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

Worked Wood

(Section 6)

by Damian Goodburn and Lorraine Mepham
with microscopic wood identification by Catherine Barnett

Worked Wood

by Damian Goodburn, with Lorraine Mepham, and with microscopic waterlogged wood identifications by Catherine Barnett

Anaerobic (waterlogged) conditions preserved prehistoric and historic woodwork on several sites; this included timbers from a number of structures, mainly riverside revetments of late medieval to post-medieval 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 mill-race channel was revealed in Trench 75, as well as foundation pile alignments or trackway supports, dating from the late 16th to the early 17th century. Very decayed remnants of the sill timbers of a range of timber-framed terraced cottages also survived on the same site. 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.

Some evidence of the bases of growing, possibly deliberately planted trees were visible in Trench 75, along the banks of the Tumbling Bay Stream.

Background

The survival of waterlogged structural woodwork from the Roman 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 of prehistoric and historic worked wood 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 Roman 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 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, stake and wattle structures of early medieval date have also recently been found (MoL code WHU08). From the later 16th to 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, on the Waterworks River channel (MoL code WHU08; on-line summary; Wroe-Brown in prep.) ; 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 waterfront sites has been closely dated, principally by tree-ring dating, and 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 1995; 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 round wood.

By linking tightly-dated timber structures to adjacent contemporaneous dry land surfaces such as quay surfaces, building floors, and river side 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 do have considerable information on approximate levels of large high tides from all but the end of the Roman and early Saxon periods where there is still a gap. This approximate OD level/dating relationship clearly applies at the Leamouth, but may be slightly affected by the 'gradient effect' by the time the tidal flow has reached Temple Mills. 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 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 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 flood plain near by surviving between *c*. 1.0 m to -1.0 m OD (occasionally lower). The current safe ground surface near Leamouth 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 sub-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 waterlogged wood (Brunning 1996), and the Museum of London Archaeological Site Manual (Museum of London 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 was. 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. 1**) cut through a channel fill containing worked and burnt flint, and produced radiocarbon dates in the Early Neolithic of 3650–3520 cal BC (4785±30 BP, SUERC-36223), 3640–3370 cal BC (4740±30 BP, SUERC-36224) and 3640–3370 cal BC (4735±30 BP, SUERC-33686), respectively. Stake 581 (**Fig. 2, 1**) was found at an inclined angle, possibly as a result of scouring, whilst the other two were more vertical, but their function is uncertain. Stake 581 was also the largest at *c*. 120 mm diameter and survived to 0.88 mm in length in a fragmentary condition. The smallest of the three stakes was 578 at 0.69 m

long by 75 mm diameter. 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 1995). 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.

Structural timbers from Trench 30

Four pieces of worked wood with clear tool marks (47-49, 56) were recovered from Trench 30 (47-49 and 56), from between the active river channel deposits and and a layer of humic silt representing a transition from active channel to marshy backwater; A radiocarbon date at the beginning of the Middle Bronze Age was obtained from the humic silt. The timbers included two planks, and presumably derived from a waterside structure of some kind. Although found *ex situ*, their condition and provenance suggested that they had not travelled far from their point of origin (Howell *et al*. 2005, 14). These pieces were not retained for further study.

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 is an oak stud end (squared tenon post) from a small timber frame, perhaps a wall frame (**Fig. 3, 2**). Similar studs known from timber framed buildings in Roman London (Goodburn 1991), but this example appears to be from a Middle Iron Age context, which renders 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 same trench, and from the base of the same Middle Iron Age ditch as the stud end, the base or lid of an oak bentwood box or tub, with peg holes around the perimeter (**Fig. 3, 3**), can be paralleled in the Iron Age and Roman period and later; such items are rare but not unknown from the Neolithic onwards (Earwood 1993, 42-5). Solid hewn tubs from the Iron or Bronze Ages are known with pegged in bases but not from the Roman 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 Roman period; although all came from a 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 were successfully dated (Payne and Spurr 2009, 101-3).

Romano-British structures

Post-and-plank structure in Trench 58

The truncated base of a much repaired post-and-plank structure (structure 42; **Fig. 4; Pl. 1**) was uncovered in Trench 58, extending around 5m along ditch 126. The structure had been much damaged by a recent intrusion and cut at each end by historic water channels. It represents a simple pile and plank revetment, where stakes and small piles supported planking set on edge with earth, including timber offcuts, dumped behind the frontage. The pressure of the earthy fill held the planking in position, and no trace of nailing or pegging was found.

During excavation, four groups of driven stakes (65 in all, one group also associated with horizontal planking) were recorded, which may represent different episodes of construction and/or repair, although all probably belonging to a single structure. To east and west of the structure, loose timbers and debris were interpreted as post-abandonment collapse of the revetment. In all, 79 timbers were recorded.

The structure had been truncated to a level where much of the original sheathing planking did not survive. As a narrow majority of the retaining stakes or small piles were driven to the east of the line of the sheathing planks (to which they were not fastened), the water probably lay to the east when the structure was in use. The board leant a little that way, perhaps pushed slightly by the fill behind it. No traces of any land-tie or front brace assemblies were found, and it is unlikely that the structure ever stood higher than 1m above the base of the lower sheathing plank 41.

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. 5, 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 tangentially sawn plank. Similar effects of erosion and truncation were found in the planking of a later pile and plank revetment on the City Mill River found in Trench 46 (see below). Plank 41 was 2.13 m long by 50 mm thick and had a surviving width of 213 mm. It must have been much wider originally, perhaps around 400 mm. This rough width may indicate an absolute minimum original height for the revetment *c*. 200 mm higher than as found. 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.

It is clear from the considerable number and variety of stakes and small piles used to retain and possibly fender this revetment that it was fairly long-lived and much repaired when it was in use.

The retaining stakes and small piles, together with those that were probably driven a little distance in front of the structure to act as fenders, were an extremely varied group. Most of the lifted examples 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. More elaborate uprights include boxed halved piles such as 264 (**Fig. 5, 4**), which survived to 0.86 m long by 120 mm wide by 70mm thick. 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. 5, 5**), which survived to 0.78 m long by 90 x 80 mm. 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, eg, timber 161, which survived to 0.99 m long by 110 x 95 mm. Hewing rectangular section timbers from small, fast-grown oak logs is typical of late medieval workmanship in London, but can occasionally be found later. Most of all the oak used in this structure was probably bought in by boat from a short distance away, and the fast grown material may well be of coppiced origin. Old oak store coppice can still be found in the London region today on dry, poor ground. 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. Initially the revetment was thought to be of early post-medieval date, on technological grounds (and other similar revetments, such as that from Trenches 46 and 59, are dated to this period; see below), but in fact one of the timbers (280) returned a radiocarbon date of cal. AD 120–340 (SUERC-36581, 1795±35 BP). This structure could have functioned as a small wharf frontage for shallow draft barges and small boats.

Structural timbers from Trench 118

Several groups of worked wood recorded from Trench 118 (**Fig. 6**), found close to the edge of channel 164, were originally tentatively dated as prehistoric on a combination of technological features, OD level and associated finds, but were subsequently radiocarbon dated to the Roman 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 possibly reused as a rough walkway surface.

The *in situ* group (73/503 [**Fig. 7, 7**], 74/504, 75/505) which, with a fourth stake implied by a stake-hole (77), formed a possible small square structure, was first revealed during the evaluation, and lifted during the subsequent excavation of Trench 118. The arrangement measured 0.80 m long by 0.60 m wide and was first seen at *c*. -43 m OD, but the stakes were clearly truncated and would have extended at least to 0 m OD. All the stakes had pencil-type metal axe-cut points and were made of whole

stems. Stake 503 was 90mm diameter with a truncated length of 0.71 m, stake 504 was 80 m diameter by 0.56 m truncated length, and stake 505 was similar with a truncated length of 0.55 m and a diameter 70mm. All the stakes were alder. A radiocarbon date of cal. AD 80–240 (SUERC-35345, 1855±30 BP) was obtained from timber 74/504.

Small four post structures are well known features of Iron Age dry land sites and two partially waterlogged examples were recently found further up the River Lea at Enfield. They were built on sand banks near the edge of the main river next to a small crannog-type platform excavated at Glover Drive, Enfield (Goodburn in prep.). The smaller of the two examples in this case was also 0.60 m wide but longer at 1.20 m. The reused oak timber of the main crannog platform has been dated to bark edge at AD 471. On dry land sites such structures have been interpreted as granaries or fowl houses. However, in the wet environment that must have existed around this site other functions have to be considered such as a fishing platform, hunting blind or possibly even a toilet platform.

Just a short distance to the north-west a fifth stake (180; **Fig. 7, 8**), roughly made and also in alder, was found in a vertical position. It was only 55mm diameter and 0.62 m long. 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 could only have been driven into very soft ground. Timber 180 yielded a radiocarbon date of cal. AD 80–330 (SUERC-34960, 1820±35 BP).

A group of three stakes (565, 567 and 568) was in a roughly north–south alignment with their truncated tops surviving up to +0.09 m OD. They varied in diameter between 60mm and 40mm and survived 0.50 m to 0.20 m long. 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 facets up to 45 mm wide (**Fig. 7, 9**). The smooth character of the facets showed that metal tools had been used, but of what form is difficult to be certain. These stakes were driven into a sandy layer with clay lenses which included an unworked tree stump (566), drift logs (573) and also a small stake (571), 35 mm diameter. An Iron Age or Romano-British date seemed likely from the stratigraphic position 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.

Finally from Trench 118, a group of four stakes or piles from Trench 118 (66, 68-70) were exposed in section, lying in a peaty deposit (181); they were not last used as stakes or piles but had been extracted and reused. Two were alder, one hazel and one willow/poplar. They were orientated horizontally with the tips all in line at the north-west end with machine cut ends (they were cut by machining during the evaluation) to the south-east indicating that they could not have been simply washed in by water movement from up stream. They must have been laid in roughly the position they were found in, perhaps to function as rough corduroy surface over part of a particularly soft area of channel fill. The uppermost parts of the reused stakes lay at *c*. -0.50 m to -0.60 m OD. All four had neatly cut 'pencil points'. The best preserved was the largest (69), which was the size of a small pile, slightly squashed to an oval section of 140 by 100 mm and surviving to a length of 0.78 m with the bark intact (**Fig. 7, 10**). 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, Roman 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 95 mm by 60 mm, surviving to a length of 0.47 m. All the material had small, almost square root holes, which is a typical feature of late prehistoric waterlogged wood on the Thames flood plain. The depth at which these timbers were found, and associated finds, suggest a prehistoric date; but a radiocarbon determination on Timber 69 proved slightly later, within the Roman period (cal. AD 80–240; SUERC-33687, 1850±30 BP).

Saxon and medieval timbers

Possible wattle-lined feature 159 in Trench 56

The very disturbed remains of a roundwood structure (159) were found in Trench 56 (**Fig. 8**). Some elements were either vertical or lying at 45 degrees, whilst other

material was horizontal. Any structural arrangement had been heavily disturbed, possibly as a result of scouring during periods when the River Lea was in spate. Several excavations in the area have shown the scouring out of worked roundwood and this timber is a typical feature of worked wood assemblages in the Lea Valley.

What appeared to be the base of a wattle lining also survived virtually *in situ*. This comprised three pointed stakes (175, 176 and 177), the first two of which were made from small, cleft quarter poles *c*. 60 x 40 mm, whilst the third (177) was a whole small stem *c*. 20 mm in diameter. The longest stake survived to *c*. 450 mm in length.

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 have not have been present – they would have been washed away). In the north-east corner several regular rods were found, between 10 mm and 20 mm in diameter (178, 181, 182), wedged behind one of the stakes, and thus possibly *in situ*.

This type of disturbed wattlework has no dateable features on technological grounds. Indeed, there are remnants of modern wattle revetments to the River Lea *c*. 80 m to the north of Trench 56 but, as noted above, it is unlikely that this feature was sited along a channel edge. Initially dated stratigraphically to the Roman period, it has now been assigned to the Saxon period on the basis of radiocarbon dates from charred plant remains from overlying layers (cal AD 1030–1210 [SUERC-35335, 905±30 BP]; cal AD 980–1160 [SUERC-34943, 985±35 BP]).

As to a function for the structure, it is very tentatively suggested that a use as a retting pit in which flax (or nettle) stems were partially rotted prior to working into separate fibres for weaving is a possible use. Fresh or brackish water would have been employed for this process, in which shallow rough pits were required to contain the material. However, environmental samples from it produced no pollen of either flax or hemp.

Stakes in Trench 105

A series of nine stakes were found *in situ* in Trench 105 (**Fig. 9**), although not all necessarily forming part of a single structure or feature. Only the tips survived, the rest having been machined away. Two of the stakes (276 and 278) were of oak and

were notably larger than the rest; they are likely to have been of more recent date. Stake 278 was box quartered, with a maximum diameter of 0.13 m and was 0.50 m in length; the top of the stake was recorded at 2.47 m OD. Stake 276 was tangentially faced, with maximum dimensions of 20 mm by 70 mm in diameter by 0.14 m in length, and survived to 2.46 m OD.

Three stakes (280, 284 and 288) were possibly associated with 276 and 278. All were evenly spaced and had comparable forms. Stake 280 was box quartered with a diameter of 30 mm x 20 mm, a length of 40 mm, with the top at 2.38 m OD. Stake 284 was whole, with a diameter of 60 mm and a length of 0.10 m, and survived to 2.34 m OD. Stake 288 was box quartered, varied between 10 mm by 10 mm to 70 mm by 30 mm in diameter, and measured 80 mm long, surviving to a height of 2.32 m OD. All three stakes were in poor condition.

Two further stakes, both in poor condition, were also possibly associated (290 and 292). Stake 90 was quartered in conversion, 0.18 m in diameter, 60 mm in length, with a maximum level of 2.33 m OD at its top. Stake 292 was possibly whole in conversion, measured 20 mm in diameter by 0,15 m in length, from a height of 2.35 m OD.

It is unclear how the remaining three stakes (282, 286, 294), all in moderate condition, relate to each other or those already described. Stake 282 was quartered in conversion, had a diameter of 50 mm, and was present from 2.36 m OD. Stake 286 was halved in conversion, measured 30 mm in diameter by 70 mm in length, and was present from 2.34 m OD. Stake 294 was seen only in section and measured 60 mm in diameter by 60 mm in length. One of these three posts (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 are likely to represent some structure exploiting the stream channel, such as 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 horizontal stakes were varied in character but generally of small diameter, eg, stake 555, made from a straight, 25 mm diameter rod cut with one blow of a small metal axe to form a chisel-type point; this survived to a crumpled length of 0.23 m. In contrast, stake 544 was cut from a crooked end of a 50 mm diameter rod to form a chisel point. Stake 546 was one of only two in the assemblage as it was made from a large stem 62 mm in diameter split in half. The horizontal material seems also to have included branch loppings and possibly displaced horizontal wattle fragments. Timber 552 was an example of a probable fragment of lopped branch wood, apparently alder. It was 60 mm diameter and over 0.3 m long with a chisel type cut end with an incomplete rounded axe stop mark 50 mm wide on it. Of ten samples taken for species identification, six were willow/poplar, two oak, one alder and one Pomoideae.

