs, point to patches of scrub, probably on the floodplain.

Pollen grains of knotgrass, cornflower and greater celandine (*Chelidonium majus*), a single seed of stinking mayweed (*Anthemis cotula*) and more unusually maple-leaved goosefoot (*Chenopodium hybridum*), all of which are common weeds of arable fields, raise the possibility of local cultivation of the floodplain at this time, although distinct cereal pollen grains were absent. A few finds of flax, dated by associated remains to cal AD 580–670 (SUERC-31558, 1415±30 BP), may derive from bundles of flax fibre brought to the area for retting, and taken together they all signify that settlement was nearby. The use of similar water bodies (pits, streams or ditches) for retting flax has been observed on the floodplain at Yarnton, Oxfordshire (Robinson 2004, 215, pl. 11.3, 408).

Trench 27

While only a few remains of flax were recovered from Trench 7, high numbers of capsule fragments and occasional seeds were recovered from Trench 27, *c.* 300 m to the north-west. The result of radiocarbon dating on the capsules, cal AD 640–770 (SUERC-31390, 1335±30 BP), is statistically consistent (χ2-Test: df=1 T=3.6 (5% 3.8)) with that from Trench 7 (SUERC-31558). Despite a narrower range of species, with seeds of water-dropwort again dominant, along with dock, sedge and club-rush, the assemblage indicates a broadly similar environment to that seen in Trench 7.

Trench 21

A minor sequence dating to the mid–Late Saxon period came from deposits in Trench 21, *c.* 200 m south-east of Trench 7. The sediments indicate a similar well vegetated, wet marshy grassland, probably with standing isolated pools and infilled channels. The pollen and waterlogged plant remains provided evidence for buttercup, bogbean, gypsywort, along with water-plantains, sedge, rushes and reeds.

Medieval and post-medieval

Only a few sequences were dated to these periods and even fewer contained any substantial remains.

Trench 118

A broadly north–south channel cut the Romano-British channel fills in the trench's south-east-facing section, appearing to truncate stake 180 (above). A horse femur from the main fill (526) in the north-west-facing section provided a date of cal AD 1430–1640 (SUERC-34938, 395±35 BP), which along with the handle of a jug in Colchester-type slipware from this same context dated to the 15th century (Jeffries 2009, 30), indicated that this major channel is likely to be 15th to early 17th century in date.

The lower part of context 526 would appear to be broadly contemporary with the lowest fill of the channel (177S) in the south-east-facing section, although 177S returned an Iron Age date, 390–200 cal BC (SUERC-34952, 2235±35 BP), suggesting some of the material is reworked (as seen in Trench 75). Further more, a sediment date from an upper fill of the channel (172), produced a date of cal AD 980–1160 (Beta-250597, 990±40 BP), again older than the other evidence demonstrates.

Further waterlogged material was only present in a few other deposits that could be reliably assigned to this period. These included the upper fills of the channel (173, 172 and 169) in the south-east-facing section, and probably 207 from the north-east-facing section, dated from sediment to cal AD 1300–1440 (Beta-250602, 550±40 BP).

Channel

The fill of the channel comprised alluvial clays, with deposits in the top more characteristic of channel-edge and overbank alluvium. The represented vegetation; stonewort, water-crowfoot, river water-droplet, water-plantain, bur-reed, common club-rush and arrowhead, all suggest a vegetated active channel for much of the period of deposition. High numbers of worm cocoons in the uppermost fills (169 and 207) might indicate the top of the channel dried out, or more likely the erosion of bank material into the channel fill, given the high number of aquatic species present.

Vegetation

The uppermost pollen samples in sequences from the north-east- and the south-east-facing sections (contexts 207 and 172, respectively) show a very open landscape (Fig. 8.23; LPAZ Tr 118 M9–3), as do the plant macro-fossils. There is very little evidence for trees, although willow, hazel and alder probably grew as isolated individuals or in small patches on the floodplain. Sedges and rushes dominate the channel edge and sides, probably extending into rough marshy-grassland containing buttercup and celery-leaved buttercup, meadowsweet, dock, and silverweed, along with bogbean, gypsywort and mint. Both the pollen and the plant macrofossils have evidence for species indicative of disturbance, including nettle, goosefoots, henbane, thistles and ribwort plantain.

Trench 21

A late 13th–early 15th century ditch deposit contained a reasonable amount of organic and molluscan evidence.

Channel

The ditch (13) (Table 5.1, above) was well vegetated, mainly with pondweed and some sedges, and contained slow-moving to still water with a muddy substrate, as seen from the molluscan, diatom and ostracod analyses. The molluscan assemblage was dominated by *Bithynia* and *Lymnaea peregra* suggesting an over-grown drainage ditch or channel, with slow-flowing water, while the ostracods included *Pseudocandona sarsi* which is found in shallow water that dries up in the summer months (Meisch 2000).

The diatoms raise the possibility of storm surges, or a slight increase in the tidal reach, with species present that are likely to have been brought up from the outer Thames estuary. Although the assemblages were dominated by the common freshwater epiphyte *Cocconeis placentula*, there were also a significant number of halophilous and mesohalobous taxa, for example, *Synedra pulchella*, *Amphora veneta*, *Gomphonema olivaceum*, *Navicula menisculus*, *Rhoicosphaenia curvata* and *Surirella brebissonii*. The small but significant numbers of polyhalobous and polyhalobous to mesohalobous diatoms from the outer Thames estuary include mainly planktonic species, such as *Campylosira cymbelliformis*, *Coscinodiscus* sp., *Cymatosira belgica*, *Paralia sulcata*, *Plagiogramma van-heurckii*, *Rhaphoneis minutissima*, *Rhaphoneis surirella* and *Actinoptychus undulatus*. These results are not reflected in the ostracods or molluscs, which comprised only freshwater assemblages. As such it is unlikely that the water was saline, but rather that these elements had been carried upstream on storm surges, similar to those found in the Saxon deposits in Trench 7 (above). Certainly there were a number of storms in the North Sea during the 14th to 15th century, with historical documents recording the loss of much farmland, and the formation of the Zuider Zee in the northern Netherlands, during this period (Gottschalk 1971; 1975; 1977).

Vegetation

The vegetation around the ditch had some indications of arable or disturbed grassland; docks, knotgrass, dandelions (*Taraxacum* sp.) and thistle, as well as hedges and scrub; winter-cress, dog-rose, bramble, elder, willow and hawthorn, particularly in the upper-fills. The pollen assessment by Scaife (2007) noted possible woodland regeneration during the final infilling of the ditch, followed by weeds associated with increase disturbance, although poor preservation may have affected the results.

Trench 24

A small assemblage of plant remains of 17th–20th century date was recovered from a probable buried soil sealed by alluvium. It was similar to that in Trench 21, indicating wasteland or disturbed ground, with buttercups, dock, knotgrass and scrub (eg, bramble).

Trench 29

A small assemblage was recovered from overbank alluvium and floodplain soils, almost certainly of 18th–20th century date. Seeds of buttercup predominated, with species of disturbed wasteland, such as orache, stitchwort and bittersweet. A single fig seed may indicate cess added as fertiliser. The pollen from the upper-part of the sequence indicates a generally open environment.

Trench 13

Ditch 184 (Table 5.1, above) was undated, but matches the line of a post-medieval ditch. The mollusc assemblage suggests a permanently wet, well vegetated, well oxygenated, slowly flowing water environment with occasional areas of marsh or swampy grassland nearby. It was dominated by the moving-water species group, in particular *Bithynia* which favours large bodies of slowly flowing water with dense growths of aquatic plants. *Anisus leucostoma*, which is 'most typical of swampy pools and ditches, especially those drying up in the summer' (Kerney 1999, 60), was also significant and would have exploited areas of marsh or swampy grassland.

Tr.	GS-1/EH	Mesolithic		Neolithic			Bronze Age			Iron Age			R–British		Saxon			Medieval		Post–med.	
		E	L	E	M	L	E	M	L	E	M	L	E	L	E	M	L	E	L	E	L
43	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	insects; waterlogged plant remains	insects; waterlogged plant remains	–	–	–	–
44	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	molluscs
46	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	molluscs; waterlogged plant remains
52	–	–	–	–	–	–	–	–	–	–	–	–	–	ostracods; molluscs; pollen; diatoms; insects; waterlogged plant remains	ostracods; molluscs; pollen; diatoms; insects; waterlogged plant remains	ostracods; molluscs; pollen; diatoms; insects; waterlogged plant remains	ostracods; molluscs; pollen; diatoms; insects; waterlogged plant remains	–	?	waterlogged plant remains	?
54	–	–	–	–	–	molluscs; pollen; waterlogged plant remains	–	–	–	–	–	molluscs; pollen; diatoms; waterlogged plant remains	molluscs; pollen; diatoms; waterlogged plant remains	?	molluscs; pollen; diatoms; waterlogged plant remains	molluscs; pollen; diatoms; waterlogged plant remains	molluscs; pollen; diatoms; waterlogged plant remains	–	–	–	waterlogged plant remains
56	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	pollen; insects; waterlogged plant remains	pollen; insects; waterlogged plant remains	–	–	–
58	–	–	molluscs; waterlogged plant remains	–	–	–	–	–	–	–	–	–	molluscs; waterlogged plant remains	molluscs; waterlogged plant remains	molluscs; waterlogged plant remains	molluscs; waterlogged plant remains	molluscs; waterlogged plant remains	–	molluscs; waterlogged plant remains	molluscs; waterlogged plant remains	–
59	–	–	–	–	–	–	–	–	–	–	–	molluscs; insects; waterlogged plant remains	molluscs; insects; waterlogged plant remains	–	–	–	molluscs; waterlogged plant remains	molluscs; waterlogged plant remains	–	–	–
65	–	–	–	–	–	–	–	–	–	–	–	–	molluscs; pollen; diatoms; waterlogged plant remains	molluscs; pollen; diatoms; waterlogged plant remains	molluscs; pollen; diatoms; waterlogged plant remains	–	–	–	–	–	–
67	–	–	–	–	–	–	–	–	–	–	–	–	–	pollen; diatoms	pollen; diatoms	?	–	–	–	–	–
109	–	–	–	–	–	–	–	–	–	–	pollen; diatoms; waterlogged plant remains	pollen; diatoms; waterlogged plant remains	molluscs; pollen; diatoms; waterlogged plant remains	?	?	–	–	–	–	–	–
111	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	ostracods; molluscs; pollen; diatoms; insects; waterlogged plant remains	ostracods; molluscs; pollen; diatoms; insects; waterlogged plant remains	–	–	–	–

Key: diatoms; insects; molluscs; ostracods; pollen; waterlogged plant remains;
? date of sequence is uncertain and environmental material of this period may be represented; GS-1=Greenland Stadial 1; EH=Early Holocene.

Table 8.9: Summary for Area 3 (South-west Area) showing representation of material type by period and trench

Area 3: South-West (West of City Mill River and the River Lea)

It is possible that the proto-Hackney Brook flowed along the western margin of this area, including a probable (though unknown) channel west of Trench 59 that would have separated a large gravel island from the western gravel terrace (Fig. 8.11 and 8.14; Table 8.9). The main channel activity in the area probably relates to the proto-River Lea flowing into the eastern side of the area, then dividing into two channel areas, one flowing south-east, the other flowing south-west before turning south along the edge of the western flood-plain terrace.

Mesolithic

Trench 65

A humic black clay (2), overlying a relatively high gravel deposit, was radiocarbon dated on a sediment samples to the Late Mesolithic, 6070–5920 cal BC (SUERC-24531, 7130±35 BP), though the reliability of this date is questionable, with no plant material suitable for additional dating found. The pollen, although poorly preserved, suggested an open environment, more akin to that of the overlying Romano-British deposits than would expected for the Late Mesolithic. It is, however, also possible that the date is actually too late, due to inclusion of humified root material in the sample. The deposit is very reminiscent of Early Mesolithic deposits found in other River Thames tributary valleys to the west, including sites at Ufton Green in the Kennet Valley (Chisham 2004) and Three Ways Wharf in the Colne Valley (Lewis and Rackham 2011). The pollen could also be intrusive, given the relative shallowness of the deposits and poor the preservation indicative of aeration of the sediments.

Neolithic

Trench 54

The lowest samples in this trench came from a thin woody peat (110) that was dated from alder cones to the 2860–2490 cal BC (SUERC-31380, 4070±30 BP).

Channel

The peat, which had formed directly above the gravels, contained molluscs indicative of a channel-edge environment (Fig. 8.29), with relatively fast-flowing water and well-vegetated marshy banks, and with a seed


19th/20th century
Saxon
Late Iron Age/Romano British
Iron Age
Neolithic
m OD Section 16
m OD Section 18
Section 19
Section 21
Sample number
Number of shells
Theodoxus fluviatilis
Valvata piscinalis
Bithynia tentaculata
Ancylus fluviatilis
Pisidium spp.
Valvata cristata
Planorbis planorbis and P. carinatus
Planorbarius corneus
Acroloxus lacustris
Lymnaea palustris
Lymnaea peregra
Bathyomphalus contortus, Gyraulus albus, G. crista and Hippeutis complanatus
Lymnaea truncatula
Anisus leucostoma
Succinea/Oxyloma spp.
Carychium minimum
Vallonia pulchella/excentrica
Limicidae
Trichia hispida
Other terrestrial species
Moving water species
Ditch species
Intermediate species (FW)
Amphibious species
Marsh loving species
Shade-loving species
Intermediate species (T)
Open country species
Ratio of Bithynia apices to operculum
Moving water species
Ditch species
Intermediate species (FW)
Amphibious species
Marsh loving species
Shade-loving species
Intermediate species (T)
Open country species

Figure 8.29 (left): Mollusc diagram from Trench 54 showing sequences through the channel in sections 21, 19, 18 and 16

assemblage dominated by alder, bur-reed and water-crowfoot, along with pondweeds, water-plantains, and common club-rush. The overlying loamy sand (109) contained a strandline deposit, indicating a well vegetated channel edge and slower flowing environment.

Vegetation

The pollen and plant macrofossils show the local vegetation to be dominated by alder, but with some other woodland elements present, such as hazel, probably growing up to the channel edge, along with oak, elm, lime and willow. Unusually, some seeds of birch were also recovered, although its pollen was not well represented.

Elder, sloe and bramble represent scrub growing along the shaded edge of the carr, possibly extending into more open, sunlit areas, along with herbaceous species, winter-cress and three-nerved sandwort, the latter being common on mull soils in more open, drier areas of fen woodland.

Wet grassland, probably situated between the channel and the woodland edge scrub, was also well represented; buttercup, dock, sedge, rush, cinquefoil and silver-weeds. Nettle, goosefoot, fat-hen and orache suggest disturbance, possibly by animals, although whether these were wild or domestic is unknown.

Iron Age

Trench 109

A date on plant macrofossils from the base of this sequence indicated that the sediments began to accumulate in the Middle Iron Age, 350–50 cal BC (SUERC-31387, 2125±30 BP), and continued into the Romano-British period.

Channel

The basal deposit, a very humic, silty clay loam, is likely to have formed at a channel edge. Despite frequent rootlets, and potential bioturbation related perhaps to animal activity, no degradation or diminishment in the amount of waterlogged material was noted. The samples contained seeds and pollen of water-crowfoot, water-starwort, duckweed, water-plantain, bur-reed, horsetails and pondweeds, all in keeping with still or slow-flowing water. There are no molluscs present, although diatoms indicative of shallow water deposits were recorded.

Vegetation

The predominant vegetation was a fairly open, wet sedge-grassland, containing many species associated with wet marsh to meadow habitats; rush, meadow-rue, marsh-marigold, meadowsweet and bogbean. While the pollen assemblage had a few components associated with disturbance (eg, goosefoots and daisies/goldenrods) and pasture (eg, bladder campion (*Silene vulgaris*), hoary plantain, ribwort plantain and bracken), there are fewer such indicator species in the seed assemblage, other than occasional seeds of nettle and thistle.

Unlike the samples from Middle Iron Age deposits in Area 2, alder was absent in the plant macrofossils, although it was still well represented in some of the pollen samples. Patches of woodland are indicated by pollen of greater stitchwort, wood vetch and maple, along with seeds of bramble and buds of willow.

Trench 54

The middle part of the sequence (context 107) was dated broadly to the Late Iron Age, 100 cal BC–cal AD 70 (SUERC-31381, 2015±30 BP), although it is possible the underlying undated contexts (108, 109) may extend this sequence back to the Early–Middle Iron Age.

Channel

Sediments comprised typical channel-edge deposits, with molluscs indicating very slow moving to almost still water with long-grassland-marsh at its margins. It is likely that there were also pools of standing water subject to seasonal drying. Mollusc shells become less frequent in the Late Iron Age/early Romano-British period, reflecting less channel influence (Fig. 8.29).

In the lower samples stonewort, yellow water-lily, water-plantain, water-starwort and bur-reed were all dominant (just above Neolithic peat 110, above), but had declined by the Late Iron Age/early Romano-British period, with generally only water edge and marshland species remaining; sedges, rushes, mint, and water-droplets.

Vegetation

Fen sedge-grassland appeared dominant vegetation, with some alder remaining. Given that alder cones only occur in the sample overlying the Late Neolithic peat, it is possible that these are reworked or derive from the underlying layer. Mint is particularly common, as is nettle and along with buttercup and dock, indicate dense swathes of over-grown wet fen grassland/scrub. The Late Iron Age/early Romano-British sample has fewer aquatics and more sedge-grassland species, as well as some indication of scrub, through the presence of seeds of bramble, sloe and elder.

Romano-British

Trench 109

A date of cal AD 60-220 (1885±30 BP, SUERC-31386) from the middle of this sequence indicated a potential Romano-British date for much of it, although a truncation/hiatus horizon above this date, at 1.15 m OD, raises the possibility that the sequence may extend into the Saxon period.

Channel

The channel is very similar to that seen in the underlying Iron Age deposits (above), with sediments accumulating at a channel edge, with a comparable range of species present. Above the dated deposit the sediments indicate deposition under shallow water, with seeds of aquatics, predominately pondweed, and water-plantain, but also bristle club-rush (*Isolepis setacea*) and frequent common reed *Phragmites australis* stems. Similarly, aquatic molluscs (eg, *Bithynia tentaculata* and *Lymnaea peregra*), absent in the lower parts of the sequence, were better represented in these shallow water channel environments. The increase in aquatics might indicate a more stable riverbank, with a smaller, perhaps slightly faster flowing channel.

A single pollen grain of sea lavender (*Limonium*), along with a consistent input of halophilous, mesohalobus and allochthonous polyhalobous diatoms, might indicate some direct contact with brackish tidal water at this time. However, given the dominance of freshwater indicators, this is likely to have been in the form of occasional storm surges (as seen also Area 2).

Vegetation

As with many of the Romano-British assemblages, a reduction in alder implies that it was only present as small stands or individual trees scatted across the floodplain at this time. Many of the species in the sample are fairly typical of long grassy, overgrown riverbanks, such as water-pepper, fool's-water-cress, dock, black horehound (*Ballota nigra*), and wild teasel (*Dipsacus fullonum*). Some of these are more frequent in slightly shaded environments, and some evidence for some scrub is provided by the presence of elder and willow, with alder also present, although only in small amounts. Elements of the open riverbank environment is reflected in the molluscan assemblage, with *Vallonia pulchella* and *Carychium minimum* both associated with marshy, water-meadow and wet pastures. A single shell of *Clausilia bidentata* would be more in keeping with a shady environment, such as that provided by the scrub element.

The pollen also shows a general increase in the grassland environment, with bladder campion, sheep's sorrel, hoary plantain, ribwort plantain and bracken, all potentially associated with disturbance related to grazing.

Trench 52

A short sequence at the base of this trench (context 61) was dated on waterlogged seeds to the Romano-British period, cal AD 250–410 (SUERC-24525, 1710±30 BP), with the two overlying contexts (60 and 59), although undated, probably continuing into the Early Saxon period.

Channel

A general slow-moving, well vegetated channel is indicated, especially in context 61 where the mollusc assemblage was dominated by *Valvata piscinalis* and *Bithynia tentaculata*, with *Theodoxus fluviatilis* also recorded. However, the high ratio of *Bithynia* operculum to apices (13:1), also suggests some input from faster flowing water.

In context 60 there are very high numbers of stonewort stems and gametes, which in places formed dense bands with some indication of lamina, which may be the result of fluctuating water levels. Stonewort are submerged aquatics, and any lowering of water levels could result in a 'death assemblage', which when followed by a return to higher water levels and accompanying sedimentation, would account for the observed bands. In addition it might be noted that species associated with temporary standing water are also much commoner within this context.

The vegetation seen is generally similar for the two lowest deposits (61 and 60), with water-lily, water-crowfoot, water-cress, marsh yellow-cress, arrowhead and water-plantain all present, along with remains of sedges, bur-reed, club-rush and spike-rush.

The channel appears to have become drier by the late Romano-British/Early Saxon period (59), with few freshwater molluscs seen.

Vegetation

The plant macrofossils provided few indications of terrestrial vegetation, other than localised scrub (eg, occasional elder seeds), and wet marsh species; sedges, water-mint, bogbean and water-droplet. Although no alder was recorded in the lowest bulk sample, the persistence of localised stands of alder, hazel, willow and oak woodland in this area is seen in the pollen record (Fig. 8.30), as were herbs indicative of woodland edge: greater stitchwort and woundwort. Grassland pasture is reflected by the dominance of Poaceae and species of waste/disturbed ground: poppy, common nettle, dandelions/chicory and daisies (*Solidago virgaurea*-type).

Trench 65

A date on seeds from context 3 indicates the infilling of a channel starting during the Romano-British period, cal AD 90–350 (SUERC-25617, 1795±40 BP). A date of cal AD 420–590 (SUERC-24532, 1545±30 BP) from the overlying organic alluvium (2b) in the channel suggests that this continued into the Early Saxon period.

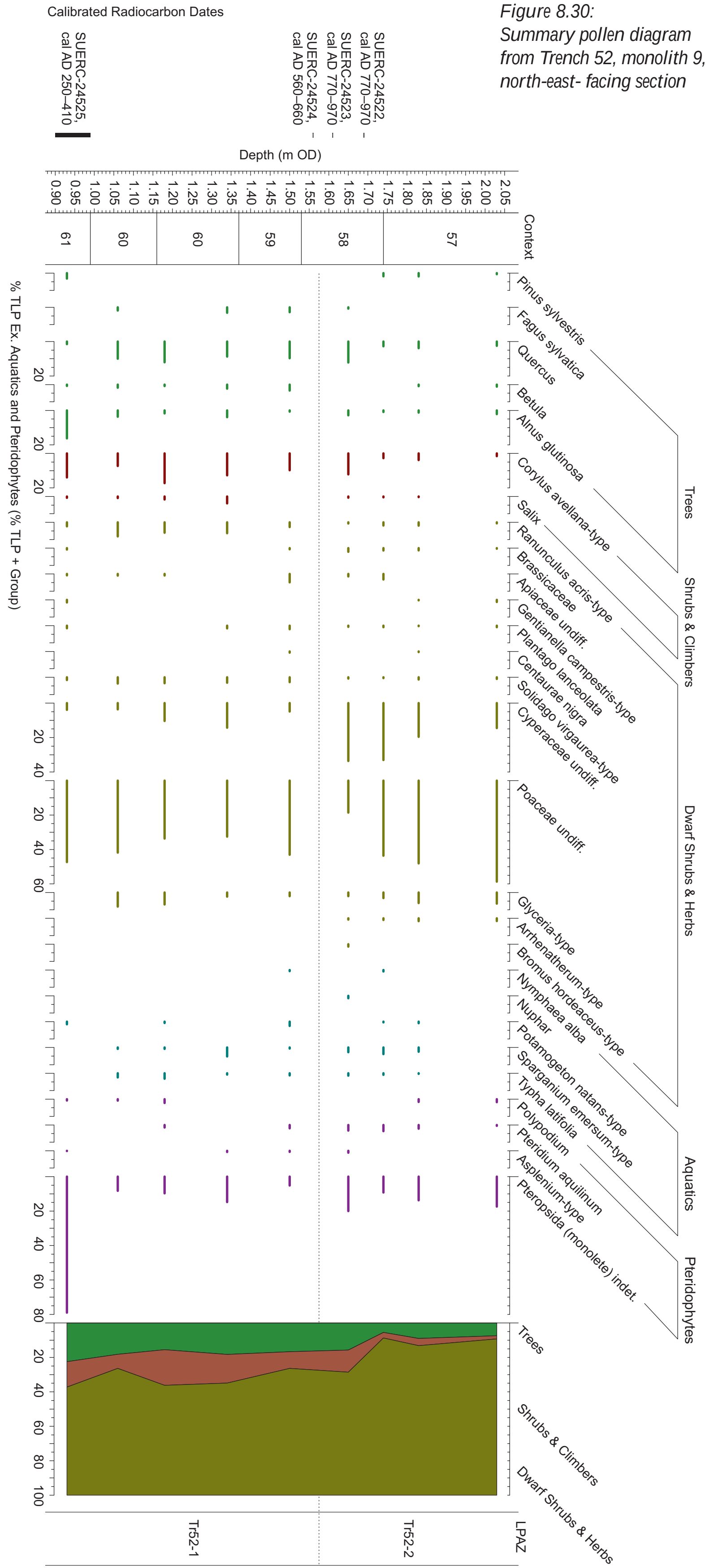
Channel

The organic nature of context 3 suggests a highly vegetated channel with slow moving water subject to occasional stagnation. The remains of stonewort, yellow-water-lily, water-crowfoots, mare's-tail, pondweed, horned-pondweed arrowhead, water-plantain, common club-rush and ephippium of water-flea, are all characteristic of permanent flowing water.