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. The evidence is not totally distinctive but it may be suggested that such truncated stakes could be the remnants of channel revetments, fish traps or hunting blinds. A radiocarbon date of cal. AD 420–580 (SUERC-36222, 1555±30 BP) was obtained for timber 560, ie, early Saxon.

Evidence for medieval basketry?

An unusual item (554) was recovered from the same medieval river channel in Trench 118 as the timber alignments described above. This 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 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. Timber 554 yielded a radiocarbon date of cal. AD 1290–1410 (SUERC-36221, 610±30 BP), confirming its medieval date.

Early post-medieval to modern revetments and other riverside structures

Early post-medieval wattlework revetment in Trench 58

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).

The two north-west – south-east wattlework revetments uncovered in Trench 58 were the most substantial wooden structures found in that trench. A length of over 6 m length was uncovered on the north side (structure 100), with less on the south side (structure 114; **Fig. 10**). They were set parallel, *c*. 6.20 m apart, with the southern revetment being a little more heavily built than the northern in terms of the size and form of the stakes - the heavier construction implies a slightly different intended use for the structure. Faint traces of a low earthy bank were seen in the west section above the surviving tops of the wattle work of structure 114.

In structure 114 (seven timbers: 239–245; **Fig. 11; Pl. 2**), the stakes used were substantial, whole log stakes of oak, and these had been driven in on 0.70–0.85 m centres. Stakes 240 and 241 (**Fig. 12, 11)** survived to over 2 m in length and 120 mm and 150 mm diameters 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. These are the largest diameter wattle stakes seen by the author. 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.

In the northern revetment (structure 100; 11 timbers: 31 [**Fig. 12, 12**], 229-238, 246), the stakes were more varied in size, species and conversion type. The oak stakes here were interspersed with smaller stakes of a softer deciduous wood. The stakes were driven on 0.60–0.75 m centres. The largest stakes were oak cleft-out quarter logs,

such as timber 31, which survived to 1.86 m in length x 110 x 80 mm; and timber 235, 1.45 m in length x 110 x 75 mm. 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). The horizontal weavers survived up to a height of 0.5 m with the stake tops rising to 0.8 m above the lowest weavers. 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-east – south-west. 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.

Isolated post-medieval piles and re-used ships' timbers in Trench 58

Further structural woodwork from Trench 58 included what may have been the bases of mooring posts or similar items made of reused timbers.

Towards what may have been the inland end of the wattle channel cut, a vertically-set timber was found (60; **Fig. 13, 13**). If this was not intrusive from higher later levels, it may have functioned as a mooring stake for craft in the dock. If later it may have been a small gate or fence post. Appropriately, it was in fact a small section of oak hull planking from a medium-sized vessel such as a river barge which was *c*. 50 mm thick. 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 only *c*. 15 to 20 mm thick and chamfered at one edge and one end. Taken together these

technical features suggest a date in the 17th century or later. As the end of the timber was not formed to a point it must have been set in a post hole. Ship-breaking and repair yards towards the mouth of the Lea would have been a ready local source of cheap, second-hand nautical timbers.

Three other timbers with relict features clearly indicate a nautical origin (84, 85 and 86). The first two survived only as small pile tips with relict nails and treenail holes but timber 86 (**Fig. 13, 14**) was a little more complete. It was clearly roughly split from a section of large carvel ship hull planking 100 mm thick with two sizes of large oak treenails (38 mm and 45 mm dia). 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 a 25 mm 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-/late 18th century revetment of Tumbling Bay Stream in Trench 75

At least two, possibly three groups of roundwood stake tips were found in Trench 75 (Temple Mills) along the western edge of the north-south Tumbling Bay channel, which was clearly used as a mill feeder channel or leat. They were located part of the way up the bank and probably functioned both as fences and revetments. Thirteen timbers were recorded, all of boxed heart conversion (timbers 752, 884–895); they were arranged in a double row set between 0.20 m and 0.30 m apart. The revetment belongs to the Phase 1 activity in Trench 75 (late 16th/early 17th century to late 17th/mid-late 18th century).

Falling into a mill channel was dangerous to both livestock and people, and a fence would also have reduced the debris passing down to the mill. Wattle fences are relatively short lived (ten years at the most) and need regular replacing. The larger stake tips could possibly have supported a heavier structure such as a post and rail fence.

Late 16th–mid-/late 18th century pile structure in Trench 75

A north-south line of piles and smaller stakes (a total of 26 timbers), mostly set in pairs, was recorded in Trench 75, over a length of *c.* 12 m. The piles were driven into alluvium, *c*. 0.40–0.60 m apart. The highest pile top was at *c*. +3.24 m OD, and the top of the alluvium up to *c*. 3.50 m OD elsewhere.

The piles and stakes 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, eg, timber 998, 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. 14, 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 re-used 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 2008). 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. 14, 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 that probably sat atop the pile group. The use of such a mix of raw materials suggests that it was an inexpensively built foundation or boardwalk, built out of what could be cheaply obtained locally.

The structure belongs to the Phase 1 activity in Trench 75 (late 16th/early 17th to late 17th/mid-late 18th century), and the piles themselves show features typical of the 16th to 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 *c*. late 16th to early 17th century.

This feature has been interpreted as a support for either a board walk over wet ground or part of a timber-built foundation. The London region corpus contains many examples from the later medieval period onward where the ground was wet, as at Temple Mills. A common post-medieval method was to drive piles in parallel lines and cap them with thick planks, upon which masonry was then laid for dwarf walls for timber buildings or heavier masonry or brick walls, as, for example, at Bellamy's Wharf, Rotherhithe (MoL site code BEY95). In the post-medieval period in the London region the timbers used were often second-hand ship timbers or shipyard off-cuts, both for the piles and capping planking. A counter-argument to this interpretation might be that the pile line did not have return foundation lines at each end.

Late 16th–mid-/late 18th century land-tie assembly, Trench 75

The landward end of a timber and metal land-tie assembly was found in Trench 75, at the western end of cut 684 (**Fig. 15**); it may have been associated with Building 1; it belongs to the Phase 1 activity in Trench 75 (late 16th/early 17th century to late 17th/mid-late 18th century). It is assumed that this construction acted as a back brace to a revetment, although this cannot be definitively proved. It comprised a decayed section of a very knotty oak beam (timber 736), at least 2230 mm x 270 mm x 190 mm, and fitted with a recess to hold a wrought iron land-tie rod. The oak beam rested on an east-west oriented plank (1064) at least 800 mm long, 300 mm wide and 50 mm thick. The location of the land tie suggests the proximity of a reveted channel frontage between *c*. 2.5 m and perhaps 6 m to the west.

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. 16; Pl. 3**) was interpreted as a wheel pit. It was timber reveted to prevent scouring around what must have been the base of an undershot mill wheel. The feature appears to have run from the Tumbling Bay channel into the Temple Mill Stream to the west. A 5.50 m length of the 0.5 m wide channel was uncovered. The channel had been

partly demolished and was made with largely re-used timbers, but its original form can be reconstructed.

It 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 (eg, plank 1073). 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 re-use 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 mill race 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.

The channel belonged to the Phase 2 activity in Trench 75. The deliberate backfill to the construction cut for the channel contained pottery dated to 1630–1700, and clay tobacco pipe dated 1700–40, while the channel itself contained a silty clay which yielded pottery dated to 1670–1900, and clay tobacco pipe dated to 1700–1740.

Early 19th century revetment in Trench 46

A north-south revetment (structure 506) was exposed over a length of *c*. 4.50 m in Trench 46 (**Fig. 17**), but was longer, extending beyond the trench limits. A total height of *c*. 0.30 m was exposed, but the piles would have protruded well below that of the north-south elevation.

Only one course of revetment planking survived. The two piles that clearly supported the revetment planking 42 and 44 were set well apart at *c*. 3.30 m centres. A further pile (43) lay to the west of the plank sheathing at an angle and it is unclear whether it would have originally supported the planking or had another function. Even if pile 43

was originally a revetment supporting pile, the spacing of piles would still be comparatively wide. 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.

A butt joint in the plank sheathing occurred on pile 42. The planks were set on edge and had a regular section *c*. 30 mm thick (also probably sawn out). It survived up to 220 mm at the widest in plank 46, which from the elevation drawing appears to have split along a windy central pith. Sheathing planking splitting along the pith is common in weathered revetments. Thus, we can be moderately sure that the sheathing was originally wider, perhaps up to 330 mm wide. Then the nails in the east faces of the piles could have secured the top edge of the planking where the bottom edge may simply have been toed into the underlying deposits.

Whilst in medieval and 16th century revetments excavated in the London area the sheathing is placed on the land-fill side of the retaining uprights, in the 17th century and later the sheathing was just as often nailed or tree-nailed to the opposite waterside of the uprights. It seems most likely in this case that this low, lightly-made revetment reinforced the west side of the City Mill River at this point. From the woodworking technology only a broad post-medieval to recent date can be suggested, but mid-19th century finds from the alluvium building up against it suggests a date in the early to mid-19th century for 506. The structure is not totally dissimilar to a deeper and more heavily built pile and plank 19th century revetment found in Trench 59, a short distance to the west by the River Lea (see below).

The revetment supporting stakes appear to have their original sawn-off tops. The Ordnance Datum level of these tops was recorded at *c*. 2.90 m OD. In the early to mid-19th century the highest spring tidal levels would have reached at least 0.50 m higher, or possibly higher still due to the slope effect up from the Leamouth area. A common sight on the Thames and its estuary today is light timber reveting for the lower parts of otherwise earthen banks. It appears that the function of such reveting is to prevent erosion where it will regularly occur rather than to protect against the short-lived tops of occasional high spring tides, and lower parts of the foreshore. The stakes were also set very far apart and no land-ties were found. Taken together, this evidence shows that the revetment could not have retained any substantial weight of backfill on

the west side, and neither could it have functioned as a wharf frontage for barges to moor along side on a regular basis.

Trench 46 lay next to a tidal channel ultimately connected with the Thames at Leamouth. Therefore it is clear that trends in tidal levels would have been closely related to those on the near by Thames but probably affected to some extent by the gradient effect where levels slowly rise travelling up stream. In summary, this was a low, lightly-built revetment designed to control erosion on part of the City Mill River's west bank, where it was not intensively used at the time.

19th century revetment in Trench 59

Fifteen timbers were recorded (1013–1027) from a plank and pile revetment found in Trench 59 (**Fig. 18**). 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 uprights were fairly evenly spaced at *c*. 0.9 m apart, except where the ends of sheathing planking lay, where an extra upright was used. The posts varied in scantling between 160 x 120 mm and 210 x 160 mm (**Table 1**); they did not show any signs of re-use. 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.

The northern, uppermost plank was of oak, 45 mm thick and more than 200 mm wide, while the southern example was of softwood, 60 mm thick (probably imported *Pinus sylvestris*). The planking was set on the land-ward 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 Stowage, Deptford, and at Rotherhithe Street in Rotherhithe (MoL site code ROZ00; Divers 2004; Heard and Goodburn 2003), and it is also sometimes

seen today. The general character of the materials and workmanship suggests a c 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 a metre, 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.

19th century revetments and storm drain in Trenches 2 and 4

Two stages of wooden revetments were recorded in Trench 2. The earliest comprised seven *in situ* posts (323–329), measuring up to 1.8m in length with the top level observed at 3.26 m OD. The section consisting of 323 and 326 was on a north–south alignment, which at its northern end turned east (327 and 328). It may be that the northern end defined the side of an inlet, although it would require further investigations to establish this for certain. All the posts were of similar length and width; all had been pile driven. Four timbers (323–326) were sealed by re-deposited alluvium, while the rest were covered by a layer of made ground.

The re-deposited alluvium and made ground were cut by the second stage of revetment, comprising five posts (318–322). These were larger and machine cut than those of the earlier revetment. They were of a standard, uniform size measuring 0.26 m x 0.26 m x 2.85 m and were made of pine. The revetment was on a north–south alignment, the posts set approximately 2 m apart. Some had metal ties connected to a wall (320 and 322). The ties were positioned on the west side of the revetment. The top was at *c.* 4.0 m OD, and was slightly further from the river than its predecessor, although it finished at the north end at about the same point within the trench.

A pine timber revetment (378) and a contemporary storm drain structure (375) in Trench 4 are likely to be of Victorian or later date. The revetment was built within a construction trench cut into the side of the river bank. Posts 360, 361, 362 and 363 were subsequently driven in, and then had planking secured by bolts resulting in

wooden (shuttered) wall (365 and 366) on a north–south alignment. The top of the revetment varied from 3.43 m to 3.09 m OD. Two further posts (358 and 359) were found to the east, and probably also formed part of the revetment. The top levels of these posts were at 3.17 m and 3.42 m OD respectively.

The drain structure 375 consisted of a timber shuttered square box (364) with a cast iron drain (376) inside.

Late 19th century revetment with land-ties, Trench 75 (structure 33/81)

Towards the end of the 19th century, a new timber revetment was constructed on the west side of the Tumbling Bay Stream in Trench 75 (**Fig. 19**). This solidly-built structure comprised *c*. 100 mm-thick vertically-driven softwood (of imported types) planks or staves, retained using a system of metal land-ties. The land-tie assembly made use of strong, industrially-produced iron rods. For the period these were cheaper than wood. The tie rods resembled those used in buildings and were bolted to now decayed softwood anchor beams at their west ends and a wale timber at their eastern ends. The tie-rods were fastened in pairs to the anchor beams at *c*. 2 m centres. There are 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). The exclusive use of manufactured and imported materials in this revetment contrasts greatly with the use of local and regional timber found in the earliest structures at the same site.

Post-medieval/modern revetments and other structures in Trench 41

The wooden structures in Trench 41, coupled with the environmental evidence, may be indicative of activity associated with the Pudding Mill River (**Fig. 20**).

A line of posts (structure 707) and associated wooden planking (structure 708) ran parallel with the western extent of the excavation in a north-south orientation. Structure 707 consisted of 19 posts, each constructed from a sawn, de-barked, squared log of *Pinus sylvestris* (Scot's 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) were secured to the eastern side of 707 with square-headed iron nails. The planks were 20 mm wide and survived in depth up to 160 mm. These planks were associated with a revetment and almost certainly were employed to retain earth within the revetment. The presence of a nail and probable nail hole suggests that the planks were originally fixed by being nailed to uprights. They were in *Pinus sylvestris* (Scot's Pine) and were closely comparable in shape to modern 'shiplap', as used for fence panels and for the exterior cladding of out-buildings. In cross-section they were a thin wedge shape and ring orientation suggests that they were split by the tangential method. This method is a means of acquiring a wide plank from relatively narrow trunk. Though certainly native to Scotland most, if not all, Scot's 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.

Within the centre of the trench, two lines of posts ran in a north–south orientation between 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 60–50 mm apart. The posts 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 (three timbers: 720, 723, 735; seven timbers: 712–17, 730) were situated in north-south orientated rows, emanating westwards from 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.

Posts 720, 723 and 735 were all circular in plan, with a diameter of between 0.18 m and 0.24 m. For each of the timbers the bark remained, except around the base of the post, which had been worked into a point. The length of the posts was not fully reached. The size and spacing of this post line was similar to the longer line of posts to its west (712–17 and 730). Within this alignment, each post was vertically set and they comprised unworked logs, with bark still attached in places. The depth of the logs and the form of each post base was not discovered. The posts varied in diameter between 0.14 m and 0.16 m. Only post 717 was excavated to its base (length 1.56 m), which was worked to a roughly circular point. The post-line may also incorporate posts 716 and 730, which were located between 715 and 717, but were not in full alignment with the line. Post 716 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. It measured 1.46 m in length and 0.16 m in diameter.

Between the two lines of posts, within the centre of the trench, was a revetment feature formed from vertically formed posts and stakes (four timbers: 718, 719, 721 and 722), which were of varying sizes, 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.

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 spanned a length of 5 m. The length of individual timbers varied between 0.45 m and 2.75 m and between 0.20 m and 0.13 m wide. Each plank was 20–30 mm thick and was clearly machine

cut, although most were broken. 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 the 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 Scot's 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.

Late 19th/early 20th century revetments in Trenches 80–82

In Trench 80, the eastern side of a river channel was supported by a wooden revetment (106), consisting of a continuous line of vertically set timbers, which appeared in form to resemble re-used railway sleepers (**Fig. 21**). Each timber measured 1.20 m x 0.30 m x 0.08 m and was secured by iron nails to a single cross beam that measured 4.00 m+ x 0.30 m x 0.10 m.

The continuation of the river channel was recorded to the south in Trenches 81 and 82 (**Fig. 21**). In Trench 81, the channel was supported, again on the eastern side, by a line of posts secured by iron nails to three horizontal planks (209). Five wooden posts (210), each measuring 1.60 m x 0.16 m x 0.16 m, were spaced out approximately 0.90m apart, in a roughly north-south orientation along the edge of the channel. The posts were squared, sawn cut timbers that were cut into a two-sided point at base. The posts had been driven through the sedimentary sequence into natural sands and

gravels and secured by iron nails to horizontal planks (209) situated between 0.56 m and 1.30 m above the natural sediments and base of the river channel. The horizontal planks comprised a single complete timber and two broken timbers, each measuring up to 2.70 m in length, 0.22 m in width and 0.03 m in depth. The wood had squared corners and contained saw marks over its surface.

In Trench 82, a horizontal wooden plank (304), which measured 4.00 m+ x 0.20 m x 0.06 m, was secured in front of posts 305 and 310 to form a basic revetment support for the eastern channel edge. A sample taken from plank 304 revealed that the post was machine-sawn and formed from pine, most probably imported into the UK during the 19th century. Post 305 measured 0.80 m x 0.15 m x 0.15 m; it was squared in section and had visible saw marks over its surface. Post 310 measured 1.28 m x 0.15 m x 0.15 m. It was similarly squared in section and the base of the post had been sawn cut into a two-sided point.

The cut of the channel changed along its course, having moderately sloping, rounded sides within the south of the gorge, which became steeper and straighter to the north, possibly relating to a bank of made ground that was built in the late 19th century. As the gradient of the cut increased towards the north of the gorge, more significant wooden posts were found piled deep into the natural gravels, held by horizontal planks, supporting the sides of the channel. Within the northernmost trench (Trench 80) a continuous line of vertical timbers secured by a single cross beam, attached by iron nails was found, whilst further to the south (Trench 82), only two sporadically placed posts and a single cross beam were found supporting the edge of the channel. It is thought that the revetment was found in its original construction, as there was no evidence that the cladding had been lost or of structural collapse within the southern trench.

A 1908 survey of the Channelsea Gorge revealed that a short stretch of a newly constructed bank was reinforced with timber piles. The revetment found during the Evaluation most likely relates to these structures. The timbers that formed the revetment appeared to be re-used. Within Trench 80, the continuous vertical timbers appeared in shape and dimensions to resemble railway sleepers, indicating an association with the late 19th and early 20th century industrialisation that was taking place within the surrounding area. However, no rail fittings were found on the timbers

and there was no evidence that the timbers had been shortened, suggesting that they had not been used prior to their incorporation within the revetment.

The form of the revetment exposed within Trench 80 shows 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) and the 20th century partial wooden revetments found along the course of Potters Ditch, which forms part of the northern stretch of the old Channelsea River (Bower and Thompson 2008, 93, fig. 73).

19th/20th century boat

Introduction

An abandoned wooden boat was found in Trench 59, buried within and on top of fluvial deposits laid down since the late 19th century (**Fig. 18**). The vessel survived relatively intact, although there were some areas of distortion and missing sections of the uppermost parts of the hull (**Fig. 22; Pl. 4**). Approximately 70% of the vessel 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.

Construction

The centre line assembly and keel

The builders would have shaped and assembled the centre line, 'backbone', members of the boat first including, the straight grained elm keel *c*. 70 mm wide and 60 mm deep at the ends and a little shallower amidships. The sides of the one piece keel appear to have been slightly cut away to provide a narrow flange for most of its length *c*. 10 mm wide on each side through which the garboard fastenings could go ('garboard' is the first plank next to the keel 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. The stern post tenon was

locked with a peg of *c.* 7 mm diameter. The stem post was simply butted to the fore end of the keel held with an overlapping knee which later cracked, the fastenings of which are obscured, by tar, other fittings and concretions but a combination of iron clench bolts and nails are likely. The stem-keel joint was clearly rather weak but was supported by the stem knee, probably an original iron stem band and the fastenings in the 'hood ends' of the boards. The cut off fastenings for that stem band of false keel were seen between the latest deep false keel and the structural keel.

The stem was *c*. 50 mm wide ('sided') by 120 mm max depth ('moulded'). It was not rabbetted but fragments of what were probably an oak 'apron' or inner stem were found, which when bolted to the stem would have formed rabbett. The stern post was *c*. 50 mm sided by 130 mm at the base tapering towards the top and was rabbetted. It was also strengthened by an oak stern knee. In both end posts the lower ends were wider fore and aft to help the vessel grip the water and strengthen the joints with the keel.

The later false keel and stem band

This timber 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 55 mm wide by 155 mm deep. It was secured by substantial iron bolts *c.* 15 mm diameter through the keel. The heads outboard can be seen recessed into the lower face of the false keel, and were *c*. 35 mm square. The inboard ends of the bolts were concreted and their form could not be seen. The iron stem band was *c*. 35 mm wide by 6 mm thick and it was fastened by round headed iron spikes at *c*. 120 mm centres.

The boards and hull shell, and a problem of which or wych elm?

The thin planks or boards of the articulated hull were all of the same hardwood species (with one softwood repair below), surviving just above the 8th strake at best on the starboard side. Originally there must have been a minimum of 10–11 strakes (or courses of boards) on either side of the keel. The timber was stained various colours but where freshest appeared to be a mid-brown, was fairly hard and had an interlocked though fairly straight grain, although a few boards had occasional knots

in. The ring widths were moderate and at points fine zig-zags could be seen between the annual rings, all these features are indicators of one of the elm family *Ulmus* Sp. Over the last 150 years many elm species and regional varieties were 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 for yacht work in Victorian times. It is also clear that the keels, stem and two of the locker planks 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.

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 boards were however planed smooth with nearly all the saw marks removed, and the arrises were also planed to remove weak corners. The thickness of the fine hull boards varied from *c*. 8–10 mm but generally it was around 8 mm or 5/16th of an inch. Only in the very lightest of Victorian craft such as canoes were thinner boards used (Goodburn 2009, 35), and these are the thinnest boards found in any excavated boat remains from the region. They were probably made from rough boards sawn out to *c.* ½" (12 mm) thickness and at least 10" wide, an incredible testament to the sawyer's craft. The boards would then have been planed down by hand to both smooth them and regularise the thickness. The interlocked grain of the elm helped resist accidental splitting which is a major problem in such thin boards.

Each board had both a longitudinal taper and curve to the edges which allowed it to fit properly in just one place so that it had to be cut from a wider stock plank. They went up to *c.* 130 mm (5 ¼") wide near mid ships but much less at the bow. They overlapped *c.* 15–18 mm (ie, about twice the board thickness. The thick tar coating made the finely worked original scarfs in the hull planks very hard to see. It may be that most original boards in the hull ran the full length of the boat but where they could be seen the scarfs were *c.* 100 mm long through splayed scarfs in which the

ends were neatly fastened by *c*. 8–10 small copper tacks with turned tips at each end. The sealant in the joint or 'luting' was a minimal layer of tar. They were designed to open aft so the water would not run into the joint under pressure as the boat moved forward. However, repairs had been made early on in the life of the craft to the uppermost surviving port and starboard side strakes requiring the use of two plank scarfs on the port side and one could be seen on the other side. In the middle sections of the upper two surviving strakes on port lengths of the original type of elm board had been scarfed in but the scarfs were slightly less well cut and the for'ad examples; these actually broke the normal rule of thumb and opened for'ad, as did one on starboard. This evidence together with the extensive frame repairs and sheet metal tingles amidships might have resulted from the craft being squashed by larger vessels in a dock or lock.

Where the strakes met the stem and the lower rabbetted part of the stern post they were carefully bevelled and fastened with at least three copper dead nails. The upper outboard edge of the lower strake was neatly cut to a twisting rabbett or 'jerrold'. This allowed the lower edge of the following hood end to lie flush against the stem or stern post. The small copper nails used at the bow end, which is vulnerable to impact, did not hold the plank hood ends firmly the whole life of the vessel. Thick tar and a 3 mm thick lead strip tingle and some iron nails were added on the port side to prevent leaking (see side elevation). The lead tingle was set in tar and secured to the vessel with small iron tacks and ran from near the base of the stem to well above the waterline. Towards the bow and stern many of the lap nails were turned twice rather than riveted over roves as the space for swinging the hammer would have been limited. It was in the shaping and fitting of the strakes to the backbone that the clinker boat builder formed the hull and later work strengthened it but did not change its form.

The framing

The frames of the boat were particularly small in dimensions and laid out and fitted in an intricate, not totally regular pattern effected by repairs and doubling. They were set on *c*. 150–170 mm centres. However, after further cleaning off-site various details became clearer. They were cut out of straight grained pieces of oak, probably planks. In places what looked like hand rip-saw marks were visible though the surfaces were

generally tar covered, worn or planed smooth. It is very unlikely the type of oak used can be identified botanically and it is assumed here that it was probably one of the two N European natives *Quercus robur* or *Q. petraea*. Only the smallest sliver of sapwood was seen on one rib end. The speed of growth in the timber was moderate to fast.

The dimensions of the frames varied a little – *c.* 18–24 mm wide or 'sided' (*c*. 1 inch) to *c.* 18 mm deep or 'moulded' (3/4 inch). A very distinctive feature of the framing (both original and repair) is that it was neatly notched or 'joggled' to fit the stepped inside profile of the boat's hull. Where thinnest the frames were only *c*. 8–10 mm, where the planks overlapped. 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, ie, whether the joggles were cut before or after bending both being known ethnographically.

There were originally 26 frame stations, the five aftermost were two half ribs overlapping one another on top of the keel or end knee. The six for'ad most were also fitted in the same way and between the two end zones a more complex system was used. This involved a central lower element laid over the keel and two side ribs over lapped alternating with two lower ribs crossing on the keel overlapped by two side ribs. The side frames were not set totally symmetrically in the midships area. But the reason for this seems to be extensive repair. The original ends and edges of the ribs were bevelled to strengthen the corners. In a more recent clinker boat from the Thames region with bent frames the ribs would not have been joggled and would have run across in one piece, a much faster method of framing out. The great over lap 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 (Phillips-Birt 1979, 167). Previously more widely spaced 'grown' frames made from naturally curved logs, where possible, were used through out, as they still were in some 20th century work boats in England, and even in some pleasure craft on the Thames. The fastenings used in the boat bent frames were twice turned copper nails, except for repairs where similar oak ribs were fitted along side existing ones on both port and starboard sides fastened by twice turned iron nails.

In two positions the original builders appear to have fitted thicker cross-wise strengthening members. Towards the stern a plank of oak (1008) 30 mm thick and

135 mm deep was neatly joggled and nailed into place between two bent frames. This plank was equipped with limber holes to allow easy bilge water flow and had a rabbetted top edge that probably supported the stern floor boards. It extended up almost to the top of the sixth strake and would have provided much reinforcement at that point. Near the bow was the decayed remains of a short oak floor timber *c*. 70 mm wide, or sided *c.* 60 mm, moulded by 0.45 m long, across the keel just aft of the stem knee (**Fig. 22, lower plate, no. 3**). It spanned the keel and the first two stakes on each side and due to decay and tar the fastening method is not clear, but iron concretions suggest some type of bolt was used. Although it was much decayed, for some obscure reason, a central recess 140 mm wide could be seen that may originally have accommodated a removed mast step or similar fitting.

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. 22, right hand plates**). The roves used for most of the lap fastenings were irregular shapes, predominantly diamond shapes like medieval iron ship roves and also many of square and rectangular form. They were clearly hand cut from a copper strip *c*. 2 mm thick by *c.* 20 mm long and *c.* 12 mm across, the longest diamond shaped examples being *c*. 24 mm long but most were smaller. The area around the nail holes in the roves were raised as in the earlier iron examples as if they had been punched through. The nails going with the roves appear to be some form of early cut nail c 2 mm square by *c.* 34 mm long (1 3/8") with a tapering blunt point and slightly irregular oval heads *c.* 4 by 3 mm, possibly made by hand? 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 is 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 turned 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. Strangely two heads of the floor ribs on the port side were fastened with a rove nail, rather than a turned one, perhaps we see the difference between the work of an apprentice and a master builder on two side of the boat here?

The same basic copper nails appear to have been used as plain 'dead nails' for plank hood ends etc. In all cases the soft copper nails would need a small pilot hole drilling for them, as probably did the iron nails to avoid splitting the thin boards and frames. Copper tacks 25 mm long with shanks *c.* 2 mm square were also used to fasten the ends of scarfs where the long tapered points were twice turned and the heads *c.* 5 mm square were driven flush with the surface.