Vegetation

The pollen assemblage indicates a very open land-scape with occasional, scattered willow and alder trees, with more distant sources of hazel and oak. Pollen and waterlogged plant remains show a typical wet sedge-grassland environment with buttercup,

Figure 8.30: Summary pollen diagram from Trench 52, monolith 9, north-east- facing section



meadowsweet, rush, sweet-grass, selfheal, water-mint, dock, sheep's sorrel and ribwort plantain. Several of these elements also imply that this was used for rough pasture.

There was also pollen of *Cerealia*-type, *Polygonum*, hare's-ears (*Bupleurum*), and possibly of thorow-wax (*Bupleurum rotundifolium*) which is more commonly associated with cornfields, all raising the possibility of arable cultivation in the vicinity. Seeds of nettle, goosefoots, orache, and sow-thistle also point to local ground disturbance, although in other trenches these have been associated with pasture and trampling by animals.

Trench 67

Late Romano-British to Early Saxon dates, of cal AD 240–400 (SUERC-26952, 1725±30 BP) and cal AD 260–540 (SUERC-26951, 1645±30 BP), were obtained from the base and top of the sequence, respectively, suggesting a relatively short period of sedimentation. The sequence is situated on a relatively high area of the gravels and, as the dates suggest, would probably not have begun to be significantly affected by alluvium accumulation until the post-Romano-British period.

Channel

The deposits formed as part of an accretional flood-plain soil, probably in wet marshland. Pollen indicates a range of aquatic species; bur-reeds, bulrush, pondweed and water-lily (*Nuphar*), as well as (in the basal samples) horsetail (*Equisetum*) spores, a species particularly associated with stabilisation horizons.

As in Trench 109, there was a single pollen grain of sea lavender, but there was no comparable presence of diatoms associated with elevated salinity levels, so it is possible that this was blown in from areas supporting this vegetation community.

Vegetation

Again many of the species recorded are characteristic of wet sedge-dominated grassland; eg, sweet-grass and meadowsweet, with others indicative of pasture and disturbance. Woodland species are present in such low quantities as to suggest either a more distant source of woodland on the drier valley slopes, for example oak, or isolated individual trees on the flood-plain, for example alder, willow and possibly hazel.

Only assessed data was available for the plant macro-fossils from this trench (Thrale 2008) indicating typical wet grassland, with spike-rush and rush present, but also seeds of species often associated with disturbance, such as poppy (possibly opium), nettle and weld (*Reseda luteola*).

Trench 58

A Romano-British date of cal AD 120–340 (SUERC-36581, 1795±35 BP) was obtained from a birch plank in timber structure 42 inserted in a ditch, aligned north-east–south-west, in the south of the trench.

Channel

The mollusc assemblages from contexts 26 and 423 were dominated by the moving water species, particularly *Valvata piscinalis*, *Bithynia* and *Theodoxus fluviatilis*. Relatively fast flowing water is also indicated by the insect assemblage, including a small number of 'elmid' riffle beetles, such as *Elmis aenea*, *Oulimnius*, *Limnebius volckmari* and *Riolus subviolaceus*, although other water beetles present, such *Hydraena britteni* and *Cercyon ustulatus*, associated with slower water conditions (see Hansen 1987), as is the weevil *Limnobaris pilistriatus*, which is usually linked with sedges and rushes (Koch 1992). The waterlogged plant remains include several fruits and embryos of branched bur-reed and occasional seeds of water-crowfoot.

Vegetation

The mollusc assemblages show local damp grassland, but with a small woodland/hedgerow component, as suggested by a few shells of *Clausilia bidentata* and a single *Curculio* 'nut weevil'.

There is only limited evidence for pasture and grass-land while the channel was filling up, in the form of a small number of *Aphodius* 'dung beetles', and plant feeding weevils, such as *Sitona waterhousei*, associated with bird's-foot-trefoil (*Lotus pedunculatus* and *L. corniculatus*), *S. flavescens* and *Hypera* spp. with clover (*Trifolium* spp.), *S. sulcifrons* with medicks and vetches (*Medicago* spp. and *Vicia* spp.), and *Mecinus pyraster* with plantain. Waterlogged seeds substantiated both elements of the insect and mollusc assemblages, with large numbers of seeds of elder and bramble indicating hedges or localised scrub close to the Romano-British channel. Seeds of nettle, buttercup and thistle are more likely associated with disturbed grassland pasture.

Trench 59

To the immediate south of Trench 58, a single sample from Romano-British ditch 2005 produced a very small insect fauna, including a limited number of *Aphodius granarius* dung beetles, which may suggest pasture in the area. Pollen from this trench indicated a largely open environment, again suggesting possible pasture.

Saxon

Trench 111

Three Middle–Late Saxon dates were obtained from the sequence in this trench: cal AD 650–860 (SUERC-25618, 1295±40 BP) from context 79; cal AD 670–880 (SUERC-25619, 1245±40 BP) from context 78; and cal AD 640–780 (SUERC-25620, 1315±40 BP) from context 67. Although just south of Trench 109, and with the underlying gravels at a similar altitude, the alluvial deposits in this trench are much thicker, and appear somewhat later than those in Trench 109.

Channel

Rapid alluviation appears to have occurred at this location during the 7th–9th centuries, with the organic alluvial sediments overlying the gravels apparently laid down in a shallow water marsh environment, with repeated inwashes of sand indicating a series of higher energy events. In the diatom assemblage, the small numbers of frustules of *Navicula menisculus*, *Rhoicosphaenia curvata* and *Gomphonema olivaceum* may indicate slightly raised salinity levels, while those of *Achnanthes clevei* and *Achnanthes kolbei* can be tied to the sand inwashes.

The aquatic vegetation points to a shallow, slow flowing to still-water environment, while the wide range of aquatic species present; stonewort, water-lily, water-cress, pondweed, horned pondweed, water-plantain, arrowhead, bur-reed, horsetails, water-milfoil, water-starworts, bulrush and, in particular, common club-rush, suggest a densely vegetated channel. More unusual were several stems and possible rhizomes of common reed (*Phragmites australis*) which were uncommon across the Olympic Park. Seeds of common club-rush were common in the basal samples, but then decline, possibly also reflected in a similar decline in pollen of Cyperaceae. These changes are also accompanied by a general reduction in aquatics.

Vegetation

High numbers of seeds of bogbean, along with rush, mint and gypsywort, are typically associated with fen-marsh communities, along with characteristic wet grassland species, such as buttercup, meadowsweet and marsh-marigold. The higher number of celery-leaved buttercup may again be of some significance, given the trench's relatively southerly location, and is also indicative of more disturbed wasteland soils, with stitchwort, goosefoots, dock, and thistle also reasonably well represented.

Trench 52

Three radiocarbon dates obtained on seeds and sediment from bulk sediments (58 and 61) indicate that these deposits formed from cal AD 560–660 (SUERC-24524, 1440±30 BP) to cal AD 770–970 (SUERC-24522, 1170±30 BP, and SUERC-24523, 1165±30 BP).

Channel

By at least the Late Saxon period the sediments (contexts 57 and 56) indicate an increased input of overbank alluvium, and potentially a drying out of the channel following the Romano-British period. Both mollusc shells and ostracods are absent from the dated Saxon parts of the sequence and diatoms are extremely rare. However, seeds were preserved from a range of species associated with marsh and fen, such as bogbean, dropwort, rush, spike-rush and mint, although, with the exception of the occasional seeds of water-crowfoot and gametes of stonewort, there are almost no aquatics to indicate standing water. Molluscs from the uppermost context (56) also indicate temporary pools of standing water subject to seasonal drying, rather than moving water.

Vegetation

In the post-Romano-British period there were changes in the local floodplain, with the channel possibly shifting away from the sample location. The plant macrofossils and pollen (Fig. 8.30) show a wet marshy sedge-grassland containing buttercup, sweet-grass, field gentian and rushes, as well as fen-marsh elements such as bogbean and gypsywort. The environment appears generally open, with the low levels of woodland taxa probably reflecting more distant woodland, with occasional alder trees on the floodplain.

Celery-leaved buttercup, seen in several trenches in earlier periods, was quite common in this period (eg, Trench 111 above), and may indicate poorly managed marshy pastureland.

Trench 54

The sediments (possibly contexts 73, 72 and 70) from the very top of the sequence were dated to the Middle–Late Saxon period, cal AD 770–970 (SUERC-31382, 1175±30 BP), although it is possible that this upper sequence begins in the Early Saxon period, and is therefore broadly contemporary with that in Trench 52.

Channel

The sediments from the top of this sequence consisted of organic over-bank alluvium deposited in a well-vegetated marsh environment on the channel edge, with (as in trench 52) indications of drying towards the end of the period.

The ostracod assemblage, including *Prionocypris zenkeri*, indicated a very slow-flowing to still-water environment. A single carapace of *Limnocytherina sanctipatricii* might indicate the presence of ponds or ditches upon the local marsh. The mollusc assemblage showed a clear change in channel activity from the Romano-British period, with moving water species dominating in the Early–Middle Saxon period (Fig. 8.29). However, by the Middle–Late Saxon period molluscs were relatively rare indicating, as with other forms of evidence, the gradually reduced channel and the eventual drying out of these deposits. Despite this, aquatics are reasonably well represented in all the Saxon contexts, with branched bur-reed recorded both through waterlogged remains and pollen, along with water-crowfoot, water-milfoil, arrowhead, water-plantain, common club-rush and branched bur-reed, although some of these seeds may have been carried in by over-bank flooding.

Vegetation

The vegetation is similar to that seen in the broadly Late Iron Age deposits in this trench, with a predominately open landscape of wet sedge-grassland, with some marsh and meadow elements, including meadow-rue, water-pepper, water-droplets and bogbean. There was very little woodland nearby; pollen of alder, willow and hazel might indicate small isolated stands along the floodplain, with pollen of oak and, more certainly, beech coming from woodland on or beyond the drier valley slopes.

Trench 43

Two ditches in this trench were dated to the Middle–Late Saxon period. Ditch 603 was dated to cal AD 610–770 (SUERC-36230, 1360±30 BP), while ditch 628 was dated to the cal AD 770–980 (SUERC-34958, 1145±35 BP). Post-hole 513, which cut ditch 628, yielded a date of cal AD 640–770 (SUERC-36231, 1335±30 BP).

Channel

The ditches appear quite vegetated with frequent gametes of *chara*, and seeds of duckweed, water-crowfoot, water-starwort, water-plantain, lesser water-plantain, arrowhead, and water-milfoil, the latter also associated with remains of the snout beetle *Phytobius canaliculatu*. They are likely to have had areas of permanent, standing and very slowly flowing water in them seen though the remains of the diving water beetle (*Hygrotus decoratus*) and whirligig (*Gyrinus* spp.). Taller vegetation included spike-rush, and common-club-rush, whose seeds may have been brought in from nearby channels, as well as sedges probably spreading beyond the ditches. The insect fauna also indicated well vegetated ditches, while the leaf beetles *Donacia clavipes* and common reed also suggest the presence of *Phragmites australis*, which is less readily identified from macrofossils alone, unless identifiable stems are present.

Vegetation

The landscape beyond the ditches can be seen to be very open, although occasional seeds of bramble and elder suggest patches of low-growing scrub. The main vegetation can be seen to be open grassland with buttercups and greater-plantain, although the high incidence of sedges, rushes and spikerush indicate abundant wetland species. Other seeds are of wet marshland and fenland species; bogbean, water-dropworts, mint and gypsywort. Remains of the weevil *Notaris* spp., associated with sweet-grass, was also present.

Given the presence of the ditches, there are surprisingly few signs of species characteristic of disturbance, with only a few seeds of nettle, orache, knotgrass, stitchwort and goosefoots, although there was a single seed of swine-cress (*Coronopus squamatus*), associated with areas of animal trampling. The dung beetle *Aphodius* sp. also indicates grazing near the ditches.

Late Saxon/early medieval

Trench 56

Three radiocarbon dates in the Saxo-Norman period, of cal AD 980–1160 (SUERC-34943, 985±35 BP), cal AD 1030–1210 (SUERC-35335, 905±30 BP) and cal AD 1010–1160 (SUERC-36288, 970±30 BP), were obtained from a pit (239) containing a possible wattle structure (Figs 4.8, 8.8, above). Although initially interpreted as a possible retting pit, it contained no environmental evidence of this or any other specific activity.

Channel

The pit appears to have been either dug in an active channel or had water from an active channel entering it during its infilling. This is seen through the presence of 'water beetles' *Haliplus* sp., *Cercyon cf. tristis* and the elmid *Dryops* spp., all associated with slow flowing water. The most common seeds were those of pondweed and horned pondweed, and there was pollen of duckweed and bur-reeds. A small amount of pollen from bulrush was present in the alluvial layer sealing the pit.

Vegetation

The local vegetation appears to be dominated by sedge-grassland. Amongst the species present were those of buttercup, spike-rush, trifid bur-marigold (*Bidens tripartita*), sweet-grass and sedge, as well as weeds of disturbance, such as sow-thistle. The vegetation post-dating the pit within the channel appears broadly similar with buttercups, and some indication of disturbance through the appearance of Chenopodiaceae, *Polygonum*, ribwort plantain, and Asteraceae pollen. There was some evidence for cereal pollen, which taken together with the remains of charred cereals in the pit, may relate to local milling activities, or generally the storage and processing of cereals on site.

There is little to no evidence for woodland in the vicinity during the infilling of the pit or within the subsequent primary filling of the channel. Sporadic pollen of willow, alder, elder, with slightly more indication of hazel, might suggest occasional trees within the floodplain, whereas low levels of oak, and at least in the pit, birch, may again relate to individual trees or more distance woodland. The final uppermost sealing layer of clay alluvium (196) had even fewer woodland species, and no hazel pollen.

A single very small insect fauna was recovered from the pit. It is one of the few samples from the Olympic Park site which contained a number of taxa that are commonly found in archaeological settlements particularly in dry materials such as hay and straw; such as the mycetophagid *Typhaea stercorea* and a range of cryptophagids and lathridiids recovered. Though these species may indicate that such material was incorporated into this feature, they can also be found in natural environments away from human habitation (Smith 2000b). There are also indications that this feature may have been flooded, given the presence of 'water beetles' *Haliplus* sp., *Cercyon* cf. *tristis* and the elmid *Dryops* spp., all associated with slow flowing water. Additionally, the weevil *Notaris acridulus*, which is associated with reed sweet-grass (*Glyceria maxima*), was also recovered.

Post-medieval and modern

Trench 52

The upper part of this sequence (context 43, and also potentially 57 and 56) was undated but is likely to date between the early medieval period and the 18th century.

Fig and grape remains were found in context 43; such remains have varying significance across the London region, depending on the circumstances of recovery. While they could be relatively recent in date (eg, 19th–20th century), deriving from cess incorporated into made ground, they could also indicate medieval or early post-medieval occupation in the area. There were also a few indicators of arable, disturbed or waste soils such as the presence of knotgrass, chickweed and goosefoots.

Trench 44

Drainage ditch 1029 contained some pony bones, derived from a total of five individuals of varying age, probably originating from a nearby bone works (see Chapter 6). The main molluscan species from the ditch are *Valvata piscinalis*, *Valvata cristata* and *Gyraulus crista*, indicating a permanently wet, well vegetated, flowing water environment, with areas of damp long grass along its edge. No insects associated with rotting animals were recovered and there is little indication of any function for this ditch beyond probably drainage.

Trench 58

A probable medieval channel (on a different line from the Romano-British channel, above) contained a wattle revetment (100, Fig. 5.10, above) dated to cal AD 1470–1670 (SUERC-36580, 315±35 BP). It subsequently underwent a number of phases of recutting.

Channel

The molluscs, from channel contexts 122, 132, 281 and 74, indicate well oxygenated flowing water in a local landscape of open, probably damp grassland, with a few areas of marshy ground on the channel edge (Fig. 8.31). The assemblages are generally dominated by *Valvata piscinalis*, *Bithynia* and *Theodoxus fluviatilis*. The level of vegetation associated with the channel fluctuated, as did the rate of water flow, possibly related to the channel's suggested use as a millstream (see Chapter 5). The occurrence of *Viviparus viviparus* and *V. contectus* (Pl. 8.1) in context 281 (in recut 81/282) may mark the onset of a greater use of this channel in a wider water-management scheme, as the channel became less densely vegetated. *Viviparus viviparus* is 'restricted to large deep bodies of still or slowly moving, well-oxygenated water in major lowland rivers, canalised waterways and canals' while *V. contectus* 'favours large bodies of well-oxygenated, hard water over muddy substrates in major lowland rivers, canals and drainage ditches' (Kerney 1999, 25–6). The waterlogged plant remains indicated a slightly more

Plate 8.1: Examples of Viviparus vivparus

vegetated channel than the molluscs, although seeds of submerged and floating aquatics, such as water-plantain and water-crowfoot were largely absent. However, seeds of both branched bur-reed and common club-rush, were quite well represented, in particular the former. Also present were a few seeds of yellow water-lily, pondweed and water-cress. Perhaps more significantly were quite high numbers of statoblasts of the bryozoa of *Plumatella*-type, which as with most bryozoa often tend to be more common where there is vegetation.

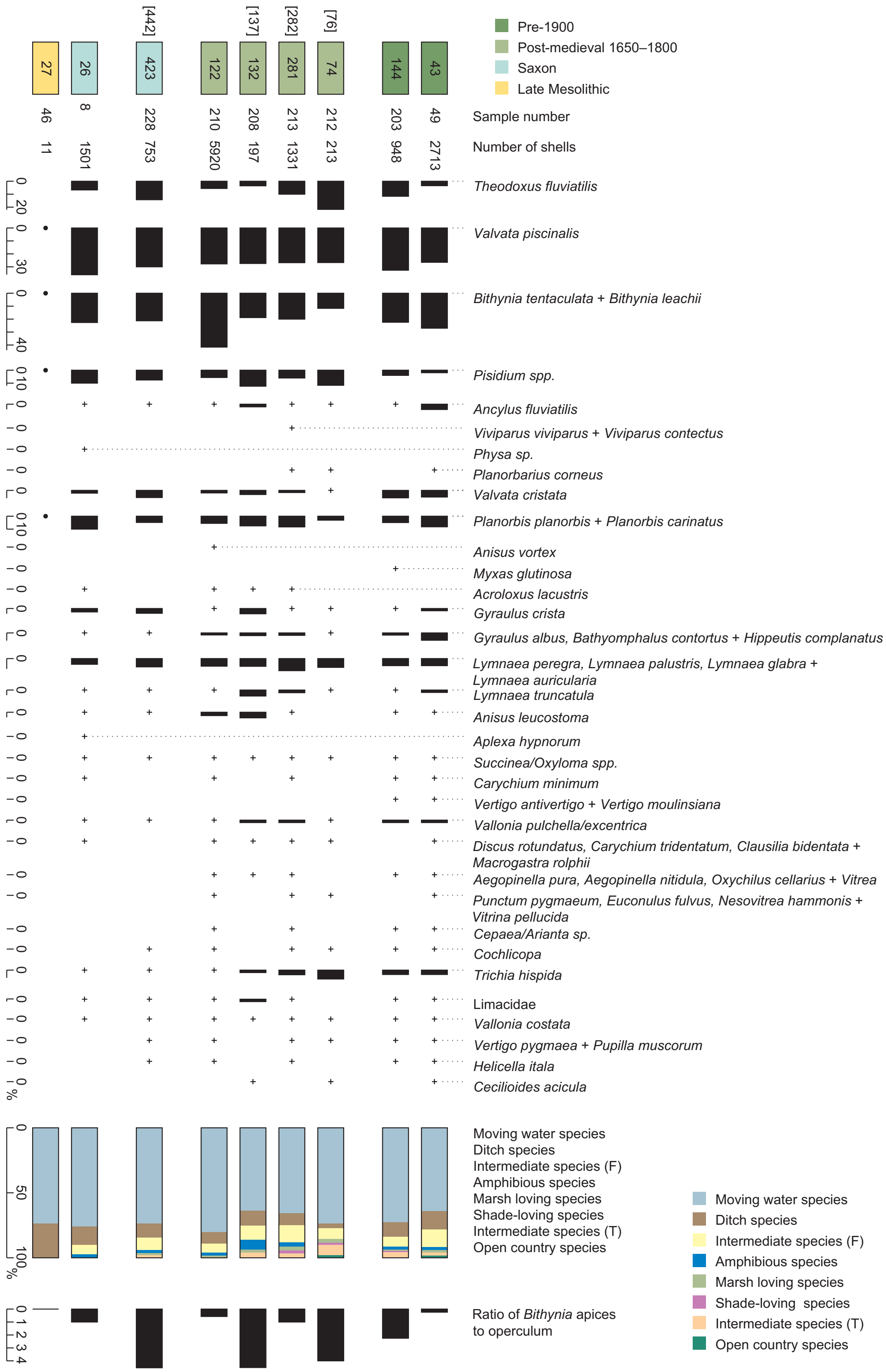
The predominant ostracod taxon in the channel is *Limnocythere inopinata* which, while known from a wide range of shallow freshwater environments (ponds, lakes, brooks and rivers), is more tolerant than any other ostracod of alkaline waters (Meisch 2000). There are two specimens of *Ilyocypris bradyi* which is often associated with spring-fed waters.

These general trends, of a channel with fluctuating flow, speed and vegetation abundance, appear to continue up to the pre-1900 phase of the site, as shown by the molluscs from contexts 144 and 43, which also include freshwater ostracod faunas dominated by the taxa *Candona candida* and *C. neglecta*. These and the other remains in the samples are indicative of deposition in a shallow, slow moving, vegetated, fresh water body. The slightly conflicting evidence most likely reflects the clearance and re-cutting of the centre of the channel with patches of vegetation surviving along the channel edges.

Vegetation

The low presence of woodland molluscs, such as cf. *Macrogastra rolphii*, are further indications of small patches of trees in the vicinity. In the pre-1900 phase of

Figure 8.31: Mollusc sequence through the Late Mesolithic deposit and the Saxon, 1650–1800 and pre-1900 deposits within the channel from Trench 58



the site there was a slight increase of molluscs likely to be exploiting marshy patches and open grassland near the channel edge, including *Vertigo* cf. *moulinsiana*, which thrives in marshy environments with tall vegetation, such as common reed or sweet-grass.

The waterlogged assemblages had relatively large numbers of seeds of buttercup, nettle, thistles and dock all in keeping with open grassland pasture. Slightly unusual were high numbers of seeds of cow parsley (*Anthriscus sylvestris*). While a characteristic plant of riverside grassland today, this species is very rarely found in waterlogged deposits dating to before the medieval period, and absent from any of the other Olympic Park contexts. However, while it was considered non-native by Godwin (1984), it has been recorded from Romano-British deposits at Appleford, Oxfordshire (Robinson 1981). As with the mollusc evidence there was also a strong indication of woody shrub, with high numbers of seeds of elder present.

Trench 46

A sample from layer 505 dating to the early 19th century was examined for molluscs. This deposit abutted revetment 506, parallel with the modern day City Mill River.

Channel

The mollusc assemblage from layer 505 indicates an area of swampy marsh and damp grassland, occasionally with water flowing down it close to the revetment. It was dominated by land snail species, notably Limacidae, *Trichia hispida* and *Vallonia pulchella/excentrica*, which can live in marsh and damp grassland. The major components of the fresh water groups were the amphibious species *Anisus leucostoma* and *Lymnaea truncatula* which favour marshy grassland and swampy pools subject to seasonal desiccation.

Vegetation

The plant assemblage in this sample (Roberts 2009b) also indicates an open, wet, disturbed grassland and marshy environment, with seeds of sedges, docks, buttercup and water-plantain, as well as some species more typical of disturbed soils and waste ground, such as stitchwort/chickweed goosefoots, dandelions and knotgrass.

Trench 54

A buried soil at the top of this trench probably dated to the mid-19th century or later. As might be expected, aquatics and mollusc remains are largely absent. The few preserved seeds indicate a wet disturbed rough-grassland, possibly pasture, with buttercup, rushes, meadow-rue, nettle, cinquefoil, gypsywort, and goldenrods and/or ragwort.

Discussion

by Chris J. Stevens, Michael J. Grant, David Norcott and Sarah F. Wyles

The Landscape Evolution of the Lower Lea Valley

The results of the environmental and geoarchaeological analyses (Table 8.10), presented above, are discussed below by period within the wider context of the lower Lea Valley and London region.