The locker planks were secured by substantial round section copper spikes 5 mm in diameter and 65 mm long, with flat round heads 12 mm diameter. Iron nails were also used in the elm planks. Finally, iron bolts *c.* 15 mm diameter were used to secure the false keel (1009). They had square outboard heads *c.* 35 mm square 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 r*esin (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 project 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. It should be noted here that the aftermost plank of oak was probably an original fitting rather than fitted at this time, it was different in having limber holes and not being set awkwardly over existing frames (see above). The for'ad most planks of each pair were of elm (1005) being *c.* 30 mm thick and (1007) *c.* 20 mm thick. They were the most decayed and distorted of all with ancient breakages and were unfortunately disturbed during the lifting of the hull. All the locker planks had small length 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 evidenced 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 would appear 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 for'ad locker, where spilled bird shot (1002) was found.

Indeed the paired recesses and hinge housings on the upper edge of locker plank (1006) 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 c*. 35 mm thick and *c.* 230 mm wide. The plank had been very neatly joggled round both the planking of the hull and much of the framing at frame station 10 aft from the stem. During cleaning off-site two mysterious upper case letter Bs 26 mm high were found carved or stamped (?) in the for'ad face of the plank . They presumably date from its first use, but might just have some historical resonance.

Mast steps or gun supports: fittings in the bow

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 been discussed above 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 *c.* 145 mm long fore and aft by 50 mm square and nailed to the stem knee (**Fig. 22, lower plate, no. 4**). The block had a shallow square recess *c.* 25 mm square and deep cut in it that must have held and upright element. The later was probably some sort of pillar for a cross wise beam or thwart (bench). The fitting would be too insecure for a mast step itself. It was covered by one coat of tar. Just aft of that fitting are two small softwood blocks nailed one on top of the other over the keel (**Fig. 22, lower plate, no. 2**). The blocks had no tar on and were probably fitted shortly before the abandonment of the boat. Again the blocks function is uncertain but we hypothesise that it had something to do with the support of a heavy punt gun.

In thick tar on the starboard side, just for'ad of the bulkhead, a *c.* 300 mm length of iron chain ending in an iron staple was found the function of which is uncertain.

Repair patches or 'tingles' of wood and metal

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 which are very difficult to see under the tar layers. These patches or 'tingles' may be made of zinc sheet which was made from the 18th century onward

(samples have been taken for future analysis). They were bedded in tar and secured with small iron tacks. At the bow on the port side a 3 mm thick lead strip was used for a tingle over the stem hood ends joints. It too was bedded in tar and secured with iron tacks. A lead tingle was also found on the out board face of the port garboard near the for'ad locker (it must be noted here that the starboard outer hull is less easily accessed in its current position, and other tingles must exist there, one can be seen just aft of midships on the uppermost strake). The last repair patches to be fitted were two *c.* 10 mm thick oak boards tacked down over tar covering a break in the starboard garboard and adjacent plank near the bow (**Fig. 22, lower plate, no. 1**). 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. Indeed, the way they were fitted may not have helped as a rib was cut to insert them.

Softwood repairs harking back to earlier post-medieval practice

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 and 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*); it was planed smooth and had a thickness of 8 mm and width of 105 mm similar to the original material. The archaic features of the repair are that the lap fastenings and scarf are secured by wrought iron versions of the copper fastenings used in the original hull. The laps and scarf were waterproofed or 'luted,' with tarred animal hair (sampled for species ID). Both the latter features are relicts of early post-medieval practice in the region. It may also be that they are indicative of contemporary work boat practice as opposed to that used in pleasure craft at the time.

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 that a rudder was pivoted on 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.

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 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 evidence in 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. Judging from this writer's knowledge of wear in small clinker boats it is likely that the boat was between 20 and perhaps 40 years old when eventually abandoned at the confluence of the Pudding Mill River and the old River Lea.

Tar layers

During the cleaning of the boat it became apparent that there were two main applications of thick gritty tar inboard clearly applied principally as a leak stopper and surface coating late in the life of the boat. These two coats bonded and even had small pebble inclusions. On lifting it was seen that a similar tar had been applied less thickly to the outside of the hull. Even after some air drying and flaking of the tar it and localised concretions masked some hull details. It is likely that this substance was coal tar, a cheap by product of making coal gas and probably available locally the mid-19th century. In good light following controlled air drying a very thin smear of what might have been wood tar or a varnish residue was visible in places under the later tar inboard. Samples have been taken of all the finishes that were thick enough to sample.

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. It appears 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 over the historic shore.

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 over-lapping 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.

The vessel is not suitable for tree-ring dating as she has no oak with more than 50 rings and sapwood in her. However, the initial dating of the ceramics and tobacco pipes suggests that the vessel was abandoned during the mid- to late 19th century. If we take into account that the boat 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.

A key attribute of the hull is its distinctive long profile below the waterline with the added 155 mm deep false keel, curving stem and near vertical straight sternpost. A fine gap between the shallow structural keel and the false keel showed that relict fastenings had been cut off before the false keel was fitted. Towards the stern it was also clear 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. Small fragments of what appears to have been an oak 'apron' timber ('apron' = vertical timber behind the stem to reinforce bow plank ends) were also found in tar and concretion at the bow. Two accurate cross sections of the lower hull were obtained from the locker planks (1006) and (1008) and will be crucial for any later performance calculations.

Clearly we cannot, as yet, prove the regional origin of the craft except to suggest that it appears that such a small, transom-sterned clinker boat of the proportions she has would be at home almost anywhere in southern England. Due to its small size a fairly local origin is here taken as 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 large 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.

The potential for further local and waterways historical research to throw light on the original and modified forms of the boat should not be ignored in future analyses. For example 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 near by Bow Fair. Various outside activities were carried out there from the 1760s to 1820s for large numbers of people (source: Old Newham OS map introductory text [anonymous]).

If this association were true it would be very early in what was later 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 1880s in England are very rare. An initial trawl of the literature on recent traditional craft and the earliest historic vessels has started to throw up some parallels for individual aspects of the construction of the boat though only very limited analogies can be referred to yet. Archaeological work on vessels of this period must be considered with ethnological surveys of varying detail, local historical studies, early drafts by naval architects and

works largely based on photographic material compiled by enthusiasts, all of which have different terms of reference, generally lack detail and have to be critically assessed against the material archaeological evidence.

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 in Divers 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) but the validity of the information needs cross checking. Earlier parallels for individual constructional details can be cited, such as for the handmade copper rove nails. Very similar nails can be seen 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 forward 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 in Divers 2004). In 2008 some clinker plank fragments were found reused near the Southwark waterfront (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.

Other worked timber

19th century casks re-used 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; **Fig. 23**). It is quite likely that the wooden shaft of re-used casks originally protected a wooden 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 code HLS07). 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-a-way 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 mm wide and *c*. 15 mm thick. They were all of radially cleft oak and had been shaved convex on the outside and flat on the inside, some still bearing occasional broad-axe 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' and 'croze' 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. The widths varied between 95 mm and 130 mm, and they were 25–8 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.

Late 18th–mid-19th century casks re-used as tanks (Trench 75)

In Trench 75, in the area between the row of terraced cottages (Building 3) and the Tumbling Bay Stream, five casks (182, 241/249, 255, 277, 692) had been set into the ground sometimes between the late 18th and mid-19th century, and re-used as small tanks, perhaps for some washing, dyeing or refining process (a calico ground is documented on the site at this period).

The remains of the casks were very decayed and were not lifted (only the iron hoops of 692 survived). However, four timbers from cask 182 were sampled, three being narrow, radially faced elm cask staves with fragments of iron hoops attached. The other timber was a narrow, tangentially faced piece of oak with bevelled edges and pierced by several small ferrous nails. This may have been a batten to hold the cask heading boards together.

Early post-medieval tree stumps, Trench 75

Three slightly decayed tree stumps were found in the early post-medieval phase (16th/17th century) in Trench 75, on the east bank of the Tumbling Bay Stream. Two were identified as willow/poplar, although the third was too decayed for identification. Their setting suggests deliberate planting. Such trees could have provided firewood, wattle fencing material and basketry stems, while the root mass would help to prevent bank erosion. It has become increasingly apparent recently that trees were often planted or were allowed to grow along the banks of watercourses in the London area in post-medieval times and earlier. Both archaeological evidence and explicit documentary sources show that these were often willows managed by pollarding or coppicing.

List of illustrated timbers and structures

Figures

Plates

Plate 1: Romano-British post-and-plank structure 42, Trench 58

Plate 2: Post-medieval wattle revetment 114, Trench 58

Plate 3: Post-medieval timber-lined channel, Trench 75

Plate 4: 19th century clinker built boat, Trench 59

Tables

Table 1: Dimensions of timbers in 19th century revetment, Trench 59

Timber	*Type*	*Conversion*	*Species*	*Dimensions (mm)*			*Level*
				N-S	*E-W*	*Height*	*(m aOD)*
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

References

Bower, K. and Thompson, G., 2008, *The Olympic Park, Waterways and associated Built Heritage Structures: Carpenter's Lock, City Mill River Footbridge, Pudding Mill Lock, Old Ford Locks, Old Ford Lock Houses, Marshgate Lane Lock, Stone and Brick Riverbank Walls Pudding Mill River London E3, E9,E10,E15. A landscape and standing buildings survey report*. London, MoLAS-PCA unpubl. rep., ref. REP-CSP-TZ-ZZZ-OLP-XXX-E-0885

Brigham, T., 2001, The Thames and Southwark waterfront in the Roman period, in B. Watson, T. Brigham and T. Dyson, *London Bridge: 2000 years of a river crossing*, MoLAS Monogr. 8, 12–27

Brunning, R. (ed.), 1996, *Waterlogged Wood*, English Heritage Guidelines

Divers, D., 2004, Excavations at Deptford on the site of the East India Company dockyards and the Trinity House almshouses, London, *Post-Medieval Archaeol*. 38, 17–132

Earwood, C., 1993, *Domestic wooden artefacts in Britain and Ireland from Neolithic to Viking times*, Univ. Exeter Press

Goodburn, D., 1991, A Roman timber framed building tradition, *Archaeol. J*.148, 182–204

Goodburn, D., 1996, Woodworking evidence, in C. Thomas and J. Rackham *et al*., Bramcote Green, Bermondsey, a Bronze Age trackway and palaeo-environmental sequence, *Proc. Prehist. Soc*. 61, 241–5

Goodburn, D., 2002, Analysis of ship timbers from the S bank excavation, in J. Ayre and R. Wroe-Brown, *The London Millennium Bridge*, MoLAS Archaeol. Studies 6, 84–9

Goodburn, D., 2003, Woodworking evidence, in R. Masefield and N. Branch *et al*. A later Bronze Age well complex at Swalecliffe, Kent, *Antiq. J*. 83, 98–105

Goodburn, D., 2008, A post-medieval boat fragment, in Stephenson 2008, 52–3

Goodburn, D., 2009, Timber, in A. Douglas and G. Spurr, *Planning Delivery Zone 6, Trench PDZ 6.01 London E15, London Borough of Newham: post-excavation assessment*, London, MoLAS-PCA unpublished report 0561-OPS-ALE-W-ASS-10, 94–9

Goodburn, D. and Davis, S., 2010, Two river Thames tide mill finds of te 690s and 1190s and a brief update on ARchaelogical evidenece for changing medieval tidal lands, in J. Galloway, *Tides and Floods: new research on London and the tidal Thames*, Centre for Metropolitan History, London, 1–14

Hardy, A., Watts, M. and Goodburn, D., 2011, The Mid-Saxon mill at Northfleet, in P. Andrews, E. Biddulph, A. Hardy and R. Brown, *Settling the Ebbsfleet Valley: High Speed 1 excavations at Springhead and Northfleet, Kent. The Late Iron Age, Roman, Saxon and Medieval Landscape. Volume 1: The Sites*, Oxford Wessex Archaeology, 307–49

Heard, K. and Goodburn, D., 2003, *Investigating the Maritime History of Rotherhithe*, MoLAS Archaeol. Studies 11

Howell, I., Halsey, C. and Corcoran, J., 2005, Site 25 New Aquatic Centre (Carpenters Road), Newham E15, London Borough of Newham: an archaeological evaluation report, MoLAS-PCA unpubl. report

Marsden, P., 1996 (ed.), A Late Saxon logboat from Clapton, London Borough of Hackney, *Int. J. Nautical Archaeol*. 18(2), 89–111

Meddens, F., 1996, Sites from the Thames estuary wetlands, England, and their Bronze Age use, *Antiquity* 70, 325–34

Milne, G., 1985, *The Port of Roman London*

Museum of London 1994, *Archaeological Site Manual* (3rd ed.)

O'Sullivan, A., 1995, Neolithic, Bronze Age and Iron Age woodworking techniques, in B. Raftery, *Trackway excavations in the Mountdillon Bogs, Co. Longford, 1985–1991*, Dublin: Irish Archaeological Wetland Unit Transactions 3, 291–342

Payne, J. and Spurr, G., 2009. *Planning Delivery Zone 1, Trench PDZ 1.12, London E15, London Borough of Newham: a post-excavation assessment*. MoLAS-PCA unpubl. rep., ref. 0561-OPS-ALE-W-ASS-07

Phillips-Birt, D., 1979, *The Building of Boats*, London

Preston, C.D., Pearman, D.A. and Dines, T.D., 2004, *New Atlas of the British & Irish Flora*, Oxford: Oxford Univ. Press

Sands, R., 1997, Prehistoric woodworking: the analysis and interpretation of Bronze And Iron Age toolmarks, *Wood in Archaeology* Vol. 1, Inst. of Archaeol. London

Simper, R., 2007, *The Barge Coast of Suffolk, Essex and Kent*, Woodbridge: Creekside Publishing

Stephenson, A., 2008, Bridging the Lea: excavations at Crown Wharf, Dace Road, Tower Hamlets, *Trans. London Mddx. Archaeol. Soc.* 59, 39–59

Valler, H.J. and Crockett, A.D., 2012. *Waterside management from the Middle Bronze Age to present day: High Speed 1 investigations at Stratford, London Borough of Newham*, Oxford Wessex Archaeology online publication

Vine, P., 1983, *Pleasure Boating in the Victorian Era*, Chichester

Wright, D., 1972, *Baskets and Basketry*, Newton Abbot: David & Charles

On-line sources

150 Stratford High Street:

http://www.museumoflondonarchaeology.org.uk/laarc/catalogue/siteinfo.asp?id=19637&code=WHU08&terms=stratford&search=simple&go=Go (accessed August 2011)