Late Pleistocene and Early Holocene

The deposit modelling has revealed the Late Pleistocene down-cutting of the underlying geology, and shown that, within the Olympic Park site, the main passage of water flow lay on the western edge of the floodplain, on the river's outer curve, with a number of tributary streams draining the adjacent terraces. The down-cutting was followed by the main period of aggradation of gravels across this newly cut valley. The presence of a number of dated organic lenses within the gravels demonstrate that aggradation occurred over a prolonged period. These comprise both reworked Arctic Bed deposits on the eastern side of the floodplain, probably derived from the proto-Phillibrook Stream, and a series of GI-1 deposits within the centre of the floodplain, found both within the gravels and immediately overlying them.

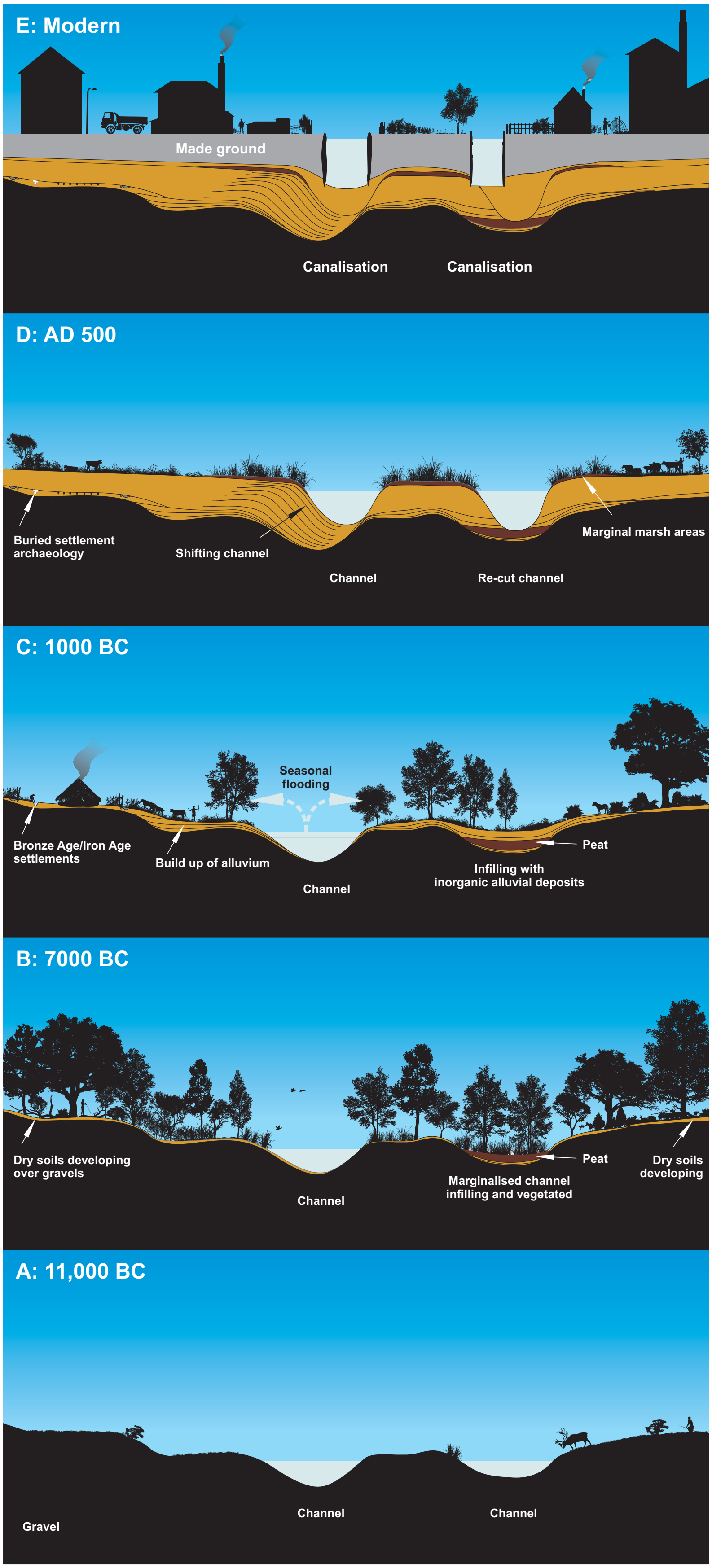
Through this gravel topography, fluctuating river flow rates and flooding carved out a series of channel areas resulting in an anastomosed floodplain. There was extensive marsh, dominated by rushes, reeds and sedges, across the valley floor, while the surrounding vegetation, including on the drier lower gravel terraces, remained largely open tundra with patches of birch and pine (Fig. 8.32a). Although not evidenced by faunal remains, this Late Pleistocene landscape in the warmer GI-1 probably supported tarpan (horse), red deer, elk (moose) and aurochs, while the succeeding colder conditions in GS-1 probably saw the return of bison and reindeer.

As flow rates lessened, marginal channel areas became cut off, forming open pools that were quickly colonised by marsh (Fig. 8.33). Initially (mainly during GS-1), they were infilled by calcareous deposits, but in the Early Holocene they saw the formation of peat deposits. Such areas were particularly prevalent along the margins of the floodplain, being recorded on the western side at Crown Wharf Ironworks (Stephenson 2008) and Omega Works (Spurr 2006), and on the eastern side at Stratford Box (Barnett *et al.* 2011), Temple Mills Depot (Bates and Stafford in press) and in Trench 118 (see above). This sequence of depositional events was also

Table 8.10: Summary of chronology of trench palaeo-environmental sequences

	GS-1/EH	Mesolithic		Neolithic			Bronze Age			Iron Age			R–British		Saxon			Medieval		Post–med.	
Tr.		E	L	E	M	L	E	M	L	E	M	L	E	L	E	M	L	E	L	E	L
Area 1 (N)																					
71	✓	✓	–	–	–	–	–	–	–	–	?	?✓	?✓	?	–	–	–	?	✓	?	–
72	–	–	–	✓	✓	✓	–	–	–	–	–	–	✓	–	–	–	–	–	–	–	–
75	[sediment]	–	–	–	–	–	✓	?✓	–	–	–	–	–	–	–	–	–	–	–	✓	–
93	–	–	–	–	–	–	✓	?✓	–	–	–	–	✓	?	–	–	–	–	–	–	–
94	✓	✓	✓	–	–	–	–	–	–	–	–	–	[animal bone]	–	–	–	–	–	–	–	–
99	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	[waterlogged plant remains]	[waterlogged plant remains]
120	–	–	–	[waterlogged plant remains]	[waterlogged plant remains]	✓	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Area 2 (SE)																					
7	–	–	–	–	–	–	–	–	–	–	–	–	–	–	✓	–	–	–	–	–	–
9	–	–	–	–	–	–	–	–	–	–	✓	–	–	–	–	–	–	–	–	–	–
10	–	–	–	–	–	–	–	–	–	[waterlogged plant remains]	[waterlogged plant remains]	–	–	–	–	–	–	–	–	–	–
13	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	[molluscs]	[molluscs]
21	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	✓	✓	–	✓	–	–
24	–	–	–	–	–	–	–	✓	–	–	–	–	–	–	–	–	?	?	?	?✓	✓
27	–	–	–	–	–	–	–	–	–	–	–	–	–	–	✓	✓	–	–	–	–	–
29	–	–	–	–	–	–	–	–	–	–	–	–	✓	✓	–	–	–	–	–		[waterlogged plant remains]
33	–	–	✓	–	–	–	–	–	–	–	✓	–	–	–	–	–	–	–	–	–	–
34	–	–	–	–	–	–	–	–	–	?	✓	?	?	–	–	–	–	–	–	–	–
35	–	–	–	–	–	–	–	–	–	–	✓	?	?	–	–	–	–	–	–	–	–
118	?✓	–	–	✓	✓	✓	–	✓	✓	–	?	✓	✓	?	?	?	?	?	✓	✓	–
Area 3 (SW)																					
43	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	✓	✓	–	–	–	–
44	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	[molluscs]
46	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	✓
52	–	–	–	–	–	–	–	–	–	–	–	–	–	✓	✓	✓	✓	–	?	[waterlogged plant remains]	?
54	–	–	–	–	–	✓	–	–	–	–	–	✓	✓	?	?	✓	✓	–	–	–	[waterlogged plant remains]
56	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	✓	✓	–	–	–
58	–	–	✓	–	–	–	–	–	–	–	–	–	✓	✓	✓	✓	✓	–	✓	✓	–
59	–	–	–	–	–	–	–	–	–	–	–	✓	✓	–	–	–	✓	✓	–	–	–
65	[sediment]	–	–	–	–	–	–	–	–	–	–	–	✓	✓	✓	–	–	–	–	–	–
67	–	–	–	–	–	–	–	–	–	–	–	–	–	✓	✓	?✓	–	–	–	–	–
109	–	–	–	–	–	–	–	–	–	–	✓	✓	✓	?✓	–	–	–	–	–	–	–
111	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	✓	✓	–	–	–	–

Key: Single analysis undertaken [molluscs] molluscs; [waterlogged plant remains] waterlogged plant remains; [sediment] sediment; [animal bone] animal bone; ✓ analysis for multiple datasets; ? date of sequence is uncertain and environmental material of this period may be represented; GS-1=Greenland Stadial 1; EH=Early Holocene.



documented in the centre of the floodplain in Area 1, in Trenches 71 and 94, showing that such changes in the channel environment were widespread across the area (Fig. 8.34).

The pollen evidence demonstrates grassland to be dominant in the Early Holocene, with a number of typical wet grassland taxa, such as buttercup and meadowsweet, also identified through plant macrofossils. Several species were also recorded that today have restricted distributions in the northerly, montane areas of the British Isles; as temperatures rose, their survival was less directly dependant on the climate, but on the speed at which competing species arrived in the valley. Prior to the domination by forest, the presence of larger herbivores, such as aurochs, elk, red and roe deer and possibly horse, is indicated by the recovery of dung beetles (cf. Yalden 1999, 65–78).

Mesolithic

The first indications of the incursion of woodland in the Olympic Park site date to around 9300-9000 cal BC, with a vegetation succession from sparse birch and open pine woodland to denser pine forest with some hazel, birch and elm. This succession was only clearly seen in the sequence from Trench 71, although it has previously been recorded at Temple Mills Depot, Stratford Box and Omega Works (Fig. 8.34), as well as further north in the lower Lea Valley.

A lack of macrofossils for this earliest phase means little information was obtained about the river-edge vegetation, although by comparison with similar sequences from further north (eg, Innova Park; Ritchie *et al.* 2008) this probably included willow, aspen, dwarf and downy birch. The establishment of these trees would have helped to stabilise the channel margins (Smith 1976), helping to fix the channel areas identified in the topographic model.

Between 8500 and 7500 BC there was a reduction in pine in the surrounding woodland and hazel and elm became dominant, although the aspen, willow, dogwood and hazel growing along the channel edges formed an important part of local valley bottom vegetation. The subsequent arrival of oak, alder and lime completed the main migration of deciduous woodland taxa found in typical later Mesolithic pollen assemblages.

The arrival of alder on the floodplain is seen in the Trench 71, the top of the Trench 94 sequence, and at Temple Mills Depot (Trench 4042, Bates and Stafford in press). Although there was no clear dating for its arrival (within the sequences that recorded its expansion), the presence of firmly established communities in the dated sequences from Omega Works and Stratford Box (dated 6000–5000 cal BC) suggest that it probably arrived locally *c.* 7500–7000 cal BC, by which time the floodplain would have been highly vegetated in places. Former channel areas were colonised by alder, forming carr communities, while dry land upon the raised gravel areas in the floodplain continued to develop soils (Fig. 8.32b).

The plant macrofossils from Early Mesolithic deposits (Trenches 71 and 94; Fig. 8.33) include a mix of woodland and scrub species, with plant communities indicative of disturbance and grassland also well represented. Coleoptera indicative of the dung of larger herbivores were recovered from Trench 71. The pollen from Trench 71 (Fig. 8.15; LPAZ Tr 71–4) also suggests some local openness, although not as open as some authors have previously suggested (eg, Vera 2000).

As found elsewhere in the lower Lea Valley, only short and intermittent sediment sequences were available for the Late Mesolithic (Trenches 71 and 94; Fig. 8.34). Moreover, because the drying out of these sediments made the macrofossils within them largely unsuitable for radiocarbon dating (some of material selected failed to yield sufficient carbon), less suitable plant material and sediments from these trenches were used, resulting in a series of apparently spurious dates.

However, a radiocarbon date on alder cones from Trench 33 (Area 2) does provide insight into the very Late Mesolithic environment, ie, of the mid–late 5th millennium BC, and the landscape that would have been encountered by the first Neolithic inhabitants. This included alder

Figure 8.32 (left): General development of the landscape of the Olympic Park site through time, showing the main features of sedimentation, vegetation and land-use occurring during the:
(A) Late Pleistocene,
(B) Mesolithic,
(C) Bronze Age,
(D) Saxon and
(E) post-medieval periods

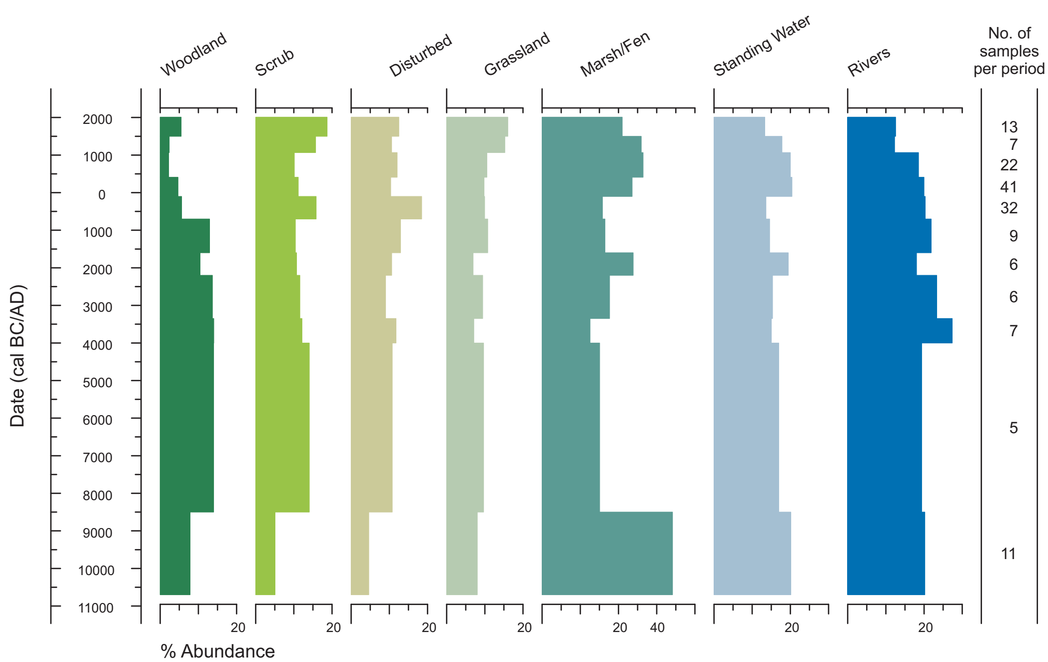
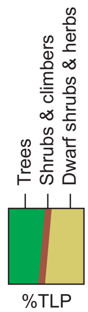


Figure 8.33: Histogram showing the percentage of species abundance, derived from waterlogged plant remains assemblages, associated with each habitat type for each period for all the combined trenches. For each sample the abundances of species associated with that habitat were totalled. Where seeds etc. were identified only to family or genus level and more than one habitat was represented, the abundances were equally divided between each habitat. The abundances from every sample were then totalled for each period and the percentage representation of each broad habitat calculated and plotted



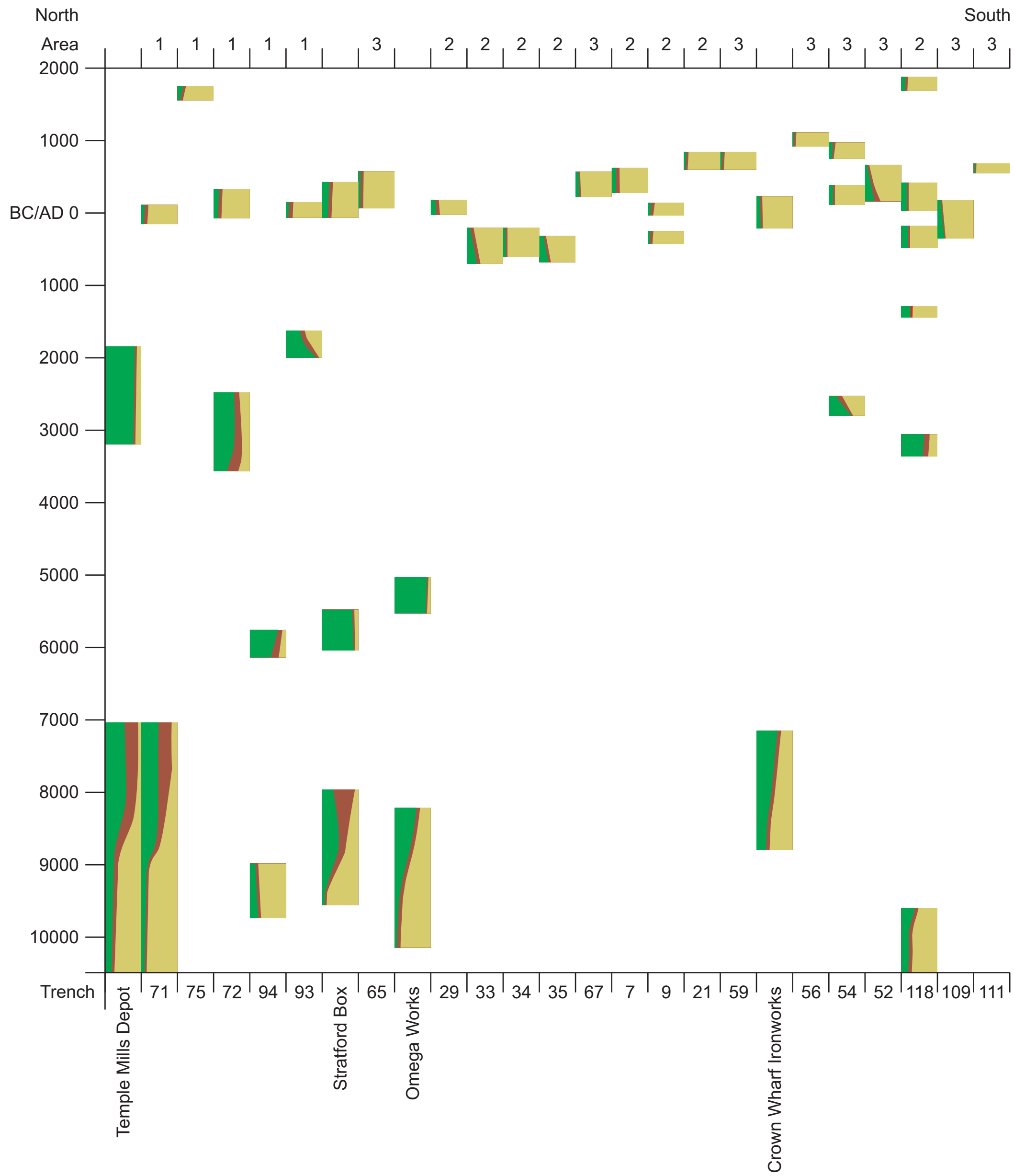


Figure 8.34: Summary of pollen sequences obtained from the Olympic Park and adjacent sites

woodland with scrub along its edge, marsh, and disturbed grassland, although the pattern in this trench may have been quite localised. The local dominance of alder carr is seen in a short sequence at Stratford Box, and possibly also at Omega Works.

The combined environmental evidence from the Olympic Park, therefore, indicates that there were patches of open grassland and scrub on the floodplain throughout the Mesolithic. These would have attracted browsing and grazing animals (Yalden 1999, 65–78), which in turn would have attracted hunters. This is a pattern reflected in other, contemporary floodplain sequences from the Britain (eg, Whitehouse and Smith 2004; 2010; Brayshay and Dinnin 1999; Hodder *et al.* 2005; Svenning 2002).

Neolithic

In many respects the Early Neolithic landscape would have been little changed from the Mesolithic, with hazel, oak and lime continuing to dominate woodland on the dry-land areas, with alder still dominating those parts of the valley floor where channel activity was limited, with small amounts of pine probably also still present in places. In the drier, less flooded areas, the carr woodland was edged by narrow strips of scrub containing hawthorn, sloe, elder and bramble, while samples from several trenches suggest long periods of more stable river-side environments, with hazel, oak and probably lime, as well as other species more associated with dry to moist soils, growing right up to the channel edge.

There was evidence for marshy-grassland in all the trenches (Fig. 8.33), with some indications of human activity and general disturbance, although the areas identified in Area 1 are unlikely to have been extensive. In Area 2 (Trench 118), there seems to have been a greater expanse of marsh, possibly associated with a wide, slow-flowing channel, although alder, hazel and wet grassland were found to extend right up to this channel's edge. The marsh attracted human activity, as evidenced by the flint axe, flint debitage and pottery, and by a wooden structure (see Chapter 2), possibly near a crossing point between the raised gravel area to the north-west (where later prehistoric settlement was located) and a gravel island to the east, where Neolithic finds were also identified at Stratford Market Depot (Hiller and Wilkinson 2005).

For the Late Neolithic, there was evidence from three trenches, across the valley, for alder and hazel woodland, that in Trench 120 following earlier disturbance. Alder and hazel predominated in Trenches 118 and 54, with antlers at the former indicating the presence of red deer in more open areas of the landscape, but little evidence for marsh or any substantial active channel nearby; at the latter there was a much greater representation of channel vegetation, such as bur-reed.

Mixed woodland containing oak, lime, hazel and some ash, but dominated by alder, was also shown to have been present at Temple Mills Depot throughout the Neolithic and continuing into the Early Bronze Age (Bates and Stafford in press).

Bronze Age

Although alder remained dominant on the valley floor at the start of the period, with oak, lime and hazel woodland on the adjacent drier soils, the Bronze Age saw substantial vegetational changes in the valley, contemporary with quite widespread archaeological remains. There appears to have been a general shifting of channel courses in this period, with new channels forming, and others becoming cut off and gradually infilled.

Pollen records from the wider region generally show reductions in drier wood-land elements, notably lime at this time, and this has often been interpreted in terms of woodland clearance (eg, Sidell *et al.* 2000; Wilkinson *et al.* 2000), although changes in sea-level and the expansion of wetland are equally possible. Waller and Grant (2012) have shown that major reductions in lime in pollen diagrams from the Thames Estuary are poor indicators of vegetation change in the adjacent dry-land areas. Its apparently consistent decline across the London area (eg, Rackham and Sidell 2000, 23) is perhaps better interpreted as related to changing wetland processes, rather than reflecting local woodland clearance. Nonetheless, clearance for the establish-ment of Bronze Age field systems and settlements is widely known to have occurred all along the Thames Valley, both along the gravel terraces and in the higher areas (cf. Yates 1999; 2007; Ritchie *et al.* 2008; also see Chapter 3).

Reductions in lime recorded in a number of trenches appear either to coincide with possible stratigraphic hiatuses and irregular depositional environments (eg, active channel deposits), or to be of uncertain date; these records should be treated with caution. It is also unclear to what extent the pollen from the trench sequences reflects woodland reduction on the valley margins rather than the immediate floodplain itself. The reductions in lime recorded in Trenches 93 and 96 occurred alongside a general decline in dry-land woodland taxa, while alder remained locally abundant in some of the overlying samples prior to its final decline.

The eventual reduction of alder can be seen across the Thames region as an on-going process beginning in the Middle–Late Bronze Age and continuing into the Iron Age. It coincided at many locations with a continued rise is sea-level (associated with the Thames IV and V transgressions; Devoy 1979), which led to major vegetation changes from wood carr to open wet grassland on the floodplain, as indicated by an expansion of herbaceous taxa (eg, Sidell *et al.* 2000; Thomas and Rackham 1996).

This change, in places often with indications of grazing, can be seen in broadly contemporaneous sequences from the Olympic Park site. An increase in the pollen of large Poaceae (notably in Trench 93), following the fall in lime values, has been identified as indicating predominantly sweet-grass rather than cereals. At other trenches too (apart from those with direct evidence of settlement, such as Trench 9), such pollen was derived from local wetland grass taxa, as supported by coincidental finds of *Glyceria* seeds and beetles associated with sweet-grass. There have been similar findings from recent studies from Aveley and Rainham Marshes (Waller and Grant 2012) and this casts doubt on the many interpretations of increases in large Poaceae pollen grains at coastal and floodplain sites as being indicative of arable cultivation (eg, Bates and Stafford in press; Stafford in press; Sidell *et al.* 2000; Coles *et al.* 2008; Rackham and Sidell 2000, 23; Branch *et al.* 2012).