Figure 1: Prehistoric timbers in Trench 118

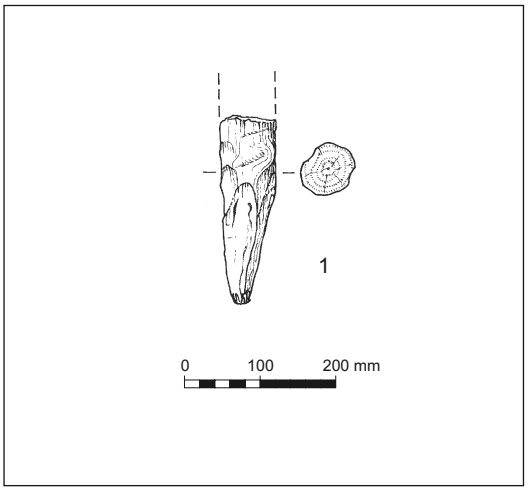


Figure 2: **1.** Stake, alder, Early Neolithic. Timber 578, Trench 118

Date:	06/07/12	Revision Number:	0
Scale:	N/A	Illustrator:	KMN
Path:	Y:\PROJECTS\74508\Drawing Office\Report Figs\ADS-OnlineReports\6_Wood		

Wessex Archaeology

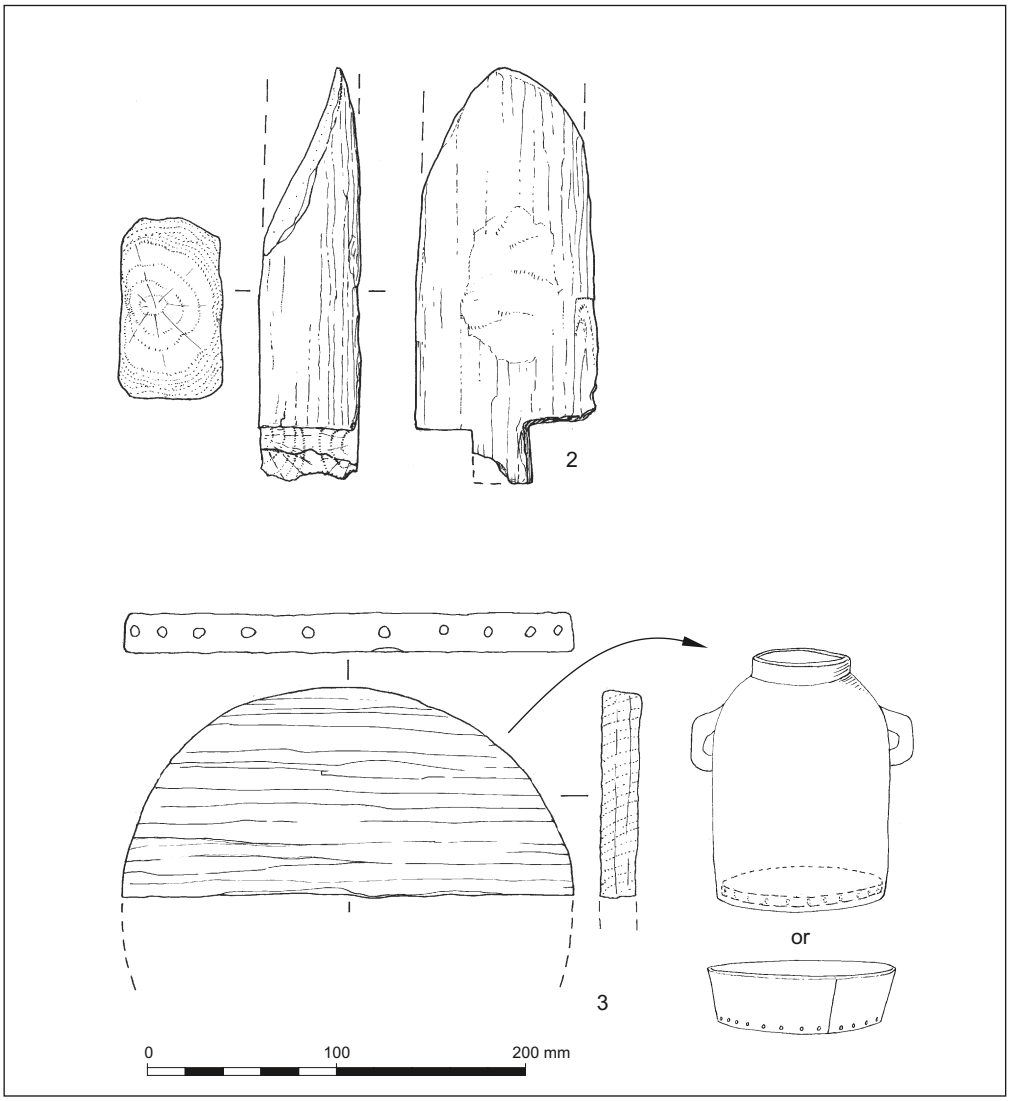
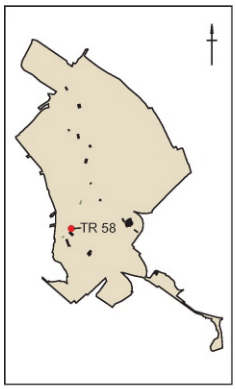


Figure 3: **2**. Oak stud end (tenon post)
Timber 2180, base of Middle Iron Age ditch 1384, Trench 9
3. Base or lid of bentwood vessel (with possible reconstructions)
Timber 2212, base of Middle Iron Age ditch 1384, Trench 9

Date:	06/07/12	Revision Number:	0
Scale:	N/A	Illustrator:	KMN
Path:	Y:\PROJECTS\74508\Drawing Office\Report Figs\ADS-OnlineReports\6_Wood		

Wessex Archaeology



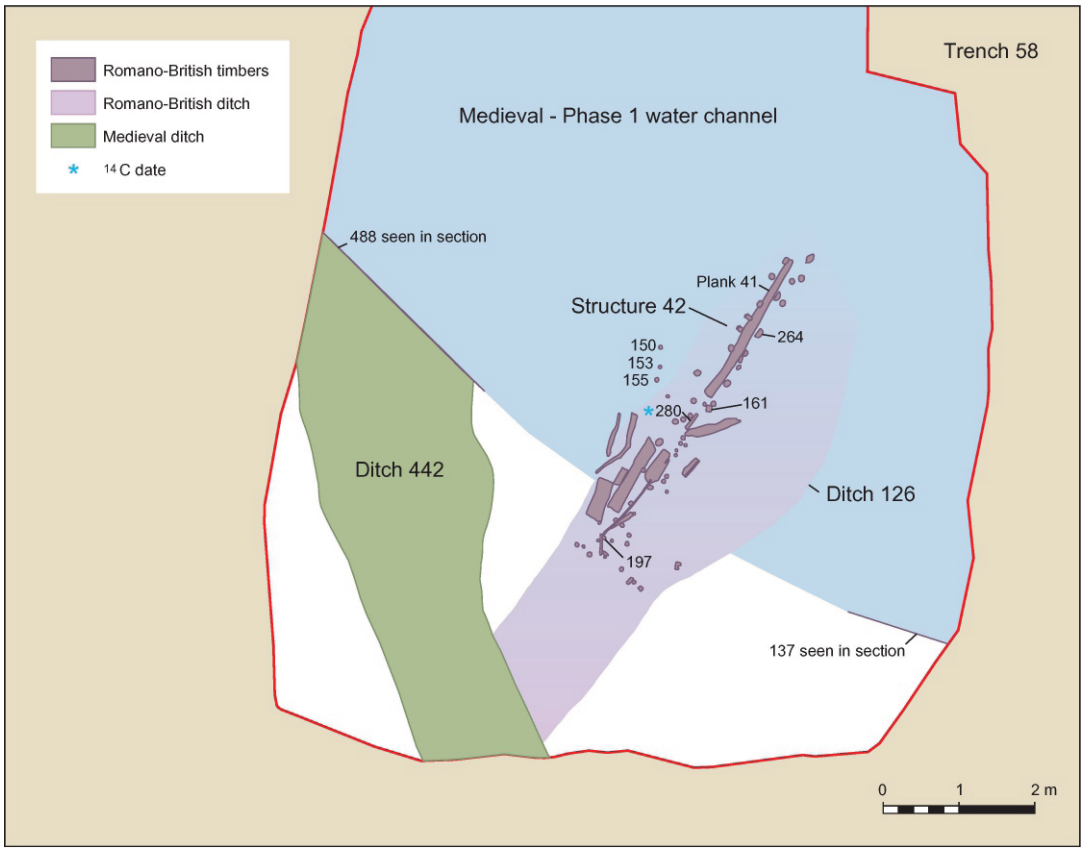


Figure 4: Romano-British post-and-plank structure 42, Trench 58

Date:	06/07/12	Revision Number:	0
Scale:	N/A	Illustrator:	KMN
Path:	Y:\PROJECTS\74508\Drawing Office\Report Figs\ADS-OnlineReports\6_Wood		

Wessex Archaeology

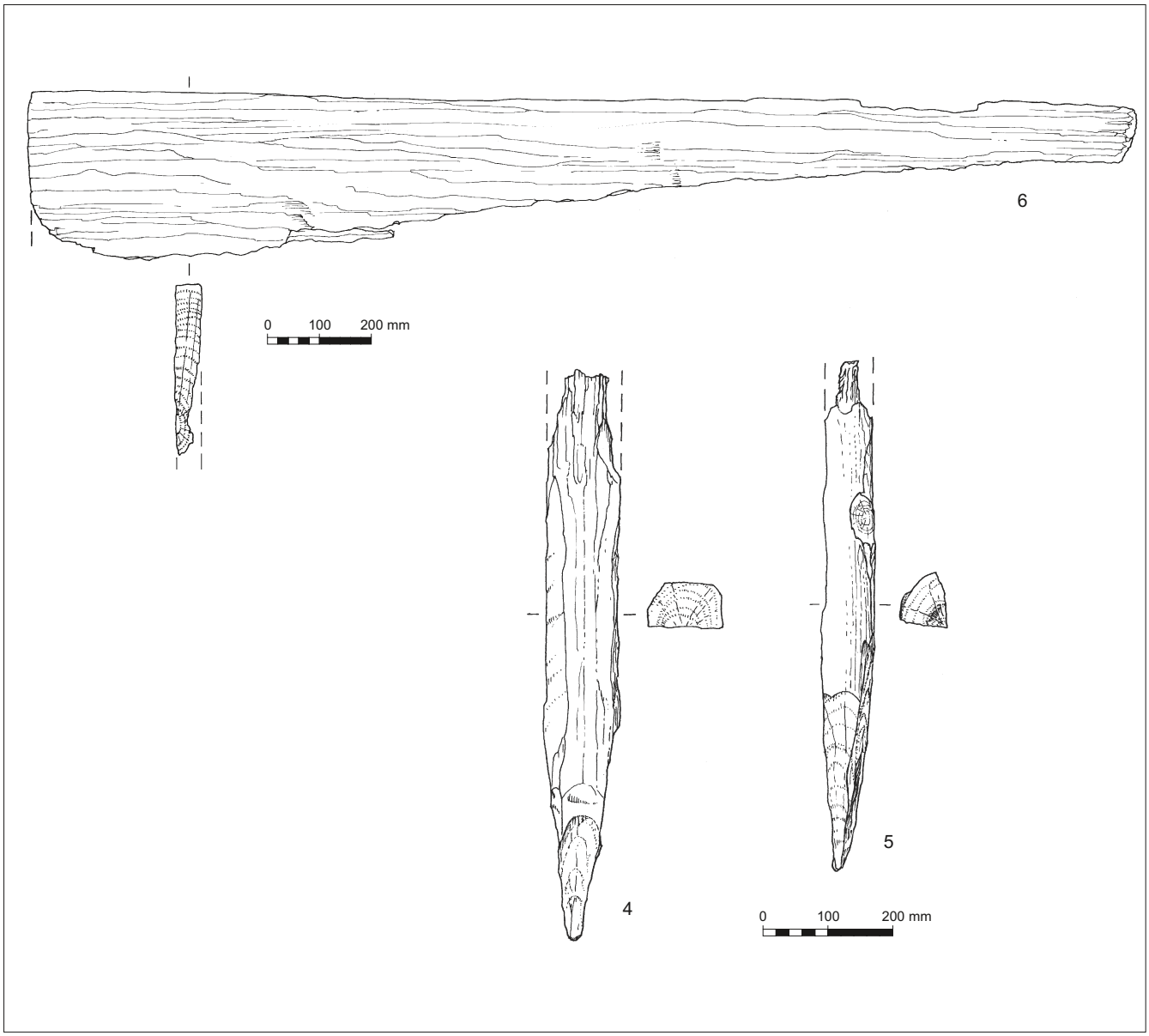


Figure 5: **4**. Stake, Romano-British. Timber 264, structure 42, Trench 58
5. Stake, Romano-British. Timber 197, structure 42, Trench 58
6. Plank. Timber 41, structure 42, Trench 58

Date:	06/07/12	Revision Number:	0
Scale:	N/A	Illustrator:	KMN
Path:	Y:\PROJECTS\74508\Drawing Office\Report Figs\ADS-OnlineReports\6_Wood		

Wessex Archaeology

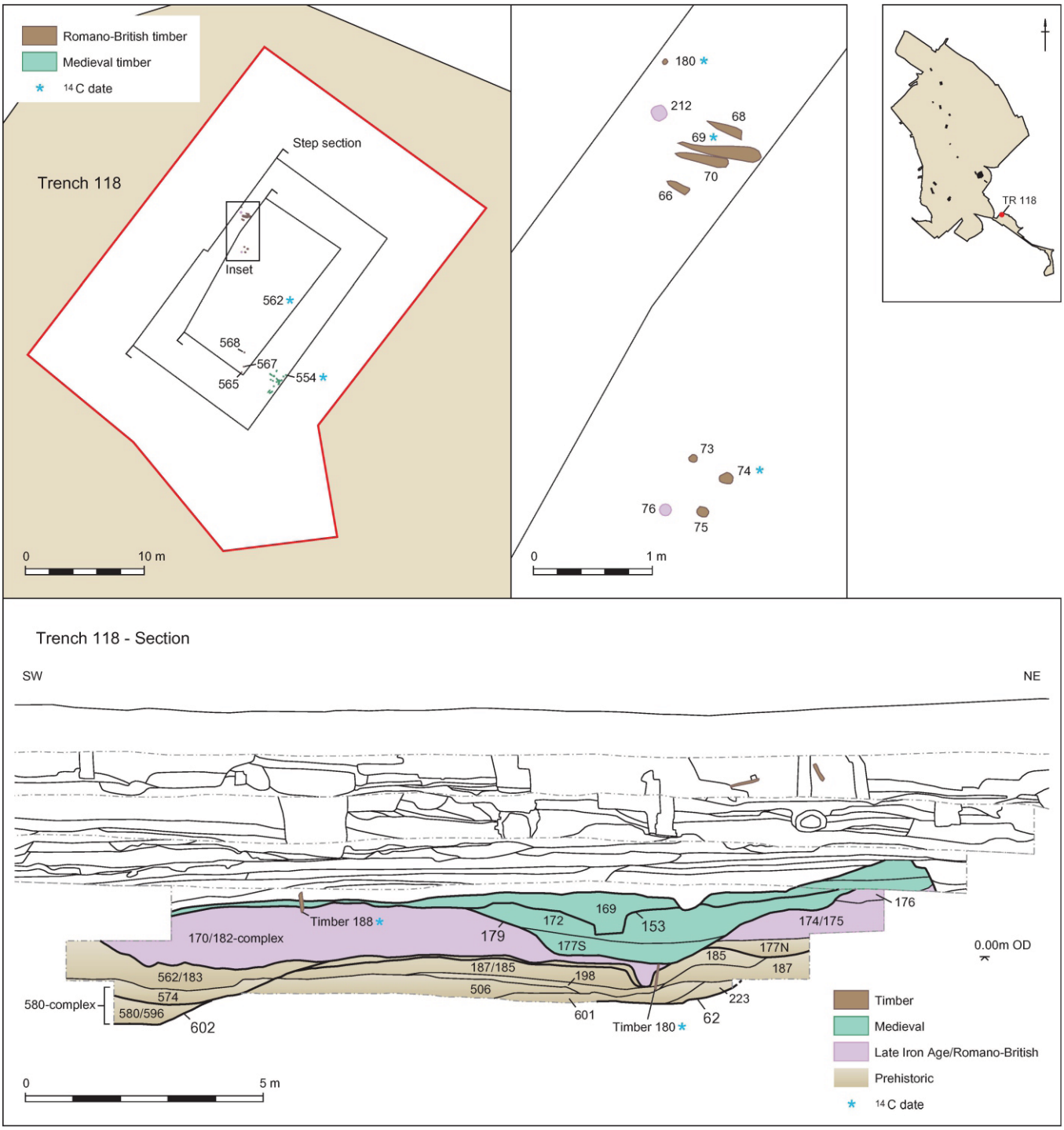


Figure 6: Roman and medieval timbers in Trench 118

Date:	06/07/12	Revision Number:	0
Scale:	N/A	Illustrator:	KMN
Path:	Y:\PROJECTS\74508\Drawing Office\Report Figs\ADS-OnlineReports\6_Wood		

Wessex Archaeology

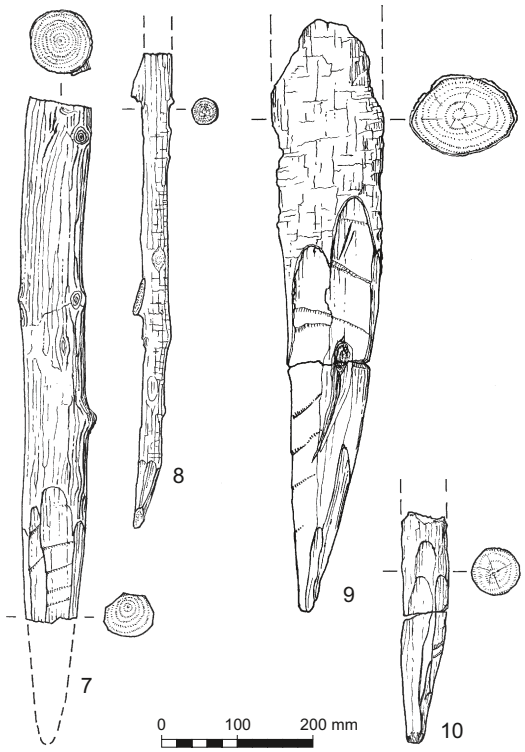


Figure 7: **7.** Stake, alder, Romano-British. Timber 73/503, four-stake structure, Trench 118
8. Stake, alder, Romano-British. Timber 180, Trench 118
9. Stake, probably alder, Romano-British. Timber 568, three-post alignment, Trench 118
10. Stake, alder, Romano-British. Timber 69, Trench 118

Date:	06/07/12	Revision Number:	0
Scale:	N/A	Illustrator:	KMN
Path:	Y:\PROJECTS\74508\Drawing Office\Report Figs\ADS-OnlineReports\6_Wood		

Wessex Archaeology

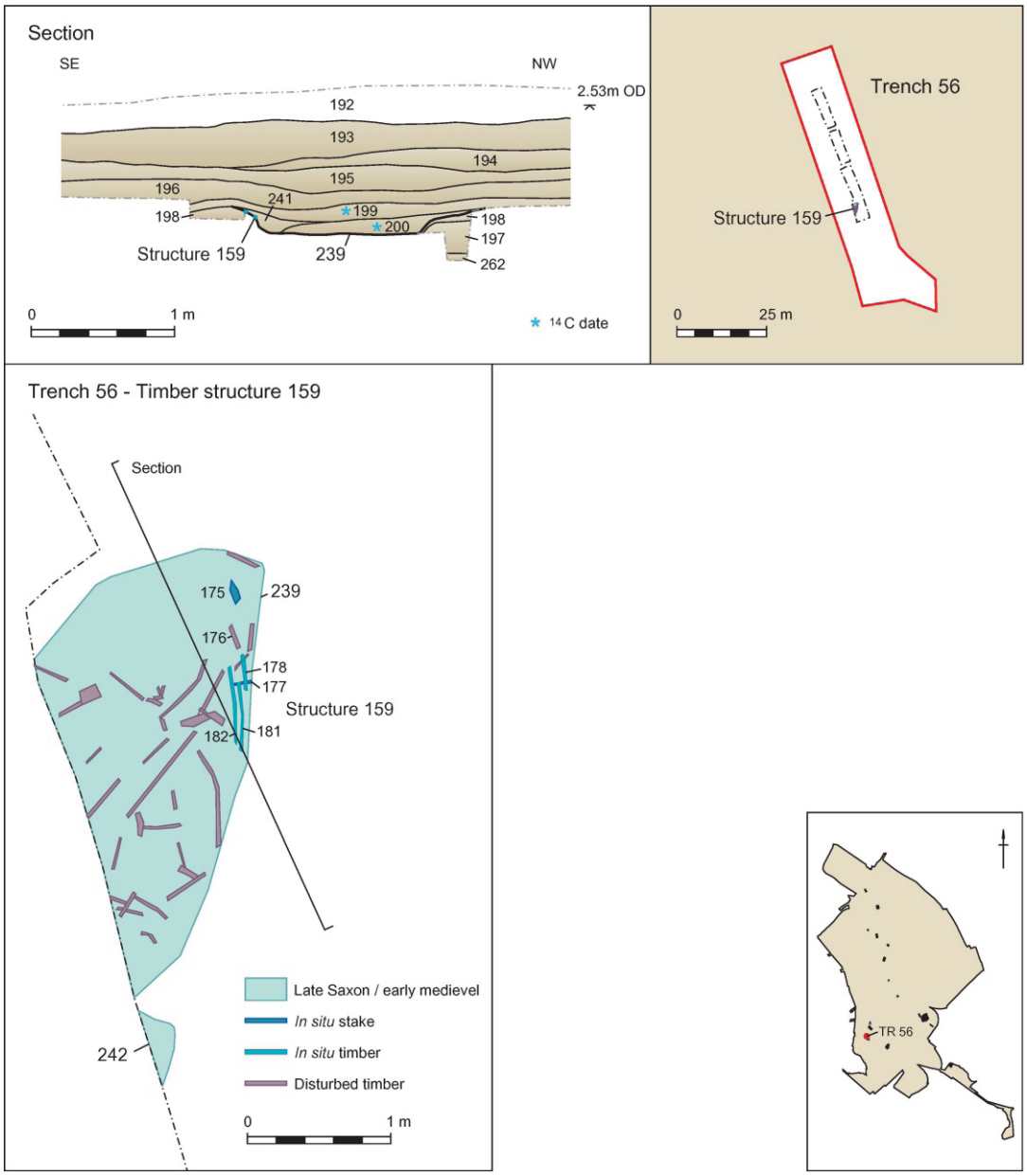


Figure 8: Late Saxon/early medieval wattle-lined structure 159 in Trench 56

Date:	06/07/12	Revision Number:	0
Scale:	N/A	Illustrator:	KMN
Path:	Y:\PROJECTS\74508\Drawing Office\Report Figs\ADS-OnlineReports\6_Wood		

Wessex Archaeology

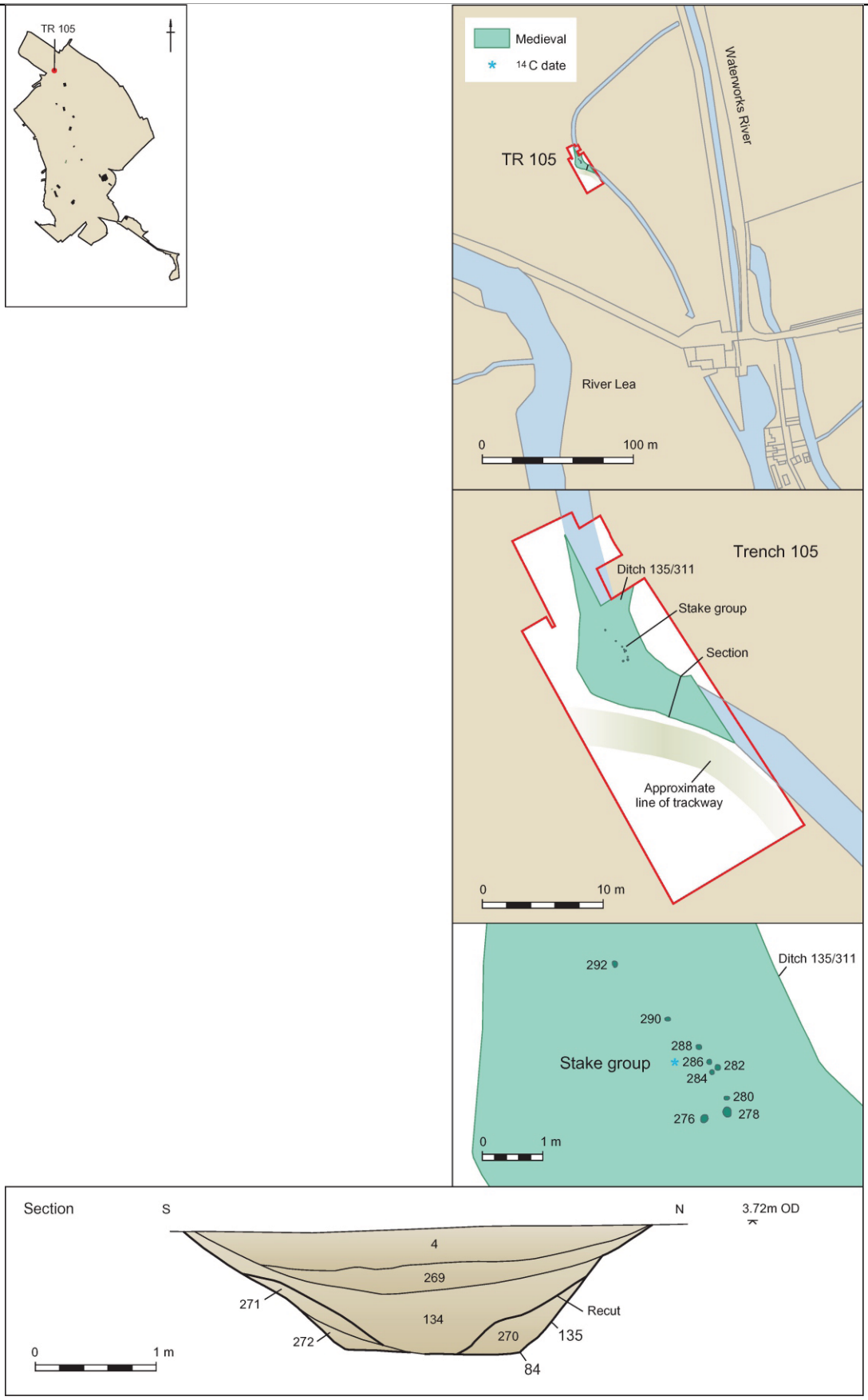


Figure 9: Late Saxon/early medieval timbers in Trench 105

Date:	06/07/12	Revision Number:	0
Scale:	N/A	Illustrator:	KMN
Path:	Y:\PROJECTS\74508\Drawing Office\Report Figs\ADS-OnlineReports\6_Wood		

Wessex Archaeology

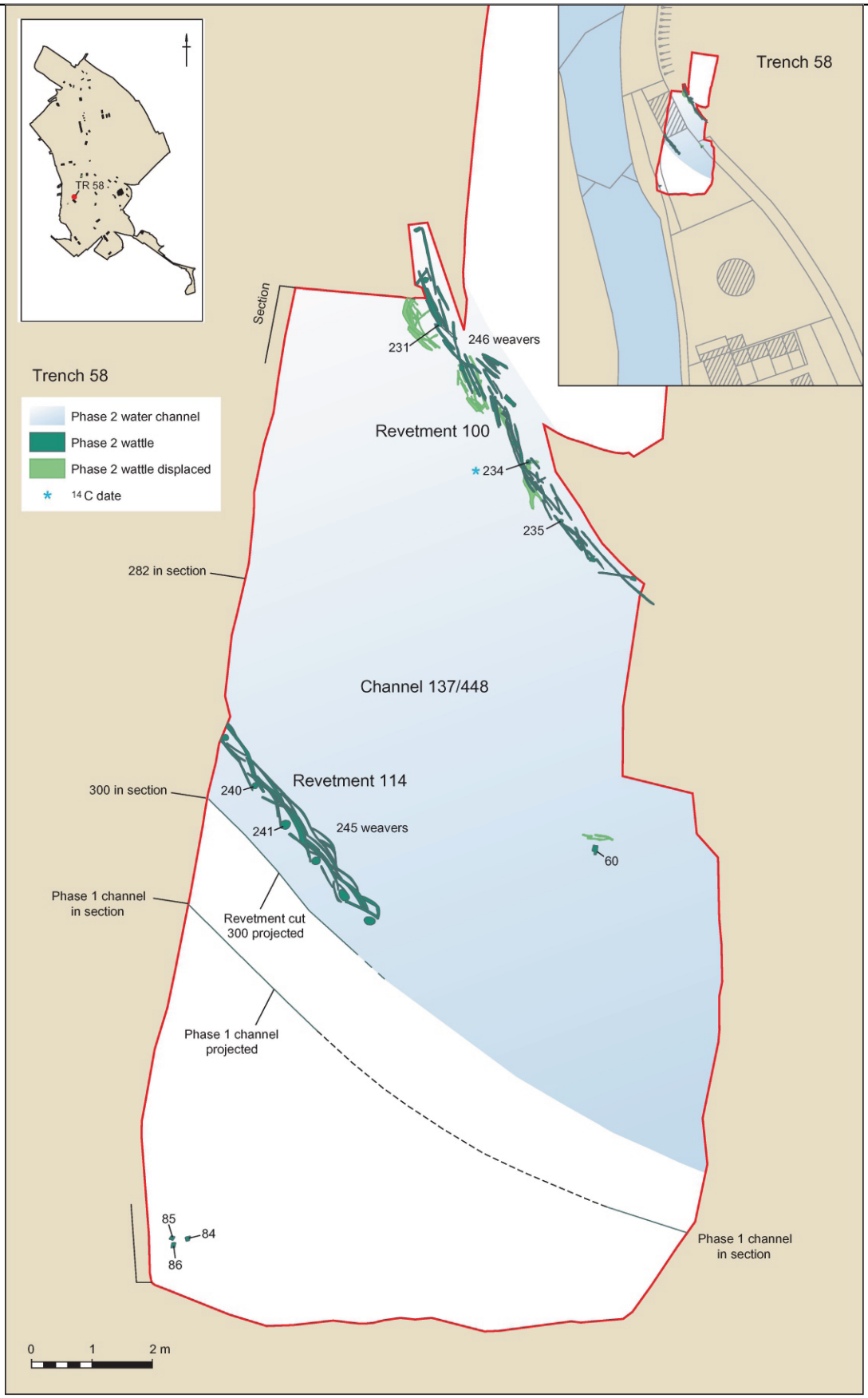


Figure 10: Post-medieval wattle revetments 100 and 114, Trench 58

Date:	06/07/12	Revision Number:	0
Scale:	N/A	Illustrator:	KMN
Path:	Y:\PROJECTS\74508\Drawing Office\Report Figs\ADS-OnlineReports\6_Wood		