The decline in alder on the floodplain, most noticeable in the Trench 118 sequences, is found to be generally widespread and accompanied by an increase in species associated with standing water and marshland, as well as those associated with grassland and grazing (Fig. 8.33). It is likely that the gradually expanding open marsh and damp grassland would have been used as pasture for cattle, some sheep and possibly pigs. A large number of trackways along the margins of the Thames floodplain, notably in the Beckton area, may have enabled herders to cross wetter areas in order to gain access to herds pasturing on grassland, in the reed swamp and on the marsh (Carew *et al.* 2009, 20). The recovery (in Trenches 9 and 118) of Middle–Late Bronze Age cattle and sheep/goat bone may reflect this general pattern of grazing upon the floodplain in the lower Lea Valley.

Iron Age

Towards the end of the Bronze Age and into the Early Iron Age there is evidence for increased flooding in the lower Lea Valley (noted along the Upper Thames; Robinson and Lambrick 1984), probably caused by a combination of factors: a gradual rise in sea-level; changed river drainage gradients (shallowing); reducing flow rates; all contributing to the development of increasingly meandering channels. In addition, clearance of upland areas and cultivation, possibly associated the creation of Middle Bonze Age field systems, would have resulted in an increase in surface water run-off into the river basin carrying with it fine-grained sediments. Finally, during the Iron Age to Romano-British period, lower temperatures in Britain, combined with a stormier and wetter climate (Turner 1981; Lamb 1981), would have led to a general rise in the water-table and increased flooding.

The resulting alluviation, however, appears to have been relatively minor and intermittent, as seen for example in the thin organic silts laid down over areas of raised gravel, most notably in Area 2. It is possible that remaining stands of alder, still present across some parts of the floodplain, would have moderated the increased run-off from the terraces and valley sides, especially on the eastern side of the valley, although this effect would have reduced as such woodland reduced.

There appears to have been a spatially variable vegetation mosaic across the valley floor. In one trench (Trench 10) in Area 2, alder was still abundant during the Early–Middle Iron Age, although there were also areas of damp marsh/grassland and some oak, while a more open environment, although with alder still well represented, was indicated just 150 m away at the same date (Trench 35). Middle Iron Age sequences from Trenches 33 and 34 show broadly similar patterns, although with some chronological variation. Increasing alluviation, however, began to reduce the distribution of alder and promote the expansion of open grassland and marsh, possibly accelerated by active grazing of the floodplain, so that by the Late Iron Age wet sedge-grassland, including sweet-grasses, had become dominant. There was little evidence for alder in a Middle–Late Iron Age channel-edge deposit in Area 3 (Trench 109), which was dominated by wet sedge-grassland with a substantial marshland element, or at the north of the Area (Trench 54), or in Area 1 (Trench 71), although the latter sequence may begin in the Late Iron Age/Romano-British period.

It is unclear whether cereal cultivation was practised locally in the valley bottom at this date. Cereal pollen was recovered from a Middle Iron Age enclosure ditch in Trench 9. However, given the presence of charred cereals, indicative of the general dumping of waste from cereal processing, and the fact that cereal pollen is generally poorly dispersed (particularly wheats which are self-pollinating), the pollen may derive from the processing of crops (Bower 1992) brought into the settlement from sites away from the floodplain, rather than from on-site.

Romano-British

The first substantial deposition of fine-grained alluvium on the floodplain, accompanied by raising of the basal water levels and reduced flow gradient, led to increasing channel migration in this period, with evidence for the cutting, abandonment and infilling of channels (similar to that seen during the Bronze Age). Several older sequences on the western margins of the floodplain, such as in Trench 71 (as well as at Omega Works and Crown Wharf Ironworks), are shown to have been truncated by Romano-British channels. In Trench 72 it appears that one of these channels was used during the Romano-British period for the retting of hemp.

The development of accretional floodplain soils was also recorded in this period in Area 1 (Trenches 72 and 93). Here, as was evident during the Iron Age, the environment was very open, with wet grassland, marsh and some evidence for pasture (Figs 8.33-4). In Trench 72 swathes of common reed were growing in a former channel that is shown to be forming peat deposits.

In Area 2 (Trench 29) there was also marshy grassland and evidence for trampling and pasture, but here, unlike in Area 1, there were still small patches of alder along with some scrub woodland that had survived on the raised gravel areas. Similarly, there was dated evidence for small remaining stands of alder, oak and hazel in Late Iron Age/early Romano-British deposits further south in Trench 118. There was evidence in this area for cereal agriculture (Trench 65) in close proximity to trenches containing peripheral evidence for Romano-British settlement.

Trenches in Area 3 also show a continuation from the Iron Age of a very open wet grassland/marsh landscape, with evidence for grazing, and (from Trenches 65 and 67) for a thin scattering of alder persisting, on the valley floor.

Saxon

Greater quantities of organic clayey alluvium were deposited on the floodplain in this period (Fig. 8.32d), as clearly shown in Trenches 7 and 111 (and to a lesser degree in Trench 27). The Saxon ditches in Trench 43 appear to have been dug through earlier (probably Romano-British–Early Saxon) alluvium and were, in turn, filled with and sealed by further alluvium.

The deposition of substantial amounts of fine grained, silty clay alluvium, commencing in the Saxon period and continuing to the present day, has also been observed on the floodplain in the Upper Thames Valley (cf. Robinson 1992a; 1992b; Lambrick 1992a; 1992b), linked to a shift of cultivation onto clay soils. This was probably facilitated by the introduction at this time of the mould-board plough (Stevens and Robinson 2004). Such changes may relate to the warming climate during the medieval Warm Period and the taking into cultivation of more marginal soils, such as difficult to work clays, in order to feed an expanding population.

In Area 2 (Trenches 7 and 21) there was evidence for very wet marshy grassland, with increases in marsh and meadow species continuing from the late Romano-British period. This was seen in the ditch deposits in Trench 43, which had some indications of grazing (although less evidence for disturbance). As well as possible evidence for flax retting (Trenches 7 and 27), there was also some potential evidence for cereal cultivation, as suggested by weeds of arable land and a potential cereal pollen grain from Trenches 7 and 21, although this could simply reflect settlement activity upon parts of the eastern gravel ridge.

The possible influence of the Thames Estuary in this period may be indicated by the presence of diatoms and some pollen, probably transported up the River Lea from the estuary on storm-surges. However, even though the river in the south of the Olympic Park was tidally influenced by this time, demonstrated by the presence of estuarine alluvium at the rivers confluent with the River Thames (eg, Wilkinson *et al.* 2000), the northward extent of tidal influence is unknown. Evidence for any brackish tidal activity within the Olympic Park site, especially given the lack of evidence for local brackish conditions (eg, foraminifera, molluscs or ostracods), implies that such storm surges were isolated events.

Medieval and post-medieval

Although, as with the previous period, there is little trace of woodland on the floodplain (Figs 8.32d, 8.33-8.34), the *Domesday* survey of 1086 records a number of surviving (Late Saxon) woodlands on the adjacent terraces (*VCH* 1973), as indicated in part by the number of swine that the woodlands could support. Other medieval documents refer to large areas of woodland to the north-west around Stoke Newington, and to the north and north-east around Leytonstone, Walthamstow and Epping Forest. The antiquity of these woodlands is unknown but analysis of *Domesday* and other medieval records indicates that by the late 11th century some of these were beginning to give way to agricultural expansion.

The medieval to post-medieval deposits in many of the trenches, probably the result of increased alluviation in the Saxon and medieval periods, were relatively dry following the lowering of water tables by the creation of improved drainage channels and the land claim of marshland, although there was some evidence (in Trench 21) for increased storm surges within this period. There are indications that channels had become more managed by this time, particularly for the operation of the watermills in the area. The channel in Trench 58, for example, which was revetted in the early post-medieval period, subsequently became less vegetated, with canalisation suggested by the presence of the molluscs *Viviparus viviparus* and *V. contectus*.

The evidence from most of the trenches indicates lightly grazed pasture and scrub, and fewer indications of wetlands. Weeds of wasteland, disturbance, and possibly arable ground were also frequently recovered. For example, arable weeds and cereal pollen were noted in Trenches 56 and 75, and charred cereals and evidence for milling were identified in Trench 56, while similar evidence in Trench 75 may also relate to milling activities. Seeds of fig, grape, possible strawberry, and plum stones from medieval–post-medieval deposits in Trenches 71 and 75 (Area 1), Trench 29 (Area 2) and Trench 52 (Area 3) suggest cess-type material, perhaps either used as fertiliser, or disposed of in the water channels (Sabine 1934).

Review of the Analyses, and Future Research

Work on the Olympic Park assemblages provided a unique opportunity to undertake geoarchaeological investigations over an extensive area of floodplain. Recent infrastructure developments in the lower Lea Valley have generated large bodies of geotechnical data, whose incorporation into a single dataset has resulted in the development, not previously possible, of a very detailed deposit model of the underlying buried landscape. This project, while continuing to develop the work begun by the LVMP (Corcoran *et al.* 2011), has provided an ever greater understanding of the development of the lower Lea Valley by integrating the deposit model with the palaeoenvironmental dataset. It has also permitted a synthesis of existing geoarchaeological investigations in the area, demonstrating a greater correlation between sequences in the lower Lea Valley (and issues over individual dating) than was previously recognised.

The use of a range of environmental indicators has shed light on the geomorphologic, hydrologic and botanic development of the floodplain since the Late Pleistocene. Such an approach, now routinely undertaken in commercial and academic archaeology, not only provides a better understanding of environmental change at different spatial scales, and of the stratigraphic development of the site, but also allows the validity of results from each individual technique to be assessed. In conjunction with the deposit model, this approach has enabled a unique insight to be gained into the environmental history of this part of the lower Lea Valley.

The use of deposit modelling has been important during all stages of the investigations, ranging from the use of the LVMP in making initial predictions of buried topography and in influencing trench locations, to the high resolution model developed as a result of ground work investigations on-site. However, given the timetable of such infrastructure projects, the development of the higher resolution model only occurred after all ground works had been completed, and therefore provides only a retrospective insight into how successful the initial excavations and deposit models were. The greatest benefit of the latest model is to provide a means by which the results of Olympic Park investigations can be synthesised with those from adjacent areas.

Of key interest was the identification of a number of sequences dating from the Iron Age to the Saxon period. These periods are poorly represented in the archaeological record of east London and the Lea Valley in particular (Fig. 8.5); around Westminster, for example, Sidell *et al.* (2000, 124) found obvious gaps in the record relating to the development of the river, in part due to major scouring in the early medieval period. The Olympic Park investigations have shown that changes during this period (as in the Upper Thames Valley; Robinson and Lambrick 1984) have had a large influence on the development of the lower Lea Valley, involving increased alluviation and flooding, pushing occupation formerly on the banks of the river towards the margins of the floodplain, followed by increased efforts at land-claim and water management.

Sidell *et al.* (2002, 55; 2006) have commented that most of the considerable increase in information generated since the advent of developer-funded archaeology ends up as grey literature, and is rarely published or considered in a broader context, hampering meaningful syntheses. In contrast, the synthesis of data during this project has helped to address some of the long-standing research priorities for the Greater London area (eg, Heppell 2010; Rackham and Sidell 2000) including:

- Collation of available geotechnical borehole/test-pit data to provide a framework for geoarchaeological interpretation and to identify areas where more detailed topographic deposit modelling is feasible;
- Compilation and analysis of existing borehole data to identify gaps by area/period where there is little or no data;
- Compilation of palaeogeographic maps illustrating the physical evolution of the study area;
- Collation and synthesis of existing environmental data (published and unpublished) to identify gaps by area/period where there is little or no data.

The development of a high-resolution deposit model for the Olympic Park site has provided a greater understanding of its buried landscape, with sampled sequences from a range of environments across that landscape, and from a range of chronological periods, providing a greater understanding of its evolution. This is particularly the case in relation to the large number Early Holocene and Iron Age–Saxon sequences, given the latter period's previous under-representation in the area.

The reassessment of the available sequences from the lower Lea Valley has shown that the chronologies and pollen-stratigraphic changes should not be taken at face value, since significant discrepancies are identifiable. Clearly more care needs to be taken in selecting material for the radiocarbon dating of such sequences, as has been seen in other studies (eg, Howard *et al.* 2009; Bayliss *et al.* 2008). The inconsistency of results obtained from dating sediments and plant macrofossils are generally similar to those found by Howard *et al.* (2009), where dates from sediments were often older than those from plant macrofossils. However, by comparing sequences of pollen, plant macrofossils, sediments and associated archaeology, it has been possible to see that in the majority of cases (where clear intrusion of younger material was absent – eg, roots or through pedogenesis) the older, sediment-derived dates can often be dismissed.

From the results of this project, therefore, the dating of specific waterlogged plant remains is seen to be preferable to the dating of sediments. However, the selection of material for dating should always be carefully considered in conjunction with an understanding of the taphonomy of the deposit. In cases where only dates on sediments can be obtained it is essential to consider possible sources of old or more recent carbon, in particular submerged aquatics or reworked alluvium in the former, or intrusive roots in the latter. Sufficient dating of sequences is also required because changes in channel activity and site formation processes can often lead to a number of stratigraphic disturbances and hiatuses; although these are identifiable through changes in the microfossil assemblages, better chronological control is required for meaningful interpretations to be made of the sedimentary environment.

Chapter 9
Overview and Concluding Remarks

Introduction
The investigations into the past of the Olympic Park site produced sets of data diverse in their character, coherence and significance – geotechnical borehole data, palaeoenvironmental, archaeological, built heritage, documentary and cartographic, and oral history data – each set subject to its own specialist disciplines of collection and analysis. Yet even when combined, this large body of information does not tell the full story of the development and history of the site, from Ice Age origins to 20th century industrial decline; and nor could it be expected to, since by their nature the investigations provided only keyhole views into the past.

As is clear from the chronological narrative presented in Chapters 2–6, there were some periods of intense activity and other, often of long duration, both prehistoric and historic, about which the investigations have added little new information. There are aspects of life (and death), of settlement and work, agriculture and industry, which become visible from the data only at particular times and in particular places – although in some instances with remarkable and revealing clarity.

In spite the inherent incompleteness of such disparate forms of evidence, the story of the Olympic Park site need not just be told as a single time-line, from past to present. Rather, in the same way that the many branches of the River Lea wind through the landscape, in places flowing apart, elsewhere with channels merging, so a number of overlapping but unifying themes weave their way through the history of the site, providing different perspectives on the forces that shaped the communal experiences of those who have lived and worked in the lower Lea Valley. Four of these thematic perspectives are presented below, drawing on the wide range of data gathered during the Olympic Park investigations:

- The river – charting people's changing perceptions and uses of the River Lea from untamed river to modern amenity;
- the evolving landscape – the interactions between natural and human influences on the evolution of the lower Lea Valley;
- life and work – the changing patterns of daily domestic and economic life through the ages;
- the London influence – how for 2000 years the history and destiny of the Lea Valley has been determined by its proximity to London.

The River
Not surprisingly the River Lea is the one constant which links together all the varied activities in the valley, while itself undergoing constant change – in its form, its uses and in the perceptions of the people who lived and worked along it.

A Changing River
The geoarchaeological evidence showed the gradual stabilisation of the river's braided, shifting channels, originally cut by glacial meltwaters but then developing sequences of wetland vegetation as the water flow slowed. The valley's buried gravel topography has been mapped, and the excavations have shown how dry-land soils developed on areas of raised ground beside and between the channels, permitting prehistoric waterside settlement and agriculture (Fig. 9.1). Such land, however, became increasingly liable to flooding, forcing settlement back from the

Figure 9.1: Reconstruction of the Neolithic and post-medieval landscapes based on the remains from Trenches 118 and 58

river's edge, and eventually from the valley floor altogether.

Rising sea levels in the historic period, with tides reaching up as far as Temple Mills, exacerbated the flooding and, combined with increased soil run-off from cultivation within the river's greater catchment, resulted in the deposition across the valley floor of the deep alluvial sediments found in all the trenches. As silt filled up the original channels cut into the underlying gravel, so the water broke out over their banks and found new, often meandering courses across the floodplain.

However, as the river's economic potential was increasingly exploited, not just within the agricultural landscape but also as a source of power for mills and as a means of communication and transport, so efforts were made to improve its channels and to fix them in their courses, by straightening them, by revetting their sides and consolidating their banks (Fig. 9.1). In the historic period, therefore, changes to the river resulted primarily from human actions – to improve navigability, to better power the valley's mills, to prevent flooding and to provide water for Victorian industries, and drinking water for the population of London. Finally there was widespread evidence for the river's decline, with some of its channels slowly clogged up with silt, some polluted by industrial waste, and some simply cut off, infilled and buried, no longer of use.

Movement

Humans' first experience of the river was probably as a route to follow through the landscape. The evidence found for the valley's early visitors – a few fragments of Early Mesolithic flint – was slim, but the range of plant and animal resources characteristic of the patchwork of ecological zones shown by the environmental research to have existed along the river's edge would have made the river, running from far inland down to the Thames and its estuary, a productive component of any seasonal round followed by mobile groups of hunter-gatherers. Even as prehistoric communities settled, imprinting themselves more permanently on the landscape, the river is likely to have provided a vital link between near and more distant communities, along which ideas, objects, produce and people passed and were exchanged. It was probably by river (the

Stort and the Lea), that the Romano-British pottery from the Hadham kilns in Hertfordshire was brought to the site.

Although in times of conflict, such as that between Dane and Saxon in the 9th century, such movements along the river may have posed an unwelcome threat to local communities, for most of history the river was a highway for trade and commerce, bringing agricultural produce from the farms of Hertfordshire and Cambridgeshire (and other goods and materials) to the city of London. Much of the character of the River Lea today, and many of the recorded features of its built heritage – its locks, new navigation cuts, wharves and revetments – were built with the single purpose of maintaining and improving the navigability of the river. However, not all traffic was for business – the small river boat abandoned at Nobshill Mill appears to have enjoyed days as a pleasure craft possibly for a spot of fishing, then as a gun punt for the more robust sport of shooting wild fowl.

Economy

Fish and wildfowl, along with game animals attracted to the water, and a rich diversity of edible plants, would have made the river economically attractive for prehistoric hunters and foragers; some of the timber stakes and structures excavated from channel deposits (of Neolithic, Romano-British and medieval date) point to the direct exploitation of the river, being the remains, perhaps, of riverside structures, fish traps, or indicating other economic activities. In time, the river's banks became the place settled by farmers, who, in the Middle Bronze Age, laid out their fields close up to the river's edge. Even though, during the Iron Age, repeated flooding eventually made the ground uninhabitable year-round, that process of regular inundation by the river, when controlled and managed, created the rich summer pastures and meadows which later became a feature of the valley landscape during the historic period.

At the same time the river brought power – by the end of the Saxon period there were watermills strung along all of its main channels, many of which remained in place, admittedly rebuilt, into the 19th century and beyond, first powering corn mills, then fulling mills, then a whole range of industrial processes where water power could operate hammers, grinders, saws and bellows. Aspects of a number of these millstreams and associated channels, such as those above the Pudding Mills, the tumbling bay at Temple Mills, and other un-named channels that may also have fed into the mills, were revealed by excavation.

The mills were originally located where tides or the river's gradient created sufficient flow to turn their wheels. The building of a medieval tidal lock at Bow allowed the penning of the high tide waters in the upstream channels, to be released through the millstreams as the tide ebbed, a process taken a stage further in the 19th century with the creation of a large compensation reservoir on the west bank of the river, whose intake gates were revealed by excavation. Throughout history, many conflicting interests – barge owners, millers, fishers, water supply companies, and landowners – competed for this vital and limited economic resource. The complex of locks, floodgates and weirs which developed to regulate the flow of water reflect a perception that the river was no longer just a natural feature of the landscape, but an asset which could be improved and, with the construction of the Hackney Cut, even added to.

The river also played an important role in late 19th and 20th century industrialisation of the lower Lea Valley. For example, it facilitated the movement of materials and goods, although it is noticeable that the location of much of the industry appears to have been determined more by the availability of road access. Although maps show riverside wharves and cranes at a number of locations, it may be significant that the clearest surviving evidence for river transport relates to the tipping wharves of a timber yard along the artificial Hackney Cut.

The water in the river channels is also likely to have been important for many industrial processes, although a consequence of this was the matching use of the river for the disposal of waste products generated by these processes. While the River Lea had a long history of this, the modern industrialisation of the river, flanked no longer by farmland but now almost wholly by factories, railways yards and manure works, must represent a significant change in people's perception of its nature, value and meaning.

Symbolic Uses

The River Lea would always have had multiple roles and meanings. Its name is believed to derive from a Celtic root – *lug* – meaning 'bright' or 'light', also possibly found in the name of the Celtic deity *Lugus* (Glover 1938; Mills 2001). There are suggestions, certainly in prehistory, that the river played some role in people's religious beliefs. The Neolithic axe, for instance, is unlikely to have been simply mislaid on the river bank, at a location where the recovery of pottery, flint working debris and worked timbers indicate a range of activities being undertaken. Axes have been found in watery places elsewhere along the River Lea, as well as along the Thames and more widely, suggesting that these objects may have been deliberately placed as a form of religious or votive offering. While we cannot recover the prehistoric beliefs which led to such practices, the similar deposition in the River Lea of bronze and then iron objects suggests that such beliefs were long held, and may even find a resonance in pagan beliefs in the early historic period, some of which were adopted by the early Christian church.

By then, the river also had another meaning, as a boundary, possibly marking the eastern extent of Roman *Londinium*'s *territorium*, but certainly marking the border between the East Saxons (Essex) and Middle Saxons (Middlesex), then between the Saxons and Danelaw. In the process, the River Lea became part of the mythology of England's origins, with tales of King Alfred having its channels cut to lower the water level upriver, so grounding the boats of Viking raiders. That boundary has endured to the present day, the river marking the border between Essex and Middlesex, as well as between the London boroughs of Waltham Forest and Newham to the east and Hackney and Tower Hamlets to the west.

Recently, the river has acquired new meanings reflecting more current concerns. Despite (or perhaps because of) its survival through the upheavals which have transformed the Lea Valley, the river now symbolises the fragility of the wider landscape we inhabit, and the need to conserve what is not just a vital ecological resource within the built environment, but also an important recreational space to be enjoyed by local communities and visitors alike. The river will soon be at the centre of east London's new River Lea Park, an extension to the Lee Valley Regional Park.

The Evolving Landscape

From the time of the first visitors to the Lea Valley, there has been a process of interaction between people and the landscape, the topography and geology, flora and fauna, shaping how people lived, but in turn increasingly shaped by them.

Topography

The physical shape of the Lea Valley was determined by the geological and climatological forces during and after the Ice Age, as meltwaters released in periods of rising temperature cut through the underlying geology, and laid down deposits of gravel and sand across the valley floor. Although now buried, in places under many metres of accumulated sediment and modern made ground, the geoarchaeological deposit model has revealed the early surface of those gravels, and the subsequent development of the valley's topography. It has identified the gradual stabilisation of the river, and the variety of ecological zones that this caused to develop – the main channel flowing fast and cutting deep around the curve on the west side of the valley, but slower elsewhere, the smaller tributaries feeding into the river from the valley sides to the east and west, the river banks, the cut-off channels, and the drier gravel islands and terraces within and on the edge of the valley.

It was this early topography, and the changing climate and sea levels, which determined the shape of the valley in the more stable Holocene environment. It would also have been one of the main influences on the subsequent patterns of human settlement and economic exploitation within the valley – at least until that human activity itself replaced the forces of nature to become the dominant influence on the landscape. Then, clearance of woodland and cultivation in the valley's wide catchment increasingly exposed soils to erosion. These were washed down into the river and deposited by the now more slowly moving water in the valley.

At first these sediments filled up just the river channels, raising the water level and allowing it to flow more freely across the valley floor, less confined by its earlier courses. Eventually, however, the alluvium completely masked the underlying gravel topography, but by then, in the medieval and post-medieval periods, people were directly and deliberately changing the shape of the valley, manipulating the courses of the river channels and draining the land between.

This process culminated in the late 18th and 19th century in major infrastructure developments, with new channels cut to aid navigation, with large areas of marsh and farmland excavated to build reservoirs and waterworks, and with high embankments crossing the valley to carry railways lines and the Northern Outfall Sewer. Finally, in the late 19th and 20th century much of the valley was blanketed in deep deposits of made ground, firstly as the base for a new, industrial landscape, but later as a convenient dumping ground for wartime demolition rubble and post-war waste.

Vegetation

While the changing topography helped shape human activity in the valley, it was the different environments which that topography supported, sometimes localised and diverse, at other times extensive and more uniform, which gave the valley its particular character at different times in its history. In particular, it was the flora and fauna it supported, both natural and influenced by human communities, that determined the uses to which the land was put, right up until the extensive industrialisation in the late 19th century.

Late Pleistocene deposits laid down during the Greenland Interstadial have been identified in the Olympic Park, in an environment of extensive marshland on the valley floor, probably flanked by open tundra with patches of birch and pine woodland on the higher, drier terraces. This environment is likely to have attracted tarpan (horse), red deer, elk and aurochs, although as colder conditions returned these would have been replaced by bison and reindeer.

The climatic warming in the Early Holocene saw an environment dominated by wet grassland. The presence of dung beetles indicates that this would have been grazed first by large herbivores such as elk, and possibly horse, and then as woodland developed by aurochs, wild boar and red and roe deer. However, the relatively pronounced topography on the valley floor allowed considerable local environmental variation, with cut-off channels, for example, being colonised by marshland vegetation, resulting in localised peat formation. It was the economic potential of this ecological variety which would have made it attractive to Mesolithic hunter-gatherers, with an ever-changing mosaic of grassland, marsh, scrub and eventually mixed deciduous forest of oak, elm, lime, ash and alder.

It was alder which was best suited to the wet conditions on the floodplain, and former channel areas became colonised by alder woodland. This persisted through the Neolithic and into the Early Bronze Age, becoming a dominant feature of the valley floor landscape alongside marshy grassland, with mixed woodland on the drier ground. No evidence was recovered for the clearance of woodland during the Neolithic, although the establishment of ditched and probably hedged field systems from the Middle Bronze Age points to extensive clearance having taken place by that date. By then the alder woodland, although surviving locally, was no longer dominant, having been replaced by open marsh and damp grassland, again with indications of wetland grazing.

This largely set the pattern for the subsequent, historic development of the valley environment, dominated by marsh and wet grassland with small patches of relict alder and isolated stands of mixed woodland on the drier gravel islands. The combination of increasing valley-wide alluvial deposition and occasional storm surges up from the Thames estuary, with continuing efforts during the historic period to drain and reclaim the marshland, created fertile pasture which formed an important part of the medieval to modern agricultural landscape.

Human Impacts

Until the Middle Bronze Age, the nature and extent of human impact on the lower Lea Valley landscape are far from clear. The Neolithic axe, although an unequivocal symbol of the potential for cutting down trees by the valley's earliest agricultural communities, was not matched by any direct evidence for woodland clearance. The riverside location of the Neolithic finds point to the continuing exploitation of the valley floor, predominantly for its wild resources, although the fashioning of stakes to form a permanent riverside timber structure hints at a new perception of place, perhaps significantly different to that held by mobile hunting groups.

While clearings within the woodland flanking the valley may have been cultivated, and areas of grassland and woodland alike could have supported the newly domesticated livestock of cattle, pig and sheep/goat, the earlier incidence of cereal-type pollen, may reflect wet grassland species rather than arable crops. The earliest clear evidence for agriculture dates only to the Middle Bronze Age, when charred cereal grains, and cattle and sheep/goat bones were recovered from field system ditches. The laying out of a possibly large-scale rectilinear field system extending back from the river's edge indicates that, certainly by this time, large areas of woodland had been cleared. It also marked, at least locally, the first deliberate and concerted attempt to visibly display a new control over the landscape, constructing it in a way which served the (not necessarily consistent) social, political and economic needs and aspirations of the community.

Although the pattern of Middle Bronze Age land-use may have been short-lived, the construction of enclosures and ditches in the Iron Age, Romano-British and Saxon periods, suggests that the valley landscape was to remain a resource under the control, albeit probably competed for, of those holding power in the area. Initially, those were probably individuals within the local communities, but by the medieval period much more wide-ranging vested interests were imposing their influence from outside. Among the most obvious of these, although sadly one for which actual evidence remains tantalisingly elusive, was the Roman military's construction of a road from *Camulodunum* to *Londinium*. However, whether the land was subsequently farmed from Romano-British farmsteads or larger villa estates, or Saxon and medieval manors or religious houses, or post-medieval gentleman farmers, the concerns would have remained very much the same – to maintain fertile pasture land, adequately drained, and protected as far as possible from both river flooding and tidal storm surges.

These agricultural concerns continued into the 19th century, but with other economic forces developing alongside. Initially the watermills, supplemented in time by windmills, would have served the economic interests of the local manors and monasteries by processing their agricultural produce, but it was inevitable, given their proximity to the London markets, that their potential would be exploited for other purposes, and the range of manufacturing processes increased. This, along with the importance of the waterways in conveying produce and materials to the same markets, resulted in the development and maintenance of the complex of straightened, deepened and revetted waterways, served by locks, floodgates, weirs and wharves, which formally divided the valley-floor pasture into a series of long strips, obstructed only by the single major crossing of the valley, the 12th century causeway between Bow and Stratford.

The catalysts for the significant changes made to the valley landscape from the late 18th century also lay outside the valley, with the Hackney Cut built to facilitate navigation through the landscape, and waterworks reservoirs built to supply the London populace. The extraction of water from the river in turn required the construction of the compensation reservoir to maintain the water levels necessary both for river traffic and the operation of the Stratford mills. In addition, the railways from London, and sewage from the city, both crossing the valley on large embankments, further fragmented the landscape into increasingly isolated and incoherent blocks, many of them no longer of any significant agricultural value, and making those most readily accessible by road, river and railway ripe for new, industrial uses.

The spread of industry across the area, therefore, was uneven, and although ultimately varied in nature – with engineering works alongside chemical works, soap works alongside printing ink works, confectioners alongside timber yards, and the Great Eastern Railway's Stratford Works alongside piggeries and the manufacturers of artificial manure (fertiliser) – what characterised many of them was their dirty, noxious and dangerous nature. Such industries had been prohibited from areas closer to the city, and the floodplain of the lower Lea Valley, of ever decreasing agricultural value, provided the perfect location, well provided with the water many of these industrial processes required. Ground levels were raised to prevent flooding, and the adjacent river channels canalised, and dotted with wharves and cranes. Some areas, too wet or too inaccessible to make the establishment of industry worthwhile, were simply designated as waste tips and became landfill sites, in time accumulating considerable depths (in places up to 9 m thick) of domestic, industrial and other waste.

Life and Work

Although the Olympic Park investigations have revealed long-term processes – environmental, archaeological, industrial – occurring not only over the large area of the lower Lea Valley but extending far beyond it, it is easy to forget the local, daily routines, and in some cases individual events, which make up of the patterns of domestic and working life for the local population. It is the daily lives – of men and women, young and old, healthy and sick, skilled and unskilled, rich and poor, during war and peace; farmers, millers, craftsmen,

Figure 9.2: Reconstruction of the Iron Age settlement in Trench 9

navvies, and factory workers; from the occupants of a prehistoric riverside settlement to still living workers in Stratford's factories – which can bring the collected data to life.

Patterns of Prehistoric Life

For the earlier prehistoric remains we need to infer much from minimal evidence, although that dearth of evidence itself provides clues. While people were present in the valley during the Mesolithic, they may have been stopping only for short periods, to hunt, fish and forage, to replenish supplies, and (just visible archaeologically) to fashion or repair their flint tools. There was not much more evidence for the Neolithic, although the cutting and sharpening of stakes to make some form of timber structure on the river edge – perhaps a platform or trackway – points to the creation of a place, somewhere to be revisited and where a range of activities, some functional, others perhaps more symbolic, were undertaken. Whatever the specific reason for the deposition of the flint axe, it was a functional tool, essential for people for whom creating or enlarging clearings in the woodland would have been a regular task.

By the Middle Bronze Age we can see for the first time the faintest traces of the houses which people built to live in, as well as the long, straight ditches they dug to define and fix the plots of land they farmed, with the possibly votive materials (coarse ware and fineware pottery and a cattle skull) they appear to have deliberately placed in those ditches, in individual acts at specific moments in time. Although these farming settlements appear to have been small, the field system points to social cooperation at the wider scale, and possible networks of kinship binding together the wider community. These relationships would have involved a range of daily or more intermittent interactions, and it would have been through these that social and economic transactions were made, some involving the exchange of objects, such as pottery used for food storage, preparation and serving, and agricultural resources, such as livestock (cattle, sheep/goat and pig) and grain (barley and wheat).

By the Late Bronze Age, these people's links to their land is seen also in the placing in the ground, close to where they lived, of the cremated remains of deceased members of their community. At the end of the Iron Age, also, inhumation burials were made on the site, although, given the absence of contemporary finds, apparently at some at distance from settlements.

In addition to the daily and seasonal routines of farming life – tilling, sowing, weeding, harvesting and processing, and raising, herding, corralling, and milking their animals, then their slaughter, butchery, and possible curing – there was evidence of some of the other activities needed to sustain family and community life. Fired clay loomweights, from Late Bronze Age and Iron Age features, indicate the spinning of yarn and the weaving of textiles, and these, along with part of a bentwood container preserved in a waterlogged Iron Age ditch, are reminders of how many of their possessions (of organic materials like wood, fabric, leather, basketry etc) have not survived. Although there was no direct evidence of pottery making, many of the pits may have been used for extracting clay for this purpose. The construction of round-houses in the Iron Age (Fig. 9.2), *c.* 12 m in diameter, may have been intermittent events, but it would still have required accomplished carpentry skills, hints of which may be provided by a wooden tenon recovered from a contemporary ditch.

There was little evidence found to throw light on the patterns of daily life in the Romano-British, Saxon and medieval periods although, certainly by the latter period, records such as *Domesday* give details about the numbers of households and their social status (villein, bordar, cottar or serf), the acreage of the landscape they farmed (ploughland, meadow and woodland), the numbers of plough-teams, and the numbers of animals they kept (cobs, cattle, pig, sheep and goat).

Patterns of Industrial Life

Domesday also lists the watermills, and while these were established for the primary purpose of milling corn, over time they were used for an increasing variety of manufacturing processes. While much of the population would still have been involved in agricultural work, the mills represent an early industrial workforce. The recovery from Temple Mills of grape pips, fig seeds, as well as strawberry seeds and plum stones indicates that some sections of the local population had access to more exotic foodstuffs.

Temple Mills was one of the mill sites that undertook a wide range of industrial activities in the post-medieval period; some of these were dangerous – a gunpowder mill blew up. However, not only were some indications of the post-medieval industries revealed during the excavation of the site, but so also were aspects of the daily lives of the workers and, later, the site's inhabitants. Finds at the late 17th and early 18th century foundry (Building 2), for example, include ceramic and glass bottles, jugs and drinking vessels, as well as clay tobacco pipes, ceramics, chamber pots and other items. Many of these may have belonged to the workers, possibly involved in the manufacture of brass kettles and tin and latten plates (probably using a variety of metal alloys); this would have involved hot or cold working by hammering, small-scale casting, turning (ie, lathe work), soldering, brazing and perhaps tinning. The presence of smithing hearth bottoms suggests that some ironworking may also have been carried out here, although possibly at an earlier date.

There were few personal items, however, until the start of the 19th century, by which time the foundry had been replaced by a new premises, and the new cottage dwellings had also been built on the site. While these may have been built to house the workers at the Temple Mills, the mill buildings were demolished in 1854 and the census returns shows the varied occupations – some rural, some craft, some domestic and some industrial – of the those living in the cottages. These included cow keeper, labourer, engineer and silk printer in 1841, coffee house keeper, butcher and gardener in 1861, waste paper dealer, sausage skin maker and domestic servant in 1881, and jam factory packer (probably at Clarnico), house painter and printer's boy in 1901. In addition to their main occupations, they may also have been involved in cottage industries to supplement their incomes; possible button manufacture, for example, is suggested by a cattle scapula blade with a disc cut from it.

In contrast to the earlier phase, finds from the site during the period of occupation now show a strong domestic element. Beverages were still drunk, and pipes smoked, but the pottery was now dominated by mass-produced ceramic tea wares and other serving wares. That this was no longer just a working environment is reflected in the evidence for household furnishings (a curtain ring, a possible curtain weight, and a lock plate, perhaps from a box or cabinet), porcelain figurines, ceramic flowerpots and part of a wire birdcage. Also found was as a wire dress hook, and buttons, a group of metal dressmaking pins, as well as a jet bead and a locket. Children's items were also found.

Aspects of Childhood

Children, so often barely visible in the material culture, can be glimpsed through a range of artefacts and records at the Olympic Park. We know some of their names, for example, 13-year-old George Bird and his 9-year-old sister Charlotte, apparently both at school as they are listed in the 1861 census as *scholars*, although their oldest brother John, aged 15, was now working as a wheelwright; their father was a carpenter and their mother a lace-maker.

Children can also be seen indirectly through items such as a 'nursery plate' depicting Robinson Crusoe (Pl. 9.1), and fragments of children's miniature tea-sets, found at Temple Mills, as well as a cylindrical mug (from Trench 52) with an illustrated nursery rhyme (*This is the house that Jack built*). Also found were stone and glass 'alleys' for the game of marbles, lead figurines, and a toy sword (Pl. 7.13, above) – although some of these may have originated from areas outside the Olympic Park itself, brought in with dumped refuse.

Plate 9.1: Robinson Crusoe nursery plate

However, it was not just toys that were made for children in the Victorian era. Children were seen to be in need of moral guidance, and part of this was done through 'moralising china' – children's plates and mugs, transfer-printed with rhymes, religious mottoes or instructive maxims, often with accompanying polychrome illustrations, and with many of the designs showing children engaged in various activities. Such objects, found not only in both middle and lower class dwellings across London but also elsewhere in the English-speaking world, may have been designed as educational tools, specifically concerned with the inculcation of religious and moral values, or perhaps as exemplars of 'self-improvement' and aspiration.

Examples from Temple Mills included a mug bearing two of Benjamin Franklin's maxims - '*If you would know the value of money, go and try to borrow some*' and '*When the well is dry, they know the worth of water*'; a third, '*Creditors have better memories than debtors*', was on a plate from Trench 22. Franklin's maxims, first published together in *Poor Richard's Almanac* (1737), were favourites for 'moralising china', as were biblical quotations, such as '*Let brotherly love continue*' (Hebrews 13, v.1) on a jar from Temple Mills. Finally, from the same site, a small plate has a polychrome transfer-printed scene of a small boy and a man playing with a kite in front of a large country mansion; the motto, unfortunately incomplete ('*And when my kite … / Who held*

Plate 9.2: Virol jar 'An Ideal Fat Food for Children and Invalids'

the string … / While pleasure spar[…] / *My Father*') appears to be an imitation of a poem written by Jane Taylor (1783–1824) in honour of her grandmother (Jeffries *et al.* 2009, 336).

A number of containers for medical remedies for children were also found. These included Virol (Pl. 9.2) – '*An Ideal Fat Food for Children and Invalids*'. Made of bone marrow, eggs, malt extract and lemon juice, and tasting something like toffee, it was considered to be an effective remedy for infant diarrhoea, as well as '*marasmus, rickets, tuberculosis, anaemia, and gastric disorders*' (*British Medical Journal (supplement)*, 28 August 1909, 204). Of more dubious efficacy was Mrs Winslow's Soothing Syrup, first sold in the USA in 1849 as a remedy for teething infants. However, it contained dangerously high levels of alcohol and morphine sulphate, leading in 1911 to the American Medical Association including it with other dubious medicinal products in a list of 'Baby Killers' (although it remained on sale in the UK until the 1930s).

There are illuminating memories of childhood from local residents, captured by the oral history project. These indicate more recent poverty, with children scavenging the rubbish dumps near Temple Mills for discarded sweets from the Clarnico confectionery factory. It was out of a philanthropic concern for east London children with few opportunities that Eton Manor Boys' Club, a sports and social club, was established in Hackney Wick in 1909.

Recreation, Health, Sanitation, Death and Burial

Due to the small number of burials, and the lack of clear dating for all but one of the inhumations, there is little direct evidence relating to the health of the local prehistoric and historic inhabitants. Nonetheless, while dental disease, strains and fractures, back pain and joint disease, and other evidence for physically strenuous activities are all indicated in the human bone assemblage, the imposing stature (at least for late prehistory), of *c.* 1.76 m (5 feet 9¼ inches), of one man aged 45–60 suggests he was well nourished. No evidence for grave goods was found either with the Late Bronze Age cremation burials or with the Iron Age and undated inhumation burials, and we can discern nothing of the ceremonial and ritual activities which may have accompanied these events.

Health, however, is likely to have been an ongoing concern. The Black Death reached England in 1348 and would have had a profound impact on the occupants of the lower Lea Valley. The following centuries saw repeated outbreaks of bubonic plague, culminating in the Great Plague, affecting mainly London, in 1665. While disease thrived in crowded and unsanitary living condition, this had more effect in London than in the more rural lower Lea Valley. Nonetheless, following a series of widespread cholera and typhoid epidemics, the provision of clean drinking water and the disposal of sewage became ever more pressing public health issues in the 19th century, although some of the solutions, such as the uncovered reservoirs at Old Ford, were found to contribute to the problem. So too were the increasing levels of pollution resulting from the noxious and dangerous industries carried out on the valley floor, and which gave the area the name 'Stinky Stratford'. An early 20th century outbreak of typhoid was traced to the watercress beds south of Temple Mills, reported as being fed by almost undiluted sewage from the surrounding piggeries and manure works.

Such widespread health concerns find their specific expression in occasional pharmaceutical items, such as drug jars and phials from Temple Mills. Other health-related items included a funnel, a cup, a jug and a tea plate all marked with '*Poplar and Stepney Sick Asylum*', which was opened in Bromley-by-Bow in 1873 under the *Metropolitan Poor Act* of 1867. A cup, or small bowl, with a monogram of entwined letters, possibly ELCH, in a shield, above '*Shadwell*' may belong to the East London Hospital for Children founded in 1868, and moved to new premises in Shadwell in 1875. Other health and beauty products included containers for toothpaste, cold cream, Vaseline petroleum jelly, Elliman's Universal Embrocation, and Owbridge's Lung Tonic.

Despite the crowded industrial landscape within the Olympic Park, Hackney Marsh to the north provided a large area for sport and recreation, and its value was recognised by its purchase as an open space by the London County Council in 1893. A sports pavilion constructed there in the late 1930s was rebuilt and extended after being damaged by wartime bombing. There were also allotments in the area that not only provided fresh food, but also healthy activity, a place for socialising, and some respite from the routines of industrial life. In addition, social clubs and societies were also attached to many of the factories in the area.

In the 1920s the Eton Manor Boys' Club moved to its new sports ground at the *Wilderness*, on 12 hectares of waste ground in Leyton, immediately north of Temple Mills. This contained football, rugby and cricket pitches; tennis, squash and netball courts; and a bowling green. There was also a running track which by a curious coincidence, aside from the numerous top-class athletes that trained there, provides a strong link with the Olympic Games. During World War II the track was damaged by the buildings of an army camp stationed there, so after the London 1948 Olympic Games, the Olympic running track from Wembley stadium was removed and re-laid at Eton Manor – under the supervision of the club's gaffers, Dicky and Dodger (Lewis 2010, 10). It is therefore entirely fitting that sporting facilities at Eton Manor will be used during the 2012 Games, and afterwards as a new sports centre for the local community.

The London Influence

In the two millennia since the establishment of the Roman city of *Londinium* the lower Lea Valley has been increasingly influenced by the growth of the nation's capital, and therefore also by events on the wider national and international scale, of which the development of the site for the 2012 Olympic and Paralympic Games is the most recent example.

Routes to London

Excavations at Old Ford, just west of the Olympic Park, have shown just how potentially important the intersection of the Roman road and river routes may have been for the local population, revealing settlement along the road-side probably exploiting the transfer of goods destined for *Londinium*. Moreover, although the precise course of the Roman river crossing has yet to be identified within the valley floor, it was a route which seems to have endured for over 1000 years. This was despite the evident difficulties and dangers involved in crossing the river when it was in flood, or when the tide was high. In the end, it was these dangers, reportedly experienced at first hand by Queen Maud (the wife of Henry I) which were the impetus for the building of a new causeway, incorporating stone bridges on either side of the valley, between Bow and Stratford. Historic maps, from the mid-17th century onwards, show the impact this new, secure crossing had on the landscape. It probably required the diversion of river channels, becoming the focus of settlement, initially at either end but eventually along its full length between, and it determined the locations of watermills and eventually other industries. Other, lesser crossings of the valley, such as that exposed near Temple Mills, may have served more local, cross-valley traffic.

The river was one of the main routes by which produce and materials were transported to London from the agricultural land of Essex, Hertfordshire and beyond. Barges either off-loaded their goods at Stratford for onward transport by road, or negotiated the obstructions, tides and long meanders down to and along the Thames. The competing interests of the barge operators and mill owners was a constant source of conflict along the River Lea in the post-medieval period, for the resolution of which the new Hackney and Limehouse Cuts were built in the later 18th century.

In the same way that the Roman road network radiated out from London, so too did the new railway network built in the first half of the 19th century, the embanked main line to the eastern counties bisecting and breaking up the long-established pattern of the landscape in the valley. While the railway terminus was at Shoreditch, the Lea Valley provided the space for the necessary accompanying infrastructure – junctions at Bow and Stratford, the goods yards serving different lines, the coal depots and factory sidings, and the sprawling locomotive manufacturing works on the former High Meads at Stratford – and the housing for the new workforce at New Stratford.

Industry and Economy

The economic impact of London's proximity on the lower Lea Valley was two-edged. On the one hand it offered many opportunities in the manufacture and shipment of goods into the London markets. On the other hand the valley increasingly became the location for activities which London's citizens could no longer tolerate in their midst. The 1844 *Metropolitan Buildings Act*, which prohibited dangerous and noxious industries from being carried out in the highly populated areas, and led to the burgeoning of such industries in Stratford, was far from the first law of this kind – edicts in the 14th century had forbidden the slaughter of large animals, and butchers from washing the entrails of their carcasses nearer to London than Stratford. The splitting of the river into its five main branches at Stratford not only permitted the establishment of the area's numerous watermills, but also provided water for many of the other industrial processes undertaken at the mill sites and elsewhere along the channels.

The range of industries known to have been undertaken at the medieval and later mill site at Temple Mills reflects the value of the valley's location close to London. Apart from the original use of the 'two mills under one roof' for milling corn, the site was involved in the production of oil, smalt (to make blue starch for washing linen), leather, gunpowder and gun barrels, pins and needles, timber water pipes, dyes, sheet lead, brass kettles, tin and latten plates, yarns, silk, calico and flock. Many of these industries were also undertaken at the other mill sites, and all before the influx of the new industries in the second half of the 19th century. It was its proximity not just to the London market which made the valley a favourable location, but increasingly also to the London docks on the Thames, linked by the Limehouse Cut. These provided access to imported materials and the potential for supplying manufactured goods to foreign markets, particularly across the Empire.

The use of the river to providing drinking water for London also had a major impact on the valley. First was the creation, by 1810, of two reservoirs of the East London Waterworks Company just west of the River Lea at Old Ford, fed directly from the river. Later these were supplied by the two larger, settling reservoirs built on the east side of the river in the 1820s, and fed by a channel running down from Lea Bridge parallel to the Hackney Cut passing below the river next to Old Ford Lock. The knock-on effect of this large-scale extraction of water was to reduce that available for navigation and the powering of the mills, for which the large compensation reservoir was built *c.* 1830; this was fed by the incoming tide and released water as the tide ebbed. However, when these reservoirs became linked to disease, and new extraction points were established further up the Lea Valley and on the Thames, they were rendered redundant, and infilled, providing land for the railway's goods yards at Bow and a timber yard. A no less visible feature in the landscape, although only indirectly related to the water supply infrastructure, was the Northern Outfall Sewer which passed over the valley on a large embankment, from Hackney to the pumping station at Abbey Mills, crossing the river channels on bridges and further fragmenting a landscape already divided by the railway line.

Plate 9.3:
Tank block at Old Ford

The banishing of dirty industry from London to the Lea Valley reflects a view of the area which continued through the 20th century. It was always considered marginal land, of little intrinsic worth, and although localised landfill made industrial development possible in places, in the end much of it was considered useful only for the dumping of London's waste, including rubble from World War II bomb damage. Items found within this waste include the products of manufacturers in Bermondsey, Bethnal Green, Bow, Camberwell, Hackney, Hoxton, Poplar, Shoreditch, Westminster and Whitechapel but not, generally, of any manufacturers east of the Lea.

War and Peace and the Wider World

Since earliest prehistory, people have moved into the lower Lea Valley, settled and made it their home. Most of the time this process was probably peaceful, but not always, and the valley is likely to have seen its share of warfare, both from invaders – Roman, Viking and Norman – and from internal conflicts. The Lea Valley, for example, appears to have provided no protection from Boudicca's revolt of AD 61; having sacked *Camulodunum* she turned her attention west to *Londinium* and burnt it to the ground. Perhaps from that time on, the valley's marshland and river channels were seen as an important buffer zone and boundary on London's eastern side. In the centuries after the withdrawal of Rome it certainly came to mark a political and military border, initially as the limits of Danelaw, but surviving as an administrative boundary up to the present.