Wessex Archaeology

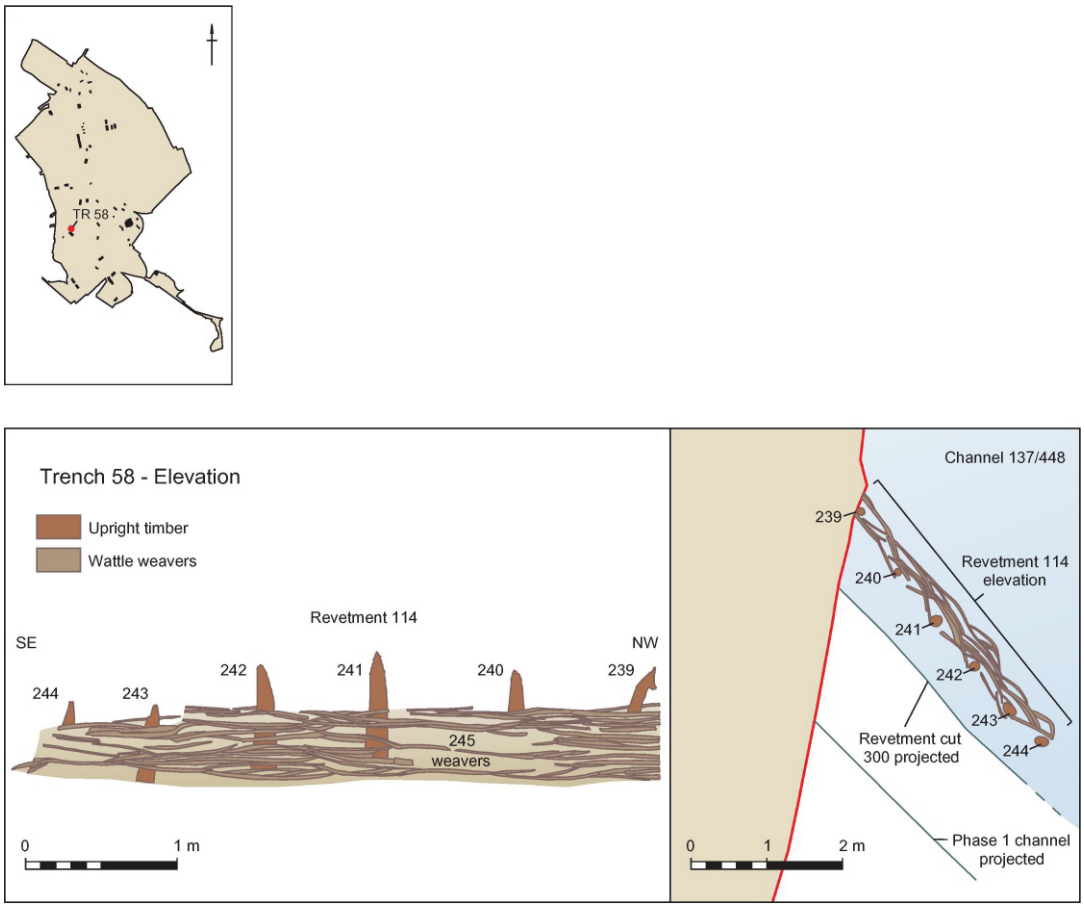


Figure 11: Wattle revetment 114, Trench 58: plan and elevation

Date:	06/07/12	Revision Number:	0
Scale:	N/A	Illustrator:	KMN
Path:	Y:\PROJECTS\74508\Drawing Office\Report Figs\ADS-OnlineReports\6_Wood		

Wessex Archaeology

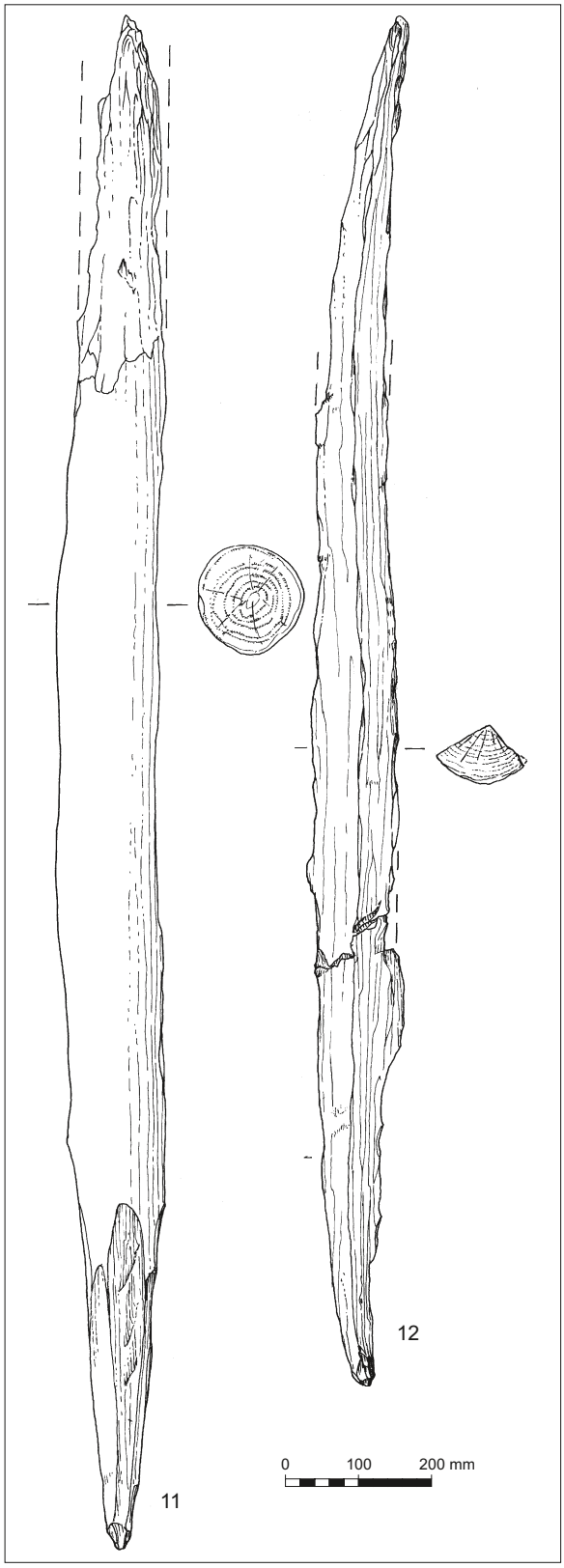


Figure 12: **11**. Stake, oak, post-medieval. Timber 241, wattlework revetment 114, Trench 58
12. Stake, oak, post-medieval. Timber 31, wattlework revetment 100, Trench 58

Date:	06/07/12	Revision Number:	0
Scale:	N/A	Illustrator:	KMN
Path:	Y:\PROJECTS\74508\Drawing Office\Report Figs\ADS-OnlineReports\6_Wood		

Wessex Archaeology

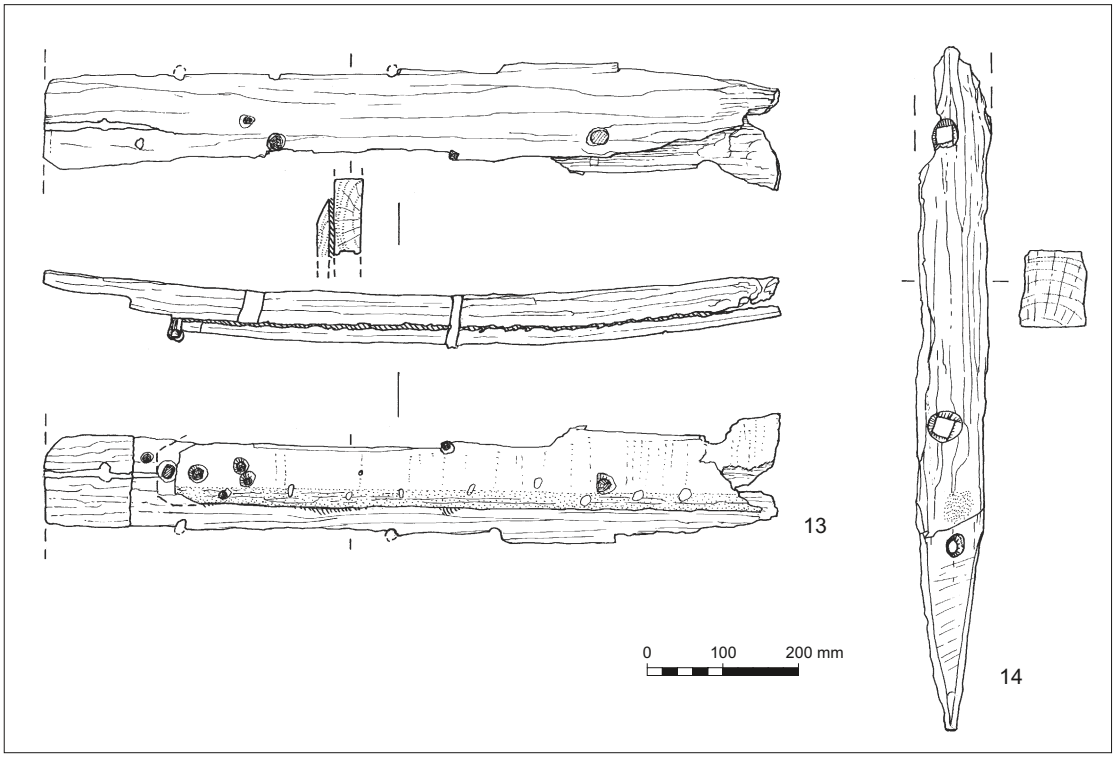


Figure 13: **13**. Re-used ship's timber (oak hull planking), post-medieval. Timber 60, Trench 58
14.Re-used ship's timber (oak hull planking), post-medieval. Timber 86, Trench 58

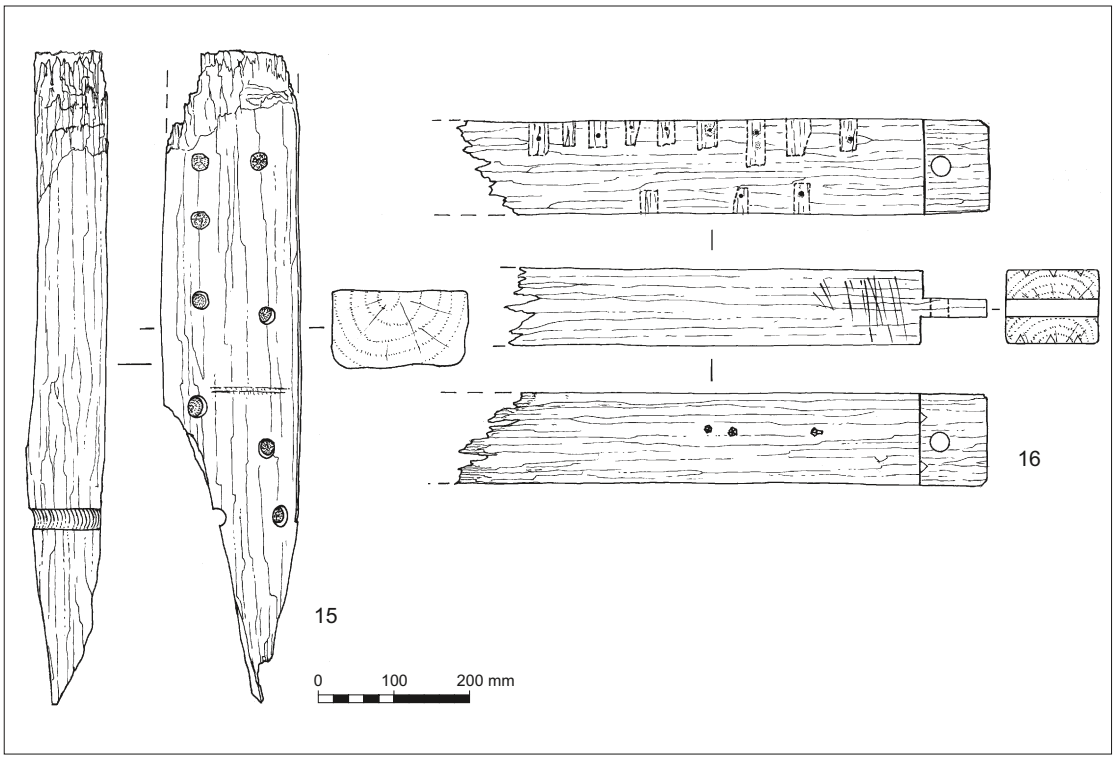
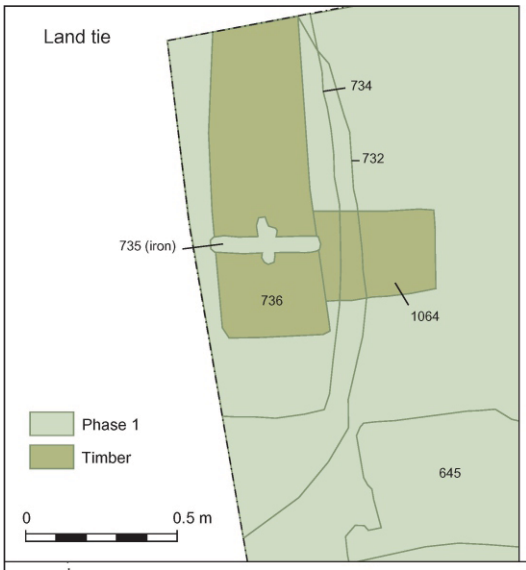