Direct evidence of conflict from the Olympic Park investigations, however, is limited to more recent times. The valley's industry, and its proximity both to the city of London and its docks, made it a target both for World War II German bombers but also, potentially, for invading forces, and the Olympic Park contains a number of defence features. These include a tank block and a pillbox on the Northern Outfall Sewer at Old Ford, and an Anti-Aircraft (HAA) battery to the south of Temple Mills (Pl. 9.3). The battery (ZE 21), sited within the Inner Artillery Zone (AIR 2/4768) and manned by 128th Rocket Anti-Aircraft Battery (101st City of London Home Guard), was the first battery to shoot down an enemy plane during the inaugural raid of the Blitz on 7 September 1940. A month later the site was hit by a high explosive bomb, and saw suffered further damage from VI bombs (doodlebugs) in July and August 1944. Bomb maps show the extensive damage to local housing and factories. Two World War II memorials were set within the boundary wall at Eton Manor Sports Ground (these will be reinstated after the 2012 Games).

It was not war, however, which ultimately determined the character of the local population, but trade and industry. The proximity of the valley to London's docklands drew goods and people in from across the world. Industry needed an increasingly large workforce, and in the late 19th and 20th century Stratford provided the necessary space for new housing developments, such as 'Hudson's Town' in New Stratford. These attracted people from East London, and from across Britain, as well as immigrants from further afield, particularly from Britain's former colonies, creating a community rich in its cultural diversity.

The Future

The selection of this part of the Lea Valley as the site for the London 2012 Olympic and Paralymic Games has once again changed the landscape (Pl. 9.4). From a neglected and derelict industrial landscape a new park will emerge providing world-class leisure and sporting facilities for Britain, becoming one of the top visitor destinations in the country. Yet elements of the earlier landscapes and histories will remain, some still buried, others as visible reminders of earlier ages.

Plate 9.4: The main Olympic Stadium

The regeneration of the area and the provision of a lasting sporting legacy were key objectives of the winning bid, and will see their fulfilment in the creation of the new Queen Elizabeth Park. However, the 2012 Games have also provided an unparalleled opportunity to examine a large area of east London, enabling the past, from the most distant to the most recent, to be brought to a wider audience than would otherwise have been possible. The large scale of the investigations, and their multi-stranded approach have enabled an understanding of the landscape and the communities it has supported to be pieced together, both in their broad patterns and in illuminating detail.

This, however, is far from the end of the story. Significant aspects of the site's past remain unknown, and many questions are still unanswered. However, the investigations have not just helped us to identify and clarify new questions to be addressed by future research, but they have also provided valuable information about how answers to those questions might be found, under the often difficult conditions, in the Olympic Park's deeply buried past.

Appendix 1

List of MoLAS/PCA and RPS Planning and Development and AOC Archaeology Group reports relating to

Detailed Desk Based Assessment Reports

MoLAS-PCA 2007a. *Olympic, Paralympic & Legacy Transformation Planning Applications, Supplementary Information. Volume 10A Environmental Statement Annexure: Archaeological and Built Heritage Impact Assessment (Detailed desk-based assessment [DBBA]) Planning Delivery Zone One,* London, MoLAS-PCA unpubl. rep. OLY/GLB/ACC/DOC/ARC/SUP/01A

MoLAS-PCA 2007b. *Olympic, Paralympic & Legacy Transformation Planning Applications, Supplementary Information. Volume 10A Environmental Statement Annexure: Archaeological and Built Heritage Impact Assessment (Detailed desk-based assessment [DBBA]) Planning Delivery Zone Two*, London, MoLAS-PCA unpubl. rep. OLY/GLB/ACC/DOC/ARC/SUP/01A

MoLAS-PCA 2007c. *Olympic, Paralympic & Legacy Transformation Planning Applications, Supplementary Information. Volume 10A Environmental Statement Annexure: Archaeological and Built Heritage Impact Assessment (Detailed desk-based assessment [DBBA]) Planning Delivery Zone Three*, London, MoLAS-PCA unpubl. rep. OLY/GLB/ACC/DOC/ARC/SUP/01A

MoLAS-PCA 2007d. *Olympic, Paralympic & Legacy Transformation Planning Applications, Supplementary Information. Volume 10A Environmental Statement Annexure: Archaeological and Built Heritage Impact Assessment (Detailed desk-based assessment [DBBA]) Planning Delivery Zone Four*, London, MoLAS-PCA unpubl. rep. OLY/GLB/ACC/DOC/ARC/SUP/01A

MoLAS-PCA 2007e. *Olympic, Paralympic & Legacy Transformation Planning Applications, Supplementary Information. Volume 10A Environmental Statement Annexure: Archaeological and Built Heritage Impact Assessment (Detailed desk-based assessment [DBBA]) Planning Delivery Zone Five*, London, MoLAS-PCA unpubl. rep. OLY/GLB/ACC/DOC/ARC/SUP/01A

MoLAS-PCA 2007f. *Olympic, Paralympic & Legacy Transformation Planning Applications, Supplementary Information. Volume 10A Environmental Statement Annexure: Archaeological and Built Heritage Impact Assessment (Detailed desk-based assessment [DBBA]) Planning Delivery Zone Six*, London, MoLAS-PCA unpubl. rep. OLY/GLB/ACC/DOC/ARC/SUP/01A

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MoLAS-PCA 2007h. *Olympic, Paralympic & Legacy Transformation Planning Applications, Supplementary Information. Volume 10A Environmental Statement Annexure: Archaeological and Built Heritage Impact Assessment (Detailed desk-based assessment [DBBA]) Planning Delivery Zone Eight*, London, MoLAS-PCA unpubl. rep. OLY/GLB/ACC/DOC/ARC/SUP/01A

MoLAS-PCA 2007i. *Olympic, Paralympic & Legacy Transformation Planning Applications, Supplementary Information. Volume 10A Environmental Statement Annexure: Archaeological and Built Heritage Impact Assessment (Detailed desk-based assessment [DBBA]) Planning Delivery Zone Nine*, London, MoLAS-PCA unpubl. rep. OLY/GLB/ACC/DOC/ARC/SUP/01A

MoLAS-PCA 2007j. *Olympic, Paralympic & Legacy Transformation Planning Applications, Supplementary Information. Volume 10A Environmental Statement Annexure: Archaeological and Built Heritage Impact Assessment (Detailed desk-based assessment [DBBA]) Planning Delivery Zone Ten*, London, MoLAS-PCA unpubl. rep. OLY/GLB/ACC/DOC/ARC/SUP/01A

MoLAS-PCA 2007k. *Olympic, Paralympic & Legacy Transformation Planning Applications, Supplementary Information. Volume 10A Environmental Statement Annexure: Archaeological and Built Heritage Impact Assessment (Detailed desk-based assessment [DBBA]) Planning Delivery Zone Eleven*, London, MoLAS-PCA unpubl. rep. OLY/GLB/ACC/DOC/ARC/SUP/01A

MoLAS-PCA 2007l. *Olympic, Paralympic & Legacy Transformation Planning Applications, Supplementary Information. Volume 10A Environmental Statement Annexure: Archaeological and Built Heritage Impact Assessment (Detailed desk-based assessment [DBBA]) Planning Delivery Zone Twelve*, London, MoLAS-PCA unpubl. rep. OLY/GLB/ACC/DOC/ARC/SUP/01A

MoLAS-PCA 2007m. *Olympic, Paralympic & Legacy Transformation Planning Applications, Supplementary Information. Volume 10A Environmental Statement Annexure: Archaeological and Built Heritage Impact Assessment (Detailed desk-based assessment [DBBA]) Planning Delivery Zone Thirteen*, London, MoLAS-PCA unpubl. rep. OLY/GLB/ACC/DOC/ARC/SUP/01A

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Appendix 2

Trench concordance
(trenches subject to mitigation excavation in bold)

New trench ID	PDZ	Original trench ID	MoL site code	Report
1	1	PDZ1.01	OL-01106 OL-01507	Adfield *et al.* 2008 PDZ1 WP7
2	1	PDZ1.02 / 03	OL-01106	Adfield *et al.* 2008 PDZ1 WP7
3	1	PDZ1.05	OL-01106	Adfield *et al.* 2008 PDZ1 WP7
4	1	PDZ1.06 / 07	OL-01106	Adfield *et al.* 2008 PDZ1 WP7
5	1	PDZ1.08	OL-01106	Adfield *et al.* 2008 PDZ1 WP7
6	1	PDZ1.09	OL-01106	Adfield *et al.* 2008 PDZ1 WP7
7	1	PDZ1.10	OL-01507	Bazley 2008 PDZ1 WP1, 2, 3, 4, 5, 6
8	1	PDZ1.11	OL-01507	Bazley 2008 PDZ1 WP1, 2, 3, 4, 5, 6
9	**1**	**PDZ1.12**	**OL-01507**	Bazley 2008 PDZ1 WP1, 2, 3, 4, 5, 6; **Payne and Spurr 2009**
10	1	PDZ1.13 and Proofing Trench 2	OL-01507	Bazley 2008 PDZ1 WP1, 2, 3, 4, 5, 6
11	1	PDZ1.14	OL-01507	Bazley 2008 PDZ1 WP1, 2, 3, 4, 5, 6
12	1	PDZ1.15	OL-01507	Bazley 2008 PDZ1 WP1, 2, 3, 4, 5, 6
13	1	PDZ1.16	OL-01507	Bazley 2008 PDZ1 WP1, 2, 3, 4, 5, 6
14	1	PDZ1.17	OL-01507	Bazley 2008 PDZ1 WP1, 2, 3, 4, 5, 6
15	1	PDZ1.19	OL-01507	Bazley 2008 Bazley 2008 PDZ1 WP1, 2, 3, 4, 5, 6
16	1	PDZ1.20	OL-01507	Bazley 2008 PDZ1 WP1, 2, 3, 4, 5, 6
17	1	PDZ1.21	OL-01507	Bazley 2008 PDZ1 WP1, 2, 3, 4, 5, 6
18	1	PDZ1.22	OL-01507	Bazley 2008 PDZ1 WP1, 2, 3, 4, 5, 6
19	1	PDZ1.23	OL-01507	Bazley 2008 PDZ1 WP1, 2, 3, 4, 5, 6
20	1	PLUG Eval Trench 1a & b	OL-00305	Halsey and Hawkins 2007 PDZ1 Site26
21	1	PLUG East-2	OL-00305	Hawkins 2005 PDZ1 PLUG Shaft East 2 West, PDZ1 Site26
22	1	PLUG Eval Trench 2a & b	OL-00305	Halsey and Hawkins 2007 PDZ1 Site26
23	1	PLUG Eval Trench 2a & b	OL-00305	Halsey and Hawkins 2007 PDZ1 Site26
24	1	PLUG Eval Trench 3 and PLUG West-2	OL-00305	Hawkins 2005 PDZ1 PLUG Shaft East 2 West, PDZ1 Site26
25	1	Proofing Trench 1	OL-01507	Bazley *et al.* 2008 PDZ1 WP1, 2, 3, 4, 5, 6
26	1	Eval Trench 1	OL-00105	Howell *et al.* 2005 PDZ1 Site 25
27	1	Eval Trench 2	OL-00105	Howell *et al.* 2005 PDZ1 Site 25
28	1	Eval Trench 3	OL-00105	Howell *et al.* 2005 PDZ1 Site 25
29	1	Eval Trench 4	OL-00105	Howell *et al.* 2005 PDZ1 Site 25
30	1	Eval Trench 5	OL-00105	Howell *et al.* 2005 PDZ1 Site 25
31	1	Eval Trench 6	OL-00105	Howell *et al.* 2005 PDZ1 Site 25
32	1	Eval Trench 7	OL-00105	Howell *et al.* 2005 PDZ1 Site 25
33	1	Eval Trench 8	OL-00105	Howell *et al.* 2005 PDZ1 Site 25
34	1	Eval Trench 9	OL-00105	Howell *et al.* 2005 PDZ1 Site 25
35	1	Eval Trench 10	OL-00105	Howell *et al.* 2005 PDZ1 Site 25
36	2	PDZ2.09	OL-06407	Thrale and Corcoran 2008 PDZ2 WP1
37	2	PDZ2.21	OL-01707	Thrale 2008 PDZ2 WP2
38	2	PDZ2.24/25	OL-01707	Payne and Yendell 2008 PDZ2 WP3, 5
39	3	PDZ3.01	OL-04207	PDZ3 WP1
40	3	PDZ3.04	OL-10008	Harris 2008 PDZ3
41	3	PDZ3.07	OL-10008	Harris 2008 PDZ3
42	3	PDZ3.12	OL-10008	Harris 2008 PDZ3
43	**3**	**PDZ3.17/18**	**OL-08607**	Sorapure *et al.* 2008 PDZ3 WP4; **Bull and Spurr 2009**
44	3	PDZ3.19/20	OL-08607	Sorapure *et al.* 2008 PDZ3 WP4
45	3	PDZ3.22	OL-08607	Sorapure *et al.* 2008 PDZ3 WP4
46	**3**	**PDZ3.24**	**OL-04207**	Archer and Corcoran 2008 PDZ3 WP1; **Bull 2009**
47	3	PDZ3.25	OL-04207	Archer and Corcoran 2008 PDZ3 WP1
48	3	PDZ3.26	OL-10008	Harris 2008 PDZ3
49	3	PDZ3.27	OL-10008	Harris 2008 PDZ3
50	3	PDZ3.28	OL-10008	Harris 2008 PDZ3
51	3	PDZ3.30	OL-10008	Harris 2008 PDZ3
52	3	PDZ3.31	OL-04307	Payne and Corcoran 2008 PDZ3 WP2
53	3	PDZ3.32	OL-04307	Payne and Corcoran 2008 PDZ3 WP2
54	3	PDZ3.33	OL-04307	Payne and Corcoran 2008 PDZ3 WP2
55	3	PDZ3.34	OL-04307	Payne and Corcoran 2008 PDZ3 WP2
56	**3**	**PDZ3.35/36**	**OL-04307**	Payne and Corcoran 2008 PDZ3 WP2; **Payne and Spurr 2009**
57	3	PDZ3.37	OL-04307	Payne and Corcoran 2008 PDZ3 WP2
58	**3**	**PDZ3.38**	**OL-04407**	Fairman and Spurr 2008 PDZ3 WP3; **Fairman and Spurr 2009**

New trench ID	PDZ	Original trench ID	MoL site code	Report
59	**3**	**PDZ3.39**	**OL-04407**	Fairman and Spurr 2008 PDZ3 WP3; **Archer and Spurr 2009**
60	3	PDZ5.81[c]	OL-04307	Payne and Corcoran 2008 PDZ3 WP2
61	4	PDZ4.08	OL-06907	Thrale 2008 PDZ4 WP3
62	4	PDZ4.10	OL-06607	Thrale 2008 PDZ4 WP2
63	4	PDZ4.16	OL-06807	Pipe et al. 2008 PDZ4 WP1, 5
64	4	PDZ4.17	OL-06807	Pipe et al. 2008 PDZ4 WP1, 5
65	4	PDZ4.21	OL-06807	Pipe et al. 2008 PDZ4 WP1, 5
66	4	PDZ4.25	OL-06907	Thrale 2008 PDZ4 WP3
67	4	PDZ4.28	OL-06707	Thrale 2008 PDZ4 WP3
68	4	PDZ4.30	OL-06607	Thrale 2008 PDZ4 WP2
69	4	PDZ4.41	OL-08207	Pipe et al. 2008 PDZ4 WP1, 5
70	4	PDZ4.51	OL-08307	Thrale 2008 PDZ4 WP3
71	5	Evaluation Trench	OL-01807	Sargent and Corcoran 2008 PDZ5
72	5	PDZ5.01	OL-10208	Harris and Melikian 2009 PDZ5, PDZ6 Wetland Areas
73	5	PDZ5.02	OL-10208	Harris and Melikian 2009 PDZ5, PDZ6 Wetland Areas
74	5	PDZ5.03	OL-10208	P Harris and Melikian 2009 DZ5, PDZ6 Wetland Areas
75	**6**	**PDZ6.01**	**OL-06507**	**Douglas and Spurr 2009 PDZ6.01**
76	6	PDZ6.07a	OL-07907	Barrowman and Yendell 2008 PDZ6, PDZ10
77	6	PDZ6.08	OL-07907	Barrowman and Yendell 2008 PDZ6, PDZ10
78	6	PDZ6.28	OL-08908	Barrowman and Spurr 2008 PDZ6 WP6
79	6	PDZ6.35	OL-08908	PDZ6 WP6
80	6	PDZ6.CG.01	OL-10308	Harris 2009 PDZ6 Channelsea Gorge
81	6	PDZ6.CG.02	OL-10308	Harris 2009 PDZ6 Channelsea Gorge
82	6	PDZ6.CG.03	OL-10308	Harris 2009 PDZ6 Channelsea Gorge
83	6	PDZ6.CG.04	OL-10308	Harris 2009 PDZ6 Channelsea Gorge
84	6	Eval Trench 9	OL-00407	Sargent and Mills 2007 PDZ6 Hennikers
85	6	Eval Trench 11	OL-00407	Sargent and Mills 2007 PDZ6 Hennikers
86	6	Eval Trench 14	OL-00407	Sargent and Mills 2007 PDZ6 Hennikers
87	6	Eval Trench 15	OL-00407	Sargent and Mills 2007 PDZ6 Hennikers
88	6	Eval Trench 16	OL-00407	Sargent and Mills 2007 PDZ6 Hennikers
89	6	Eval Trench 17	OL-00407	Sargent and Mills 2007 PDZ6 Hennikers
90	6	Eval Trench 18	OL-00407	Sargent and Mills 2007 PDZ6 Hennikers
91	6	Eval Trench 19	OL-00407	Sargent and Mills 2007 PDZ6 Hennikers
92	6	PDZ6.07	OL-10108	Harris and Melikian 2009 PDZ5, PDZ6 Wetland Areas
93	6	PDZ6.08	OL-10108	Harris and Melikian 2009 PDZ5, PDZ6 Wetland Areas
94	6	PDZ6.09	OL-10108	Harris and Melikian 2009 PDZ5, PDZ6 Wetland Areas
95	6	PDZ6.48	OL-10108	Harris and Melikian 2009 PDZ5, PDZ6 Wetland Areas
96	7	PDZ5.01 [c]	OL-01607	Barrowman and Corcoran 2008 PDZ7
97	7	PDZ5.02 [c]	OL-01607	Barrowman and Corcoran 2008 PDZ7
98	7	PDZ5.04 [c]	OL-01607	Barrowman and Corcoran 2008 PDZ7
99	7	PDZ5.06 [c]	OL-01607	Barrowman and Corcoran 2008 PDZ7
100	7	PDZ6.04 [c]	OL-01607	Barrowman and Corcoran 2008 PDZ7
101	7	PDZ6.05a [c]	OL-01607	Barrowman and Corcoran 2008 PDZ7
102	7	PDZ6.05b [c]	OL-01607	Barrowman and Corcoran 2008 PDZ7
103	7	PDZ6.06 [c]	OL-01607	Barrowman and Corcoran 2008 PDZ7
104	7	PDZ7.01/6.02 [c]	OL-01607	Barrowman and Corcoran 2008 PDZ7
105	7	PDZ7.02/6.03 [c]	OL-01607	Barrowman and Corcoran 2008 PDZ7
106	7	PDZ7.03	OL-01607	Barrowman and Corcoran 2008 PDZ7
107	7	PDZ7.04	OL-01607	Barrowman and Corcoran 2008 PDZ7
108	7	PDZ7.05	OL-01607	Barrowman and Corcoran 2008 PDZ7
109	8	PDZ5.36 [c]	OL-08807	Barrowman and Yendell 2008 PDZ8
110	8	PDZ5.38 [c]	OL-07807	Barrowman and Yendell 2008 PDZ8
111	8	PDZ5.41 [c]	OL-08807	Barrowman and Yendell 2008 PDZ8
112	8	PDZ8.01/5.40 [c]	OL-08807	Barrowman and Yendell 2008 PDZ8
113	8	PDZ8.04/5.35 [c]	OL-08807	Barrowman and Yendell 2008 PDZ8
*114	9	Eval Trench H08	OL-01607	Barrowman et al. 2008 PDZ9 Stratford H08
*115	9	F10a Eval Trench 1	OL-01307	Sargent 2007 PDZ9 WP2 - Bridge F10
116	10	PDZ10.01	OL-08107	Barrowman and Yendell 2008 PDZ6, PDZ10
117	10	PDZ6.07b	OL-07907	Barrowman and Yendell 2008 PDZ6, PDZ10
118	12	PDZ12.01	OL-08707	Birchenough *et al.* 2008 PDZ12 WP1, 2; Howell and Spurr 2009
119	12	PDZ5.42 [c]	OL-08507	Birchenough *et al.* 2008 PDZ12 WP1, 2
120	15	PDZ15.01	OL-02907	Pooley *et al.* PDZ15
121	15	PDZ15.02	OL-02907	Pooley *et al.* 2008 PDZ15

* Trenches in PDZ 9 are not included in this report

Appendix 3

Built Heritage Assets Concordance

BHA Heritage Assets	Asset name	PDZ	Original built heritage asset no.	MoL site code	Report
1	Romeny Huts, Carpenter's Road	1	145	OL-04007	Robertson 2008
2	Mock Elizabethan Cottage	3	79	OL-2107	Bower 2008
3	20th century industrial sheds	3	140	OL-02807	Bower 2008
4	Industrial shed & adjacent building, Marshgate Centre	3	146	OL-03907	Robertson 2008
5	King's Yard, Carpenter's Road	4	43	OL-02607	Robertson 2008
6	Rails from Travelling Cranes & Brundles Industrial Warehouse	4	72	OL-05207, OL-06007	Bower 2008
7	Chimney east of Roach Road	4	48	OL-07107	Bower and Pierazzo 2008
8	Eton Manor Sports Ground	7		OL-00906	Cohen 2006
9	39, 41, 43–45 Marshgate Lane & associated warehouse	8	93	OL-03207	Robertson 2008
10	39, 41, 43–45 Marshgate Lane & associated warehouse	8	137	OL-03407	Robertson 2008
11	39, 41, 43–45 Marshgate Lane & associated warehouse	8	94	OL-03307	Robertson 2008
12	39, 41, 43–45 Marshgate Lane & associated warehouse	8	138/139	OL-03107	Robertson 2008
13	7, Pudding Mill Lane	8	98	OL-03607	Dwyer 2008
14	Unit 1, Vanguard Trading Estate	8	95	OL-05507	Westman 2008
15	Units 5–7, Vanguard Trading Estate	8	96	OL-05607	Westman 2008
16	Brick Wall, Angel Lane	11	142	OL-07707	Dwyer 2008
17	Machinery, Temple Mills	11	143	OL-08407	Dwyer 2008
18	Wall opposite 116–130 Abbey Lane	12	23	OL-04807	Bower 2008
19	Second World War Defences	6	128	OL-01907	Robertson 2008
20	Greenway pillboxes and tank traps	3	147	OL-08007	Robertson 2008
21	Sports Pavillion, East Marsh	15	31	OL-4907	Dwyer 2008
22	98–100 Carpenter's Road	1	–	CPX04-07, CPX04-08, CPX04-09	Dixon 2004
23	103, 105 and 107 Carpenter's Road	1	–	CPX04-02, CPX04-03, CPX04-05	Dixon 2004
24	Warton Road viaduct & road alignment	1	26	OL-00305	Dixon 2005
25	The Waterways	1	-	OL-01207	Bower and Thompson 2008
26	Henniker's & Potter's Ditches	6	86	OL-02007	Bower and Thompson 2008
27	Carpenter's Lock	2	73	OL-03007	Bower and Thompson 2008
28	Pudding Mill River	3	-	OL-02707	Bower and Thompson 2008
29	City Mill River Footbridge	2	75	OL-03507	Bower and Thompson 2008
30	Old Ford Locks	4	62	OL-05007	Bower and Thompson 2008
31	Pudding Mill Lock	3	80	OL-05407	Bower and Thompson 2008
32	Stone & brick riverbank walls	3	70	OL-07207	Bower and Thompson 2008
33	Old Ford Lock Houses	4	71	OL-07307	Bower and Thompson 2008
34	Marshgate Lane Lock	8	89	OL-07407	Bower and Thompson 2008
35	Great Eastern Railway	1	34	OL-02407	Dwyer 2008
36	GER bridges from River Lea to City Mill River	2	78	OL-05307	Dwyer 2008
37	GER bridges over Waterworks River, Warton Road & Carpenter's Road	1	83, 84, 85	OL-05807	Dwyer 2008
38	Northern Outfall Sewer	3	35	OL-02507	Bower 2008
39	Greenway Bridge over River Lea	3	77	OL-02207	Bower 2008
40	Greenway Bridge over Marshgate Lane & Pudding Mill Lane	3	76	OL-02307	Bower 2008
41	Pedestrian subway	8	87	OL-04107	Bower 2008
42	Abbey Lane Pedestrian Bridge	12	9	OL-04507	Bower 2008
43	Pedestrian Bridge spanning Channelsea River	12	110	OL-04607	Bower 2008
44	Viaduct of Outfall Sewer	13	111	OL-04707	Bower 2008
45	Eastway Road Bridge	5	63	OL-05107	Dwyer and Sorapure 2008
46	Bridgewater Road Concrete Bridge	8	99	OL-05707	Dwyer and Sorapure 2008
47	Waterden Road Bridge	4	135	OL-05907	Dwyer and Sorapure 2008
48	White Post Lane Bridge	4	-	OL-07007	Dwyer and Sorapure 2008
49	Temple Mill Lane Bridge	11	107	OL-07507	Dwyer and Sorapure 2008
50	Angel Lane Bridge	11	141	OL-07607	Dwyer and Sorapure 2008
51	Overhead powerlines transmission & associated structures, Lower Lea Valley	13	-	OL-01207	Dwyer 2007
52	Tow Path Wall	3	79	OL-06207	Bower 2008

Appendix 4

Prehistoric pottery fabric descriptions

C1	Soft fabric with abundant calcareous matter and voids
FL1	Hard, micaceous sand, variably oxidised matrix; common, well-sorted, angular, fine to very coarse crushed calcined flint
FL2	Hard, micaceous quartz sand, oxidised; sparse, fine, angular crushed calcined flint
FL3	Soft, micaceous quartz sand, variably oxidised; moderate, well-sorted, angular, fine to coarse crushed calcined flint
FL4	Soft, quartz sand, oxidised; sparse to moderate, poorly-sorted, angular, fine to very coarse crused calcined flint
FL5	Soft, externally oxidised, internally and core unoxidised matrix; common, well-sorted, angular, fine to very coarse crushed calcined flint
FL6	Soft, micaceous sand, oxidised matrix; abundant, well-sorted, angular, fine to coarse crushed calcined flint
FL7	Soft unoxidised fabric; sparse to moderate fine to very coarse poorly sorted crushed calcined flint
FL99	Flint-tempered crumbs too small to identify
G1	Soft, soapy fabric, moderate grog
I1	Soft, micaceous quartz sand; abudant, well-sorted, very fine, sub-rounded and rounded black iron minerals naturally occurring?
QU1	Soft, micaceous quartz sand, unoxidised; rare, poorly sorted, angular, very coarse calcined flint (possibly accidental)
QU2	Hard, micaceous quartz sand, unoxidised; rare, poorly-sorted, angular, very fine to medium calcined flint (probably accidental)
SH1	Soft soapy fabric; moderate shell
SH2	Soft irregularly oxidised fabric; frequent shell
SH3	Hard, unoxidised micaceous fabric; sparse to moderate well-sorted shell
V1	Soft, soapy fabric with frequent large voids

Appendix 5: Radiocarbon Determinations

All Phases 2–5 dates are included in this appendix. Quoted dates have been checked against original laboratory reports to ensure they are correctly quoted below. The reliability of each radiocarbon date for dating the sedimentary context within which it has been obtained is noted, using a scale of 1–3 (1 = reliable; 2 = questionable; 3 = problematic/rejected); # = unreliability of dates on bone based on C:N ratios above 3.5. All dates are AMS unless indicated by * (radiometric) or + (method unknown)

Trench	*Lab code*	*Feature*	*Context*	*Sample*	*Depth (mOD)*	*Material dated*	*Date BP*	*$\delta^{13}C$‰*	*$\delta^{15}N$‰*	*C:N*	*Calibrated date (2σ; 95.4%)*	*Reliability of date*
6	SUERC-35319	Feature 352	351	Bulk 72		Charcoal: *Corylus avellana*	2200±30	–28.5	–	–	380–180 cal BC	1
7	GU-22480	–	167	Bulk 49 + 50		Plant material: 3 x *Linum usitatissimum* capsule + seed	Failed	–	–	–	–	–
7	SUERC-25621	–	169	Mono. 43 M4	0.94	Wood/stem: indet. roundwood	1605±40	–29.3	–	–	cal AD 350–560	2
7	SUERC-25622	–	169	Mono. 43 M4	1.05	Wood/stem: indet. stem	1500±40	–29.2	–	–	cal AD 430–650	2
7	SUERC-25623	–	165	Mono. 43 M2	1.87	Sediment (acid wash)	1505±40	–28.0	–	–	cal AD 430–650	2
7	SUERC-31558	–	167	Bulk 49 + 50	0.52–0.94	Seeds: 8 x *Oenanthe* sp.	1415±30	–29.1	–	–	cal AD 580–670	1
9	Beta-254059	–	80	Mono. 21	2.2	Sediment (acid wash)	2380±40	–25.6	–	–	750–380 cal BC	2
9	Beta-254060	–	74	Mono. 21	2.5	Sediment (acid wash)	1710±40	–26.1	–	–	cal AD 240–420	2
9	Beta-254061	–	1704	Mono. 578	1.3	Sediment (acid wash)	2250±40	–26.4	–	–	400–200 cal BC	1
9	Beta-254062	–	1703	Mono. 578	1.8	Sediment (acid wash)	2200±40	–25.7	–	–	390–170 cal BC	1
9	Beta-254063	–	307	Mono. 65	1.29	Sediment (acid wash)	3430±40	–28.4	–	–	1880–1630 cal BC	2
9	Beta-254064	–	1724	Mono. 584	1.7	Sediment (acid wash)	2200±40	–25.6	–	–	390–170 cal BC	1
9	Beta-254065	–	1723	Mono. 584	1.97	Sediment (acid wash)	2570±40	–26.4	–	–	820–540 cal BC	3
9	Beta-254066	–	206	Mono. 65	2.09	Sediment (acid wash)	2000±40	–27.2	–	–	160 cal BC–cal AD 90	2
9	Beta-254067	–	2221	Mono. 668	1.29	Sediment (acid –alkali-acid wash)	2180±40	–26.6	–	–	380–110 cal BC	1
9	Beta-254068	–	2181	Mono. 668	1.9	Sediment (acid wash)	2350±40	–26.0	–	–	730–260 cal BC	1
9	GU-23537	Ditch 1920 (cut 1738)	1737	–	–	Bone: *Bos* pelvis (6g)	Failed	–	–	–	–	–
9	GU-23547	Inhumation 1158	1156	–	–	Human bone: L. femur (1.7g)	Failed	–	–	–	–	–
9	GU-23548	Inhumation 1041	1057	–	–	Human bone: R. femur (2.0g)	Failed	–	–	–	–	–
9	GU-23549	Inhumation 1662	1663	–	–	Human bone: L. femur (1.8g)	Failed	–	–	–	–	–
9	GU-24229	Inhumation 1041	1057	–	–	Human bone: long bone 7.3	Failed	–	–	–	–	–
9	GU-24230	Inhumation 1158	1156	–	–	Human bone: long-bone 4.3g	Failed	–	–	–	–	–
9	GU-24231	Inhumation 1662	1663	–	–	Human bone: long-bone 6.9g	Failed	–	–	–	–	–
9	SUERC-33659	Pit 1790	1933	–	–	Bone: *Cervus elaphus* antler (6 g)	2200±30	–28.0	7.1	16.1	380–180 cal BC	#
9	SUERC-33660	Pit 1256	1255	–	–	Bone: *Ovis/capra* scapula/tibia (6g)	1785±30	–26.3	7.4	8.9	cal AD 130–340	#
9	SUERC-33661	Post-hole 2055	2014	–	–	Bone: *Capra* (kid) skeleton (5g)	2240±30	–24.4	2.2	5.3	390–200 cal BC	#
9	SUERC-33662	Pit 1005	1004	–	–	Bone: *Ovis/capra* scapula/tibia (6g)	2675±30	–22.8	11.1	3.9	900–790 cal BC	#
9	SUERC-33666	Ditch 1922 (cut 1477)	1476	–	–	Bone: *Bos* skull (7g)	3030±30	–22.2	7.1	3.6	1400–1130 cal BC	#
9	SUERC-33667	Ditch 1920 (cut 1738)	1737	Bulk 599	–	Charred cereal: 2 x *Hordeum* grains	3085±30	–25.1	–	–	1430–1270 cal BC	1
9	SUERC-33668	Pit 1019	1018	Bulk 501	–	Charred cereal: 4 x *Triticum* cf. *dicoccum* grains	2780±30	–20.8	–	–	1010–840 cal BC	1
9	SUERC-33669	Pit 1322	1321	Bulk 528	–	Charred cereal: 2 x *Triticum dicoccum* /*spelta* grains	2780±30	–22.0	–	–	1010–840 cal BC	1

Trench	Lab code	Feature	Context	Sample	Depth (mOD)	Material dated	Date BP	$\delta^{13}C$‰	$\delta^{15}N$‰	C:N	Calibrated date (2σ; 95.4%)	Reliability of date
9	SUERC-33670	Pit 2115	2114	Bulk 655	–	Charred cereal: 2 x cf. *Triticum dicoccum /spelta* grains	2815±30	–22.2	–	–	1060–890 cal BC	1
9	SUERC-33671	Pit 1645	1644	Bulk 564	–	Charred cereal: 2 x cf. *Hordeum* grains	2785±30	–23.3	–	–	1010–840 cal BC	1
9	SUERC-33672	Curved gully 1260	1259	Bulk 523	–	Charred cereal: 2 x *Triticum dicoccum /spelta* grains	2195±30	–24.4	–	–	370–180 cal BC	1
9	SUERC-33676	Pit 1219	1218	Bulk 524	–	Charred cereal: 2 x cf. *Triticum spelta* grains	2785±30	–21.3	–	–	1010–840 cal BC	1
9	SUERC-33677	Pit 1730	1729	Bulk 586	–	Charred cereal: *Hordeum*, cf. *Triticum spelta* grains	2820±30	–25.3	–	–	1070–890 cal BC	1
9	SUERC-33678	Inhumation 1852	1810	–	–	Human bone: right femur (3g)	2020±30	–20.2	12.5	3.3	110 cal BC–cal AD 60	1
9	SUERC-33679	Ditch 1213	1926	Bulk 643	–	Plant material: *Prunus spinosa* stone	2190±30	–30.0	–	–	370–170 cal BC	1
9	SUERC-34930	Cremation 1972	1971	Bulk 633	–	Cremated indet. bone (3.7g)	2845±35	–23.1	–	–	1130–910 cal BC	1
9	SUERC-34932	Cremation 2052	2051	Bulk 638	–	Cremated indet. bone (1.8g)	2835±35	–23.4	–	–	1120–900 cal BC	1
9	SUERC-34942	Gully 1106	1196	Bulk 519	–	Charred cereal: *Hordeum*, cf. *Triticum dicoccum* grains	2215±35	–22.3	–	–	390–190 cal BC	1
9	SUERC-35323	Cremation 1972	1971	Bulk 633	–	Charcoal: *Quercus* cf. sapwood	3075±30	–26.4	–	–	1420–1260 cal BC	2
9	SUERC-35324	Cremation 2052	2051	Bulk 638	–	Charcoal: Maloideae	2840±30	–28.1	–	–	1120–910 cal BC	1
10	NZA-32947	–	134	Bulk 26	0.86–1.04	Plant material: 10 x *Alnus glutinosa* cones	2484±35	–28.1	–	–	780–410 cal BC	1
21	Beta-213550*	–	11	Mono. 14	1.77	Sediment (acid wash)	1300±50	–29.4	–	–	cal AD 640–870	2
21	Beta-213551*	–	14	Mono. 13	1.61	Sediment (acid wash)	1110±60	–28.7	–	–	cal AD 770–1030	3
21	GU-19373	–	11	Bulk 17	–	Seeds: 10 x *Schoenoplectus*	Failed	–	–	–	–	–
21	GU-20504	–	11	Bulk 17	1.73–1.93	Seeds: *Ranunculus* sp., *Mentha*, *Menyanthes*, *Rumex*, *Schoenoplectrus*	Failed	–	–	–	–	–
21	SUERC-24956	–	14	Bulk 15	1.60–1.79	Seeds: 4 x *Rumex* + bract, *Carex* trig, *Ranunculus arb*, *Polygonum aviculare*	580±30	–25.5	–	–	cal AD 1290–1420	1
22	Beta-210489	–	35	–	1.67	Plant material: Fine root material	550±40	–27.0	–	–	cal AD 1300–1440	3
22	SUERC-35333	–	29	Bulk 29	–	Seeds: 4 x *Ranunculus* sp., *Rumex*, 2 x *Carduus/Cirsium*, *Sonchus asper*, 2 x Trig. *Carex*, *Carex cf. nigra*, *Thalictrum flavum*	1200±30	–25.1	–	–	cal AD 710–940	1
24	Beta-210488	Pit 7	6	Mono. 1	2.12	Charred material indet.	2990±40	–24.7	–	–	1390–1050 cal BC	1
24	SUERC-24954	–	4	Bulk 8	2.12–2.31	Seeds: *Schoenoplectus*, *Ranunculus arb*	1050±30	–26.3	–	–	cal AD 890–1030	3
24	SUERC-24955	–	2	Bulk 12	2.44–2.58	Charred cereal: 2 x frags. *Avena* sp.	135±30	–27.5	–	–	cal AD 1670–1950	1
24	SUERC-25013	–	3	Bulk10	2.31–2.44	Seeds: *Carex*, *Ranunculus*, *Atriplex*, 2 x Alismataceae,	310±60	Not quoted	–	–	cal AD 1440–1800	2
24	SUERC-35325	Gully 23	24	Bulk 24	–	Charcoal: *Prunus spinosa*	3075±30	–27.8	–	–	1420–1260 cal BC	1
26	Beta-204033*	–	12	Mono. 18	1.8	Concentration of fibrous organics from within sediment	2020±70	–28.3	–	–	340 cal BC–cal AD 130	2
27	Beta-220048	–	6(C13)	Mono. 1	1.54	Sediment (acid wash)	2130±40	–28.7	–	–	360–40 cal BC	3

Trench	Lab code	Feature	Context	Sample	Depth (mOD)	Material dated	Date BP	$\delta^{13}C$‰	$\delta^{15}N$‰	C:N	Calibrated date (2σ; 95.4%)	Reliability of date
27	Beta-220051*	–	C13	Mono. 9	2.02	Sediment (acid wash)	1630±50	–28.6	–	–	cal AD 250–550	3
27	SUERC-31390	–	15/16	Bulk 4/3	1.3	Plant material: *Linum usitatissimum* capsule fragments	1335±30	–29.0	–	–	cal AD 640–770	1
29	Beta-204034*	–	37	Mono. 45	0.7	Bulk low carbon analysis on sediment	3310±60	–29.1	–	–	1740–1450 cal BC	3
29	Beta-220049	–	36	Mono. 32	1.71	Sediment (acid wash)	2720±40	–28.0	–	–	980–800 cal BC	3
29	GU-24454	–	–	Mono. 30	1.19–1.20	Plant material: *Sparganium erectum*, *Solanum,* 2 x bud scales, twig + bud, *Juncus*, *Montia fontanum*	Failed	–	–	–	–	–
29	SUERC-26953	–	37	Bulk 44	0.80–0.95	Seeds: 16 x *Ranunculus cf. repens*, 2 x *Rubus* sp.	1855±30	–26.1	–	–	cal AD 80–240	1
29	SUERC-26954	–	37	Bulk 40	1.55–1.70	Seeds: 2 x *Iris pseudacorus*	1720±30	–26.7	–	–	cal AD 240–400	1
30	Beta-204035*	–	54	Mono. 48	1.9	Bulk low carbon analysis on sediment	3210±50	–28.6	–	–	1620–1400 cal BC	2
33	Beta-204036*	–	82	Mono. 69	1.1	Bulk low carbon analysis on sediment	3690±60	–28.7	–	–	2280–1910 cal BC	2
33	Beta-220050	–	79	Mono. 28	2.01	Sediment (acid wash)	2420±40	–28.2	–	–	760–390 cal BC	3
33	Failed	–	81	Mono. 25	1.58–1.60	Seeds: *Urtica dioica*, *Mentha* sp.	Failed		–	–		
33	SUERC-31388	–	83	Bulk 79	0.95–1.05	Plant material: 2 x *Alnus glutinosa* cones	6240±30	–26.2	–	–	5310–5070 cal BC	1
33	SUERC-31389	–	79	Mono. 25	1.66–1.68	Sediment	2745±30	–28.2	–	–	980–810 cal BC	3
33	SUERC-31556	–	81	Bulk 77	1.45–1.55	Plant material: 3 x *Alnus glutinosa* cones	2285±30	–28.5	–	–	410–210 cal BC	1
33	SUERC-35334	–	82	Bulk 26	1.35–1.37	Plant material: 21 x *Alnus glutinosa* seeds + catkin frag., 6 x *Persicaria hydropiper*	2270±30	–26.7	–	–	400–200 cal BC	1
34	Beta-204037*	–	90	Mono. 90	1.16–1.20	Bulk low carbon analysis on sediment	4160±80	–26.3	–	–	2910–2490 cal BC	2
34	Failed	–	90	Bulk 86	1.10–1.27	Seeds: *Alnus glutinosa*, 11 x *Chenopodium polyspermum*, *Barbarea*, 3 x *Urtica*	Failed	–	–	–	–	–
34	SUERC-31557	–	88	Bulk 84	1.44–1.65	Seeds: 10 x *Rubus* sp.	2325±30	–28.4	–	–	490–230 cal BC	1
35	NZA-32949	–	94	Bulk 93	1.55–1.70	Plant material: *Alnus glutinosa* cone, 3 x *Crataegus monogyna* stones	2462±35	–28.1	–	–	760–410 cal BC	1
35	SUERC-36296	Interface of gravel (95) and silt (94)	95	–	–	Bone: *Equus* sp. metatarsal	2425±30	–22.6	6.6	3.2	750–400 cal BC	1
43	Beta-250982	–	501	Mono. 115	1.57	Sediment (acid wash)	4190±40	–25.0	–	–	2900–2630 cal BC	3
43	Beta-250983	–	500	Mono. 115	1.95	Sediment (acid wash)	3200±40	–25.7	–	–	1610–1400 cal BC	3
43	Beta-250984	–	544	Mono. 115	2.47	Sediment (acid wash)	2870±40	–26.7	–	–	1200–920 cal BC	3
43	GU-24251	Ditch 603	602	Bulk 135	–	Seeds: 7x *Ranunculus* sp., 2 x *Oenanthe*	Failed	–	–	–	–	–
43	SUERC-34931	Cremation 527	526	Bulk 107	–	Cremated indet. bone (1.7g)	2830±35	–23.1	–	–	1120–900 cal BC	1
43	SUERC-34941	Pit 587	588	Bulk 131	–	Charred cereal: 2 x degraded cf. *Hordeum* grains	2710±35	–24.3	–	–	920–800 cal BC	1
43	SUERC-34958	Ditch 628	629	Bulk 147	–	Seeds: 3 x *Menyanthes,* 3 x *Sparganium*	1145±35	–27.0	–	–	cal AD 770–980	1

Trench	Lab code	Feature	Context	Sample	Depth (mOD)	Material dated	Date BP	$\delta^{13}C$‰	$\delta^{15}N$‰	C:N	Calibrated date (2σ; 95.4%)	Reliability of date
43	SUERC-35326	Cremation 527	526	Bulk 107	–	Charcoal: *Acer campestre*	2810±30	–24.4	–	–	1050–860 cal BC	1
43	SUERC-36230	Ditch 603	602	Bulk 135	–	Seeds: *Ranunculus* sp., *Carex*, *Eleocharis*, *Mentha* sp.	1360±30	–26.7	–	–	cal AD 610–770	1
43	SUERC-36231	Post–hole 513	512	Bulk 102	–	Seeds: *Menyanthes*, *Schoenoplectrus*, *Sparganium erectum*, *Carex*, *Ranunculus* sp.	1335±30	–26.2	–	–	cal AD 640–770	1
45	GU-24236	Post–hole 46	45	Bulk 23	–	Charred cereal: *Triticum dicoccum* /*spelta* grain	Failed	–	–	–	–	–
45	SUERC-34940	Post–hole 42	41	Bulk 21	–	Charred cereal: *Hordeum* grain	2860±35	–23.0	–	–	1130–910 cal BC	1
45	SUERC-35327	Post–hole 32	31	Bulk 16	–	Charcoal: *Prunus spinosa*	2915±30	–25.7	–	–	1260–1010 cal BC	1
45	SUERC-36232	Post–hole 34	35	Bulk 18	–	Charcoal: Maloideae	2860±30	–25.0	–	–	1130–920 cal BC	1
52	SUERC-24522	–	58	Mono. 9 M2	1.69	Sediment (humic acid)	1170±30	–29.0	–	–	cal AD 770–970	1
52	SUERC-24523	–	58	Mono. 9 M3	1.61	Seeds: *Menyanthes*, *Ranunculus* subg. *Batrachium*, *Carex*	1165±30	–24.0	–	–	cal AD 770–970	1
52	SUERC-24524	–	58	Mono. 9 M3	1.56	Sediment (humic acid)	1440±30	–29.1	–	–	cal AD 560–660	1
52	SUERC-24525	–	61	Bulk 10	0.90–0.99	Seeds: 8 x *Sagittaria*, *Schoenoplectrus, Sambucus nigra*	1710±30	–25.4	–	–	cal AD 250–410	1
54	SUERC-31380	–	110	Bulk 32	0.54–0.59	Plant material: 4 x *Alnus glutinosa* cones	4070±30	–27.4	–	–	2860–2490 cal BC	1
54	SUERC-31381	–	107	Bulk 23	1.00–1.36	Seeds: 10 x *Carex* sp., *Oenanthe*, *Prunus*	2015±30	–28.1	–	–	100 cal BC–cal AD 70	1
54	SUERC-31382	–	72	Bulk 34	1.64–1.83	Seeds: 10 x *Schoenoplectus*, *Cirsium*, 3 x *Ranunculus*, *Thalictrum*, *Menyanthes*	1175±30	–25.2	–	–	cal AD 770–970	1
56	Beta-250527	Channel fill	143	Mono. 77	2.06	Sediment (acid wash)	1790±40	–28.1	–	–	cal AD 120–350	2
56	Beta-250528	–	196	Mono. 65	2.17	Sediment (acid wash)	1590±40	–27.8	–	–	cal AD 390–570	3
56	Beta-250529	–	193	Mono. 65	2.56	Sediment (acid wash)	1180±40	–27.1	–	–	cal AD 710–980	3
56	Beta-252889	Land surface 215/217	215	Mono. 77	1.72	Sediment (acid wash)	2310±40	–27.1	–	–	510–200 cal BC	2
56	SUERC-34943	Cut 239 (associated with structure 159)	199	Bulk 66	–	Charred cereal: 2 x *Triticum dicoccum* /*spelta* grains	985±35	–22.6	–	–	cal AD 980–1160	1
56	SUERC-35335	Cut 239 (associated with structure 159)	200	Bulk 67	–	14 x *Ranunculus* sp., *Bidens* tri, 10 x *Eleocharis* sp., *Carex* trig, *Carex* flat, 2 x *Sonchus asper*	905±30	–26.9	–	–	cal AD 1030–1210	1
56	SUERC-36288	Cut 239 (associated with structure 159)	199	Bulk 66	–	Charred *Triticum dicoccum* (spikelet forks)	970±30	–25.3	–	–	cal AD 1010–1160	1
58	Beta-250978	–	27	Mono. 40	1.65	Sediment (acid wash)	5350±40	–26.2	–	–	4330–4050 cal BC	2
58	Beta-250979	–	26	Mono. 41	2.08	Sediment (acid wash)	1490±40	–29.3	–	–	cal AD 430–650	2
58	Beta-250980	–	33	Mono. 43	3.5	Sediment (acid wash)	3270±40	–26.0	–	–	1640–1440 cal BC	3
58	Beta-250981	–	23	Mono. 42	2.9	Sediment (acid wash)	2600±40	–26.3	–	–	840–560 cal BC	3
58	SUERC-36580	Structure 100	–	Timber 234	–	Worked wood: *Salix*/*Populus* sp.	315±35	–27.3	–	–	cal AD 1470–1650	1
58	SUERC-36581	Structure 42	–	Timber 280	–	Worked wood: *Betula* sp.	1795±35	–27.1	–	–	cal AD 120–340	1
59	Beta-251398	–	311	Mono. 225	1.87	Sediment (acid wash)	1120±40	–29.2	–	–	cal AD 780–1020	2
59	Beta-251399	–	311	Mono. 225	1.95	Sediment (acid wash)	660±40	–28.5	–	–	cal AD 1270–1400	2
59	Beta-251400	–	315	Mono. 226	1.21	Sediment (acid wash)	2100±40	–27.8	–	–	350–1 cal BC	3
59	Beta-251401	–	312	Mono. 226	1.82	Sediment (acid wash)	1540±40	–27.3	–	–	cal AD 420–610	2

Trench	Lab code	Feature	Context	Sample	Depth (mOD)	Material dated	Date BP	$\delta^{13}C$‰	$\delta^{15}N$‰	C:N	Calibrated date (2σ; 95.4%)	Reliability of date
65	SUERC-24531	–	2a	Mono. 1	2.18	Sediment (humic acid)	7130±35	–25.4	–	–	6070–5920 cal BC	2
65	SUERC-24532	–	2b	Mono. 6	2.4	Sediment (humic acid)	1545±30	–28.3	–	–	cal AD 420–590	1
65	SUERC-25617	–	3	Bulk 3	<2.00	Seeds: 23 x *Schoenoplectrus*	1795±40	–26.3	–	–	cal AD 90–350	1
67	SUERC-26951	–	–	Mono. M3	3.2	Sediment (humic acid)	1645±30	–28.3	–	–	cal AD 260–540	1
67	SUERC-26952	–	–	Mono. M4	2.02	Sediment (humic acid)	1725±30	–28.3	–	–	cal AD 240–400	1
71	SUERC-24526	–	17/18	Mono. 1 M3	2.07	Sediment (humic acid)	2245±30	–28.6	–	–	400–200 cal BC	2
71	SUERC-24530	–	20	Mono. 14 M1	1.21–1.23	Waterlogged plant material: 6 x indet. buds	9050±35	–27.0	–	–	8300–8230 cal BC	1
71	SUERC-24868	–	20	Mono. 14 M2	0.93	Seeds: 30 x *Carex*	9365±110	–	–	–	9130–8300 cal BC	1
71	SUERC-35328	–	22	Mono. 14 M1	1.46–1.49	Charcoal: cf. *Quercus* sp.	385±30	–25.1	–	–	cal AD 1440–1640	3
71	SUERC-35336	–	21	Mono. 14 M2	0.83–0.84	Seeds: 2 x cf. *Potamogeton natans*, 2 x *Schoenoplectus lacustris*, 2 x *Carex* sp. flat, *Carex*/*Viola* trig. 13 x *Ranunculus* subg. *Batrachium*	10285±35	–22.1	–	–	10430–9880 cal BC	1
71	SUERC-35337	–	20	Mono. 14 M2	1.06–1.08	Waterlogged plant material: cf. *Populus tremula* bud scale	8715±35	–25.0	–	–	7940–7590 cal BC	2
71	SUERC-35338	–	20	Mono. 14 M1	1.36–1.38	Waterlogged plant material: indet. organics x 2, could be roots or twigs.	5740±30	–25.0	–	–	4690–4500 cal BC	2
72	SUERC-23167	–	105	Mono. M1	1.62–1.64	Sediment (humic acid)	4465±30	–27.3	–	–	3340–3020 cal BC	2
72	SUERC-23168	–	103	Mono. M3	2.44–2.46	Sediment (humic acid)	2000±30	–28.2	–	–	90 cal BC–cal AD 80	2
72	SUERC-31368	–	105	Bulk 4	1.69–1.74	Seeds: 6 x *Sambucus*	4795±30	–27.5	–	–	3650–3520 cal BC	1
72	SUERC-31369	–	103	Bulk 10	2.34–2.39	Seeds: 24 x *Schoenoplectus* sp.	1755±30	–26.4	–	–	cal AD 170–390	1
72	SUERC-31370	–	102	Bulk 14	2.54–2.59	Seeds: 2x *Ranunculus*; 4x *Schoenoplectus*, 2x *Carex*, 1x *Persicaria minor*	1900±30	–25.9	–	–	cal AD 20–220	1
72	SUERC-35329	–	104	Mono. M2	2.04–2.05	Charcoal: 1 x indet. roundwood	4100±30	–26.7	–	–	2870–2500 cal BC	2
72	SUERC-35339	–	109	Mono. M2	2.20–2.21	Seeds: *Sambucus* sp., *Carex* flat, *Lycopus europaeus*, *Schoenoplectus* sp., 2 x *Carex* trig, *Juncus* sp.	1870±30	–25.0	–	–	cal AD 70–230	1
72	SUERC-35343	–	–	Mono. M1	1.80–1.81	Seeds and waterlogged plant material: 4 x *Rubus* sp., *Sambucus nigra*, *Potamogeton coloratus*, largish Root/twig fragment	3395±30	–26.3	–	–	1760–1610 cal BC	1
75	Beta-257993	–	939	Auger	1.41	Sediment (acid wash)	3880±40	–27.3	–	–	2480–2200 cal BC	3
75	Beta-257994	–	837	Mono. 30	1.6	Sediment (acid wash)	3840±40	–27.5	–	–	2470–2150 cal BC	3
75	Beta-257995	–	837	Mono. 30	1.9	Sediment (acid wash)	3850±40	–27.8	–	–	2470–2200 cal BC	3
75	Beta-257996	–	822	Mono. 30	2.32	Sediment (acid wash)	910±40	–27.8	–	–	cal AD 1030–1220	2
75	Beta-257997	–	838	Mono. 26	1.95	Sediment (acid wash)	1330±40	–27.1	–	–	cal AD 640–780	3
75	Beta-257998	–	833/839	Mono. 26	2.45	Sediment (acid wash)	1400±40	–26.9	–	–	cal AD 570–680	3
75	Beta-257999	–	830	Mono. 28	2	Sediment (acid wash)	11080±60	–25.7	–	–	11180–10780 cal BC	2
75	Beta-258000	–	827	Mono. 28	2.21	Sediment (acid wash)	2540±40	–27.7	–	–	810–530 cal BC	3
75	Beta-258001	–	845	Mono. 28	2.49	Sediment (acid wash)	1710±40	–27.2	–	–	cal AD 240–420	3
75	Beta-258002	–	281	Mono. 2	3.53	Sediment (acid wash)	2030±40	–25.5	–	–	170 cal BC–cal AD 60	3
75	Beta-258003	–	270	Mono. 3	3.04	Sediment (acid wash)	1240±40	–26.7	–	–	cal AD 680–890	3

Trench	*Lab code*	*Feature*	*Context*	*Sample*	*Depth (mOD)*	*Material dated*	*Date BP*	*δ¹³C‰*	*δ¹⁵N‰*	*C:N*	*Calibrated date (2σ; 95.4%)*	*Reliability of date*
75	SUERC-36284	–	845	Bulk 36	–	Plant material: *Prunus domestica* stone	420±30	–25.2	–	–	cal AD 1420–1620	1
75	SUERC-36285	–	833	Bulk 37	–	Seeds: 7x *Salix* buds, 5x *Ranunculus* sp, 1x *Solanum,* 2x *Cirsium,* 1x *Oenanthe, Rumex aquatilis* +4 *Rumex* sp.+ 2x *Carex* sp.	425±30	–27.3	–	–	cal AD 1420–1620	1
75	SUERC-36286	–	842	Bulk 27	–	Plant material: 4x *Alnus glutinosa* cones/female catkins	3360±35	–27.6	–	–	1750–1530 cal BC	1
93	GU-24463	–	814	Mono. M3	1.42–1.43	Plant material: *Oenanthe* sp., *Sambucus nigra*, 4 x *Ranunculus repens*, 3 x *Schoenoplectus lacustris*, *Carex* trig, 2 x *Carex* flat, Twig (cf. Abscission plate), *Sphagnum* leaf/*Typha*/small Poaceae	Failed	–	–	–	–	–
93	SUERC-23172	–	807	Mono. M2	2.13–2.15	Sediment (acid wash)	1890±30	–28.1	–	–	cal AD 50–220	1
93	SUERC-23173	–	813	Mono. M4	0.87–0.89	Sediment (acid wash)	3970±30	–28.4	–	–	2580–2350 cal BC	2
93	SUERC-31371	–	807	Bulk 3	1.79–1.84	Plant material: 2 x *Alnus glutinosa* cones	3495±30	–28.7	–	–	1900–1740 cal BC	2
93	SUERC-31372	–	803/807	Bulk 11	2.19–2.24	Seeds: 2 x *Nuphar lutea*	1945±30	–25.5	–	–	30 cal BC–cal AD 130	1
93	SUERC-31376	–	813	Mono. M4	0.87–0.92	Plant material: 12 x *Alnus glutinosa* seeds + 6 x catkins	3510±30	–27.2	–	–	1920–1740 cal BC	1
93	SUERC-35344	–	807	Mono. M2	1.85	Seeds: *Cirsium*/*Carduus*, 2 x *Rumex* sp., *Schoenoplectus*, *Ranunculus* sp., *Alisma plantago-aquatica*, *Betula* sp., *Rorippa nasturtium aquaticum*, *Carex cf. nigra*, 3 x frags cf. Cyperaceae/*Rumex* sp.	1990±30	–25.0	–	–	50 cal BC–cal AD 80	1
94	GU-24464	–	910	Mono. M1	0.54–0.56	Plant material: root (maybe twig) heavily impregnated with iron (Fe) mineralisation, so probably associated with periods of drying? 1 x *Salix* budscale	Failed	–	–	–	–	–
94	SUERC-31377	–	904	Mono. M2	1.11–1.13	Seeds: 6 x *Ranunculus arb*, 23 x *Ranunculus* subg. *Batrachium*, 3 x *Lycopus europaeus*, 4 x *Carex*	9735±35	–27.0	–	–	9290–9150 cal BC	1
94	SUERC-31378	–	904	Mono. M2	1.36–1.38	Sediment	6935±30	–28.2	–	–	5890–5730 cal BC	2
94	SUERC-31379	–	906	Bulk 18	1.13–1.18	Seeds: 9 x *Ranunculus* sp., 5 x *Schoenoplectus,* 7 x *Lycopus, 4 x Carex*	9945±35	–26.4	–	–	9660–9290 cal BC	1
94	SUERC-36294	–	905	Skeleton 911	–	Bone: *Equus* sp. tibia (left)	1875±30	–22.4	5.9	3.2	cal AD 60–230	1
94	SUERC-36295	–	905	Skeleton 911	–	Bone: *Equus* sp. tibia (left)	1880±30	–22.4	9.8	3.2	cal AD 60–230	1
105	SUERC-36585	Cut 287	–	Timber 286	–	Worked Wood: *Alnus glutinosa*	895±35	–25.5	–	–	cal AD 1030–1220	1

Trench	Lab code	Feature	Context	Sample	Depth (mOD)	Material dated	Date BP	$\delta^{13}C$‰	$\delta^{15}N$‰	C:N	Calibrated date (2σ; 95.4%)	Reliability of date
109	SUERC-31386	–	37	Mono. 1	1.00–1.02	Seeds: 5 x *Eleocharis palustris*, *Carex,* 3 x R*anunculus* subg. *Batrachium*, *Rubus* sp., *Mentha*	1885±30	–25.0	–	–	cal AD 60–220	1
109	SUERC-31387	–	37	Mono. 1	0.58–0.60	Seeds: 5x *Eleocharis* sp, 3x *Ranunculus* sp. 3x *Mentha*, 4x *Carex* sp.,	2125±30	–25.0	–	–	350–50 cal BC	1
111	SUERC-25618	–	79	Mono. 18	0.67–0.68	Plant material: *Phragmites* stem	1295±40	–27.5	–	–	cal AD 650–860	1
111	SUERC-25619	–	78	Mono. 18	0.95–0.96	Seeds: 10 x *Menyanthes trifoliata*	1245±40	–26.1	–	–	cal AD 670–880	1
111	SUERC-25620	–	67	Mono. 18	1.75	Bulk sediment with *Phragmites* stems	1315±40	–29.4	–	–	cal AD 640–780	1
118	Beta-250594	–	223	Mono. 1 M1	–0.82	Sediment (acid/alkali/acid)	5110±40	–28.3	–	–	3990–3790 cal BC	3
118	Beta-250595	–	177N	Mono. 1 M3	0.19	Sediment (acid/alkali/acid)	4120±40	–28.3	–	–	2880–2570 cal BC	2
118	Beta-250596	–	172 (lower)	Mono. 1 M4	0.67	Sediment (acid wash)	2630±40	–28.2	–	–	900–670 cal BC	3
118	Beta-250597	–	172 (upper)	Mono. 1 M5	1.07	Sediment (acid/alkali/acid)	990±40	–26.9	–	–	cal AD 980–1160	2
118	Beta-250598	–	183–191	Mono. 9 M11	–0.4	Sediment (acid/alkali/acid)	4250±40	–27.2	–	–	2930–2670 cal BC	2
118	Beta-250599	–	183	Mono. 9 M6	–0.44	Sediment (acid/alkali/acid)	2970±40	–24.3	–	–	1380–1050 cal BC	1
118	Beta-250600	–	210	Mono. 9 M8	0.20	Sediment (acid wash)	3080±40	–28.5	–	–	1440–1220 cal BC	3
118	Beta-250601	–	208	Mono. 9 M9	0.64	Sediment (acid wash)	1790±40	–27.9	–	–	cal AD 120–350	1
118	Beta-250602	–	207	Mono. 9 M9	1.05	Sediment (acid/alkali/acid)	550±40	–24.4	–	–	cal AD 1300–1440	1
118	GU-24246	–	174	Bulk 6	*c.* 0.68	Plant material: Carex, *Schoenoplectrus*, *Sambucus*, Twig w abscission scar, *Urtica dioica*, *Mentha*, *Hypericum* sp., 2 x male *Alnus glutinosa* catkins, *Rubus* frag.	Failed	–	–	–	–	–
118	SUERC-33680	Channel cut 602	580–compl. = 596	Bulk 126	–0.76 to –1.0	Waterlogged wood: has bark, but possibly large root.	2960±30	–29.6	–	–	1300–1050 cal BC	3
118	SUERC-33681	–	580–compl. = 574 labelled as 596	Bulk 121	?–0.66 to –0.56	Seeds: 25 x *Alnus glutinosa,* 2 x *Ranunculus*, *Persicaria hydropiper, Schoenoplectrus, Galeopsis*	3005±30	–26.9	–	–	1380–1120 cal BC	2
118	SUERC-33682	Channel cut 602	585	Bulk 127	unknown	Plant material: twig with clearly identifiable bud scales cf. *Alnus glutinosa*	4605±30	–29.0	–	–	3510–3130 cal BC	3
118	SUERC-33686	–	cuts 580/574	Timber 581	–0.57 (top)	Worked wood: *Alnus glutinosa*	4735±30	–28.9	–	–	3640–3370 cal BC	1
118	SUERC-33687	–	cuts 221	Timber 69	–0.51 (top)	Worked wood: *Alnus glutinosa*	1850±30	–28.4	–	–	cal AD 80–240	1
118	SUERC-34933	Channel fill	55	n/a	base is at –0.36	Bone: *Equus* sp. tibia (6g)	1700±35	–22.4	5.6	3.3	cal AD 250–420	3
118	SUERC-34934	Channel cut 602	580–compl. ?=574	n/a	?–0.61 to –0.81	Bone: *Bos* tibia (6g)	2980±35	–21.8	6.7	3.3	1380–1050 cal BC	3
118	SUERC-34938	Channel 563	526	n/a	unknown	Bone: *Equus* sp. femur (7g	395±35	–23.1	3.4	3.3	cal AD 1430–1640	1
118	SUERC-34939	Channel 600	569	n/a	–0.26 to –0.41 or 0.09 to –0.15	Bone: *Bos* femur (5g)	2040±35	–22.2	6.2	3.3	170 cal BC–cal AD 50	1
118	SUERC-34944	Channel fill	182	Bulk 21	0.53 to –0.35	Charred cereal: 2 x *Hordeum* grains	1865±35	–24.5	–	–	cal AD 70–240	1

Trench	Lab code	Feature	Context	Sample	Depth (mOD)	Material dated	Date BP	$\delta^{13}C$‰	$\delta^{15}N$‰	C:N	Calibrated date (2σ; 95.4%)	Reliability of date
118	SUERC-34948	–	177N	Mono. 1 M3	0.26	Sediment (humic acid)	4480±35	–28.3	–	–	3350–3020 cal BC	1
118	SUERC-34949	–	580	Mono. 122 M2	–1.1	Sediment	10,325±40	–29.8	–	–	10,440–10,040 cal BC	1
118	SUERC-34950	–	574	Bulk 125	–0.85 to –0.51	Plant material: 11 x *Alnus glutinosa* seeds + cone	2935±35	–28.8	–	–	1270–1020 cal BC	1
118	SUERC-34951	–	162	Bulk 38	–0.7 to –0.4	Plant material: *Alnus glutinosa* cone	4650±35	–26.9	–	–	3520–3360 cal BC	1
118	SUERC-34952	–	177S	Bulk 27	–0.17 to –0.23	Seeds: 5 x *Schoenoplectus*, 2 x *Carex*, 2 x *Oenanthe.*	2235±35	–27.0	–	–	390–200 cal BC	3
118	SUERC-34953	–	182	Bulk 12	–0.10–0.1	Plant material: 2 x *Nuphar lutea* seeds, *Alnus glutinosa* cone	2970±35	–27.3	–	–	1320–1050 cal BC	3
118	SUERC-34954	Channel fill	210	Bulk 14	0.32–0.55	Seeds: 10 x *Ranunculus*, 5 x *Schoenoplectrus*	1900±35	–26.2	–	–	cal AD 20–220	1
118	SUERC-34959	–	–	Timber 565	0.09 (top)	Wood: *c.* 5cm roundwood - *Salix/Populus*	1835±35	–28.5	–	–	cal AD 80–260	1
118	SUERC-34960	–	?180	Timber 180	–0.85 (top)	Wood: *Alnus glutinosa* branch	1820±35	–30.4	–	–	cal AD 80–330	1
118	SUERC-35345	–	below 55?	Timber 74/504	–0.43 (top)	Wood: *Alnus glutinosa* roundwood	1855±30	–29.5	–	–	cal AD 80–240	1
118	SUERC-36220	–	cuts 168/169	Timber 188	1.43	Wood: *Quercus* sp.	315±30	–27.5	–	–	cal AD 1480–1650	1
118	SUERC-36221	–	537	Timber 554	–	Wood: *Salix/Populus* sp.	610±30	–29.3	–	–	cal AD 1290–1410	1
118	SUERC-36222	–	Unstrat.	Timber 560	–	Wood: *Salix/Populus* sp.	1555±30	–27.0	–	–	cal AD 420–580	1
118	SUERC-36223	–	577	Timber 577	–0.57 (top)	Wood: *Alnus glutinosa*	4785±30	–28.1	–	–	3650–3520 cal BC	1
118	SUERC-36224	–	578	Timber 578	–0.57	Wood: *Alnus glutinosa*	4740±30	–25.4	–	–	3640–3370 cal BC	1
118	SUERC-36225	–		Timber 567	0.06	Wood: *Alnus glutinosa*	1875±30	–29.8	–	–	cal AD 60–230	1
118	SUERC-36226	–	177N	Bulk 5	0.2–0.4	Plant material: *Corylus avellana* nut shell	4120±30	–29.3	–	–	2870–2570 cal BC	2
118	SUERC-36287	–	596	Bulk 126	–0.76 to –1.0	Seeds: 100 x *Carex* sp.	10,000±35	–25.3	–	–	9750–9330 cal BC	1
118	SUERC-36289	–	580–compl.	on 7	unknown	Bone: *Cervus elaphus* antler	3935±35	–23.2	6.8	3.4	2570–2290 cal BC	2
118	SUERC-36293	–	580–compl.	on 9	unknown	Bone: *Cervus elaphus* antler	3910±30	–23.1	6.5	3.3	2480–2290 cal BC	2
118	SUERC-36571	–	183	Bulk 11	–0.2 to –0.4	Seeds: 26 x *Ranunculus*, 8 x *Persicaria hydropiper*, 4 x *Potentilla*, 30 x *Rumex*	3055±35	–26.7	–	–	1420–1210 cal BC	1
118	SUERC-36575	–	183	Bulk 24s7	–0.55 to –0.65	Plant material: 2 x *Corylus avellana* fragments, 2 x *Alnus glutinosa* cones	4680±35	–29.5	–	–	3630–3360 cal BC	1
118	SUERC-36576	Channel fill	532	Bulk 101	0.1– 0.4	Seeds: 12 x *Thalictrum flavum,* 15 x *Stachys*	1920±35	–27.6	–	–	cal AD 1–220	1
118	SUERC-36577	Channel fill	182	Bulk 24s3	–0.1 to –0.15	Seeds: 10 x *Oenanthe*, 3 x *Ranunculus*	1945±35	–27.5	–	–	40 cal BC–cal AD 130	1
118	SUERC-36578	Channel 600	572	Bulk 113	–0.4–0.1 (–0.44 to –0.3)	Plant material: 5 x *Alnus glutinosa* cones	2040±35	–28.5	–	–	170 cal BC–cal AD 50	1
118	SUERC-36579	–	cuts 580/574	Timber 581	–0.57 (top)	Worked wood: *Alnus glutinosa*	4780±35	–28.3	–	–	3650–3380 cal BC	1
120	NZA-32943	–	20	Bulk 4	–	Seeds: 2 x *Corylus avellana*	3960±35	–24.5	–	–	2580–2340 cal BC	1

Lab code	*Borehole*	*Depth (mOD)*	*Easting*	*Northing*	*Material*	*Date BP*	*δ13C‰*	*Calibrated date (2σ; 95.4%)*
Beta-216947*	BHCZ6A-044J	2.30–2.35	537494.3	185389.1	Organic mud	4430±40	-27.6	3340–2920 cal BC
Beta-216948	BHCZ6D-008C	1.05–1.02	537636.6	185010.1	Organic mud	6220±40	-27.8	5310–5050 cal BC
Beta-216949	BHCZ6D-008C	2.22	537636.6	185010.1	Organic mud	2020±40	-28.6	170 cal BC–cal AD 70
Beta-216950*	BHCZ6A-008A	1.73–1.71	537537.9	185417.8	Organic mud	3470±40	-28.4	1900–1680 cal BC
Beta-216951*	BHCZ6D-005	1.4–1.3	537618.6	185141.4	Organic mud	4090±70	-28.6	2880–2480 cal BC
Beta-216952*	BHCZ6A-025	2.39–2.44	537537.1	185287.8	Organic mud	2220±70	-28.1	410–90 cal BC
Beta-216953*	BHCZ6A-025	1.74–1.84	537537.1	185287.8	Organic mud	2870±40	-27.2	1200–920 cal BC
Beta-216954+	BHCZ6D-013	1.2	537635.5	184872.7	Organic mud	11130±40	-29.5	11210–10860 cal BC
Beta-216955*	BHCZ6A-017A	3.37	537723.5	185366.2	Organic mud	1940±40	-27.3	50 cal BC–cal AD 140
Beta-216956*	BHCZ6B-009	2.99–2.79	538010.11	185231.05	Oxidised Org	4870±40	-24.2	3760–3530 cal BC
Beta-218157*	BHCZ7Ai-003	1.07–0.87	537521.84	185559.85	Organic Sediment	12080±40	-29.9	12110–11830 cal BC
Beta-218158+	BHCZ7Ai-005A	1.88–1.83	537484.69	185629.29	Organic mud	2940±40	-28.7	1300–1010 cal BC
Beta-218159+	BHCZ7Ai-004	2.01–1.91	537478.88	185653.27	Organic mud	2900±60	-29.1	1290–910 cal BC
Beta-218160	BHCZ7Ai-006	2.93–2.90	537455.93	185614.65	Organic mud	2410±80	-27.7	780–380 cal BC
Beta-218608+	BHCZ4-040	1.34–1.29	537421.22	184094.8	Organic mud	2350±40	-25.6	730–260 cal BC
Beta-218609+	BHCZ4-007	1.18	537438.55	184469.96	Organic mud	4570±40	-28.5	3500–3100 cal BC
Beta-218610+	BHCZ4-014	0.89	537397.61	184413.6	Organic mud	7450±60	-28.2	6440–6220 cal BC
Beta-218760+	BHCZ5C-014	1.89	537045.26	185003.86	Organic Sediment	3410±40	-27.4	1880–1610 cal BC
Beta-218761+	BHCZ5C-007	1.89–1.85	537156.56	185078.71	Organic Sediment	3640±50	-29.3	2190–1880 cal BC
Beta-218762+	BHCZ5C-025	0.02	537257.7	184813.41	Organic Sediment	10470±70	-30.2	10630–10170 cal BC
Beta-226481	WSOLY2-005	3.7	537461.6	185831.03	(Plant material): acid/alkali/acid	1170±40	-29.9	cal AD 720–980
SUERC-28031	Deep Foul Sewer P4	-0.9– -0.91	537602.82	184701.66	Organic Sediment	12020±40	-28.7	12060–11800 cal BC
SUERC-28032	Deep Foul Sewer P11	2.00–2.02	537660.75	183798.04	Organic Sediment	1385±35	-29.7	cal AD 590–690

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The construction, in east London's lower Lea Valley, of the Olympic Park as a venue for the London 2012 Olympic and Paralympic Games, prompted a comprehensive series of investigations into the site's environmental and cultural heritage. The work was commissioned by the Olympic Delivery Authority and comprised geoarchaeological, palaeoenvironmental and archaeological investigations, built heritage recording, documentary research, oral history and other forms of community engagement.

This volume combines many strands of evidence in order to chart the evolution of the valley landscape over some 10,000 years, and changes in the patterns of human settlement, land and waterway management, and economic activity. It has revealed important new evidence for prehistoric farming, post-medieval milling, Victorian infrastructure development, the area's 19th and 20th century industrial heritage, and World War II defences.

The creation of the Olympic Park is the most recent of a long series of transformations which the lower Lea Valley and its communities have witnessed over their history. These cultural history investigations, the results of which form part of the legacy of the 2012 Games, have ensured that the site's past has been preserved, and renewed for the future.

Wessex Archaeology and Olympic Delivery Authority

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