Figure 14: **15**. Pile, oak, post-medieval. Timber 772, pile structure, Trench 75
16. Post, oak, post-medieval; part of tenoned end; nails and mortar marks
Timber 749, Trench 75. Mono fig 7.16

Date:	06/07/12	Revision Number:	0
Scale:	N/A	Illustrator:	KMN
Path:	Y:\PROJECTS\74508\Drawing Office\Report Figs\ADS-OnlineReports\6_Wood		

Wessex Archaeology



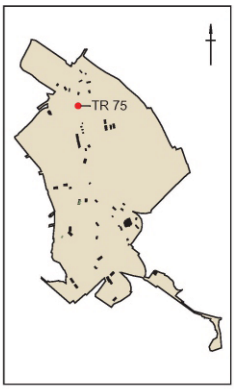
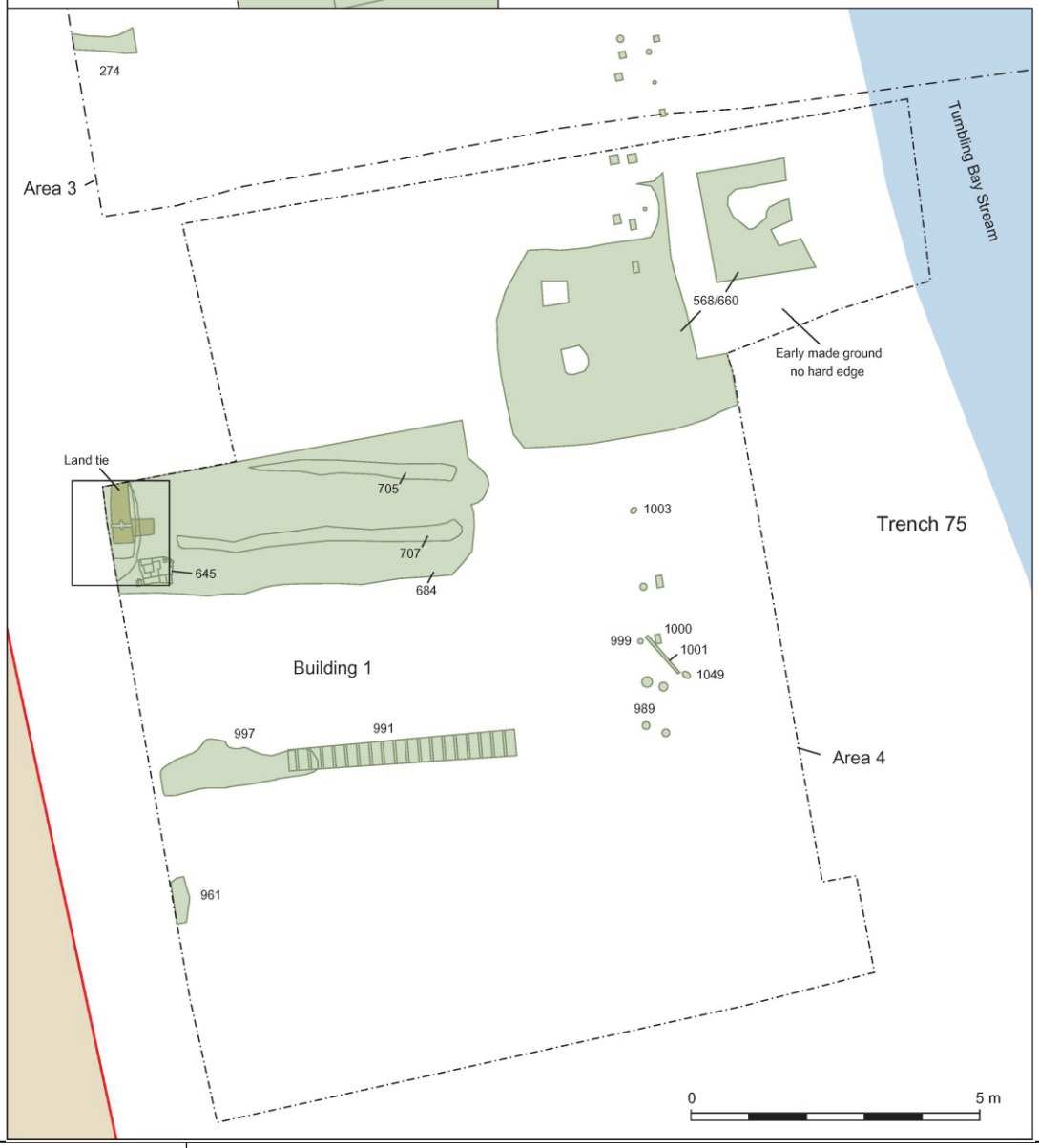


Figure 15:
Post-medieval land-tie assembly, Trench 75



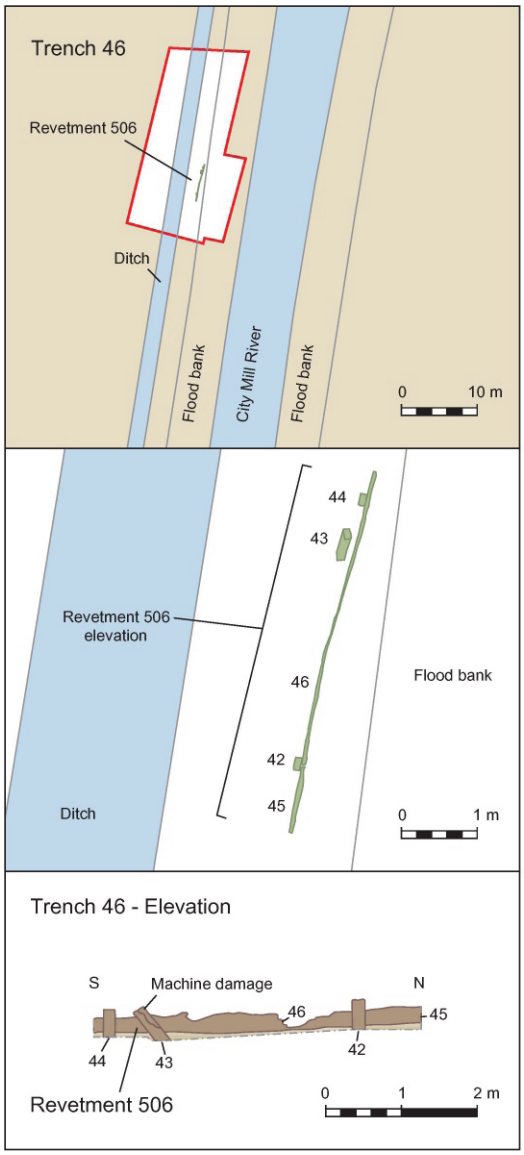
Date:	06/07/12	Revision Number:	0
Scale:	N/A	Illustrator:	KMN
Path:	Y:\PROJECTS\74508\Drawing Office\Report Figs\ADS-OnlineReports\6_Wood		

Wessex Archaeology

Figure 16: 18th century timber timber-lined channel, Trench 75

Date:	06/07/12	Revision Number:	0
Scale:	N/A	Illustrator:	KMN
Path:	Y:\PROJECTS\74508\Drawing Office\Report Figs\ADS-OnlineReports\6_Wood		

Wessex Archaeology



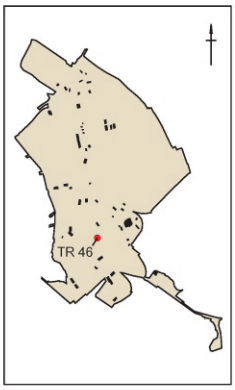
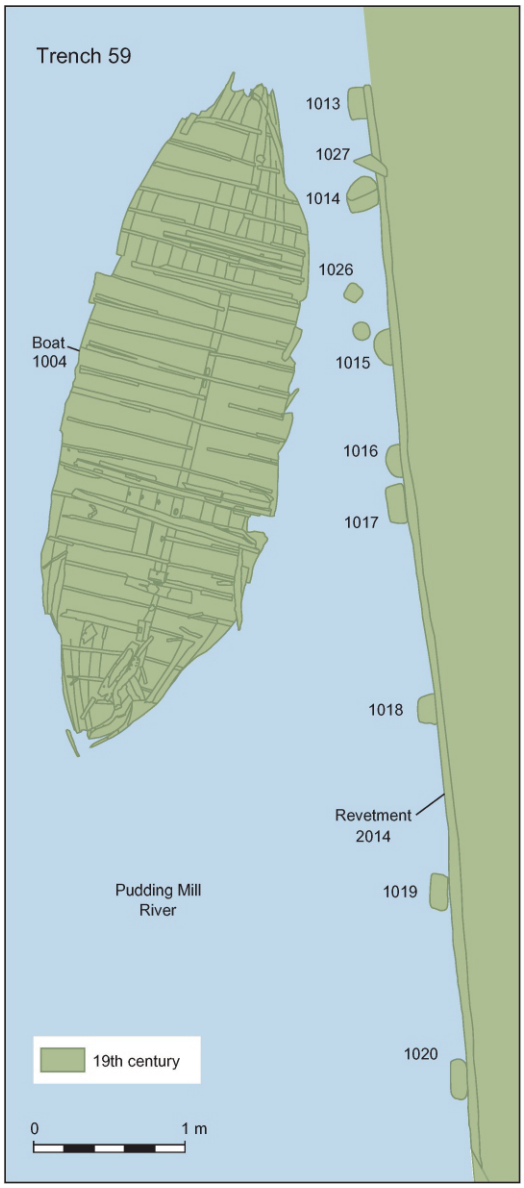


Figure 17: Early 19th century revetment, Trench 46

Date:	06/07/12	Revision Number:	0
Scale:	N/A	Illustrator:	KMN
Path:	Y:\PROJECTS\74508\Drawing Office\Report Figs\ADS-OnlineReports\6_Wood		



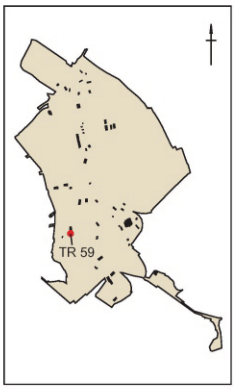


Figure 18: 19th century revetment, Trench 59

Date:	06/07/12	Revision Number:	0
Scale:	N/A	Illustrator:	KMN
Path:	Y:\PROJECTS\74508\Drawing Office\Report Figs\ADS-OnlineReports\6_Wood		

Wessex Archaeology

Figure 19: Late 19th century revetment of Tumbling Bay Stream, Trench 75

Date:	06/07/12	Revision Number:	0
Scale:	N/A	Illustrator:	KMN
Path:	Y:\PROJECTS\74508\Drawing Office\Report Figs\ADS-OnlineReports\6_Wood		

Wessex Archaeology

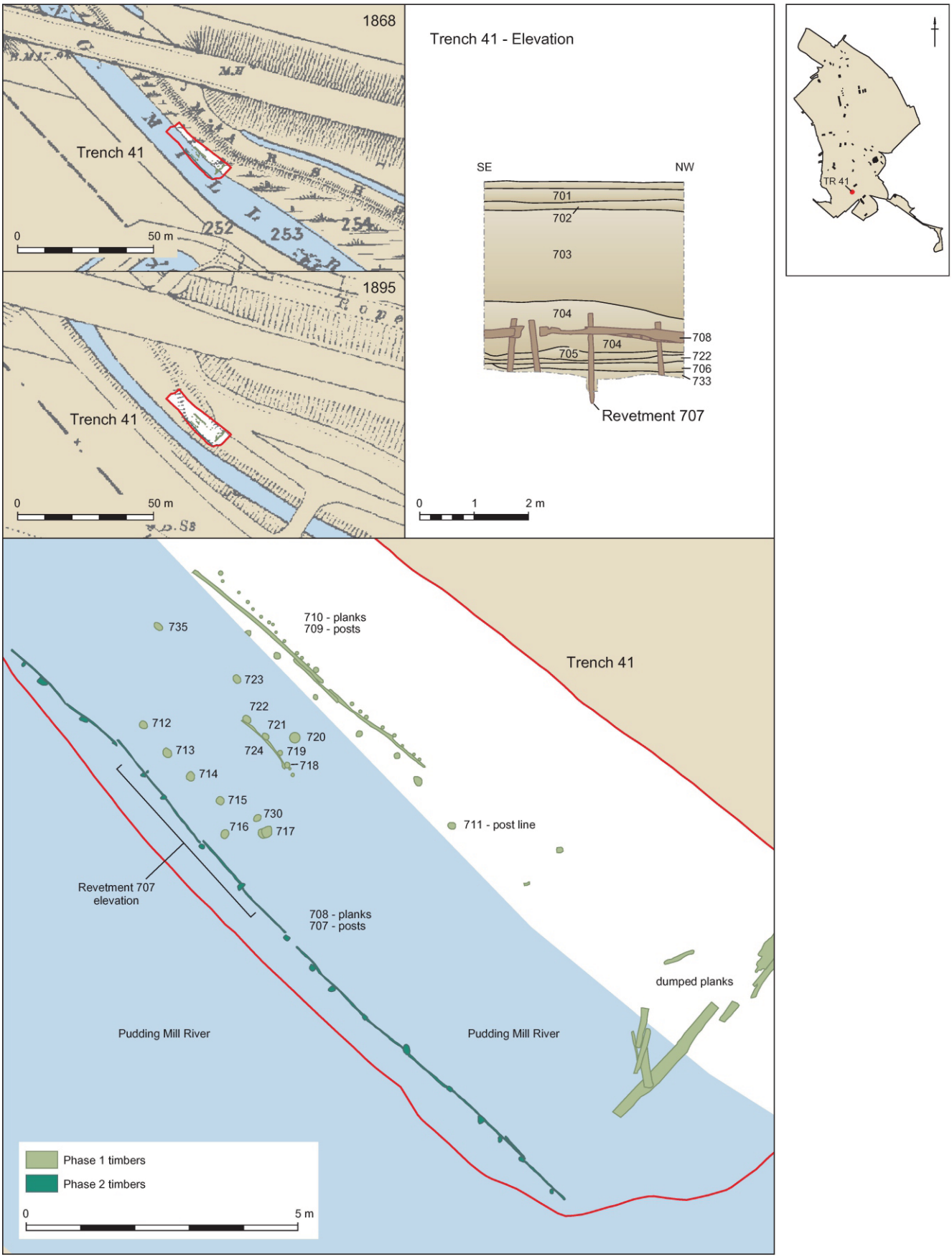


Figure 20: Post-medieval/modern timber structures, Trench 41

Date:	06/07/12	Revision Number:	0
Scale:	N/A	Illustrator:	KMN
Path:	Y:\PROJECTS\74508\Drawing Office\Report Figs\ADS-OnlineReports\6_Wood		

Wessex Archaeology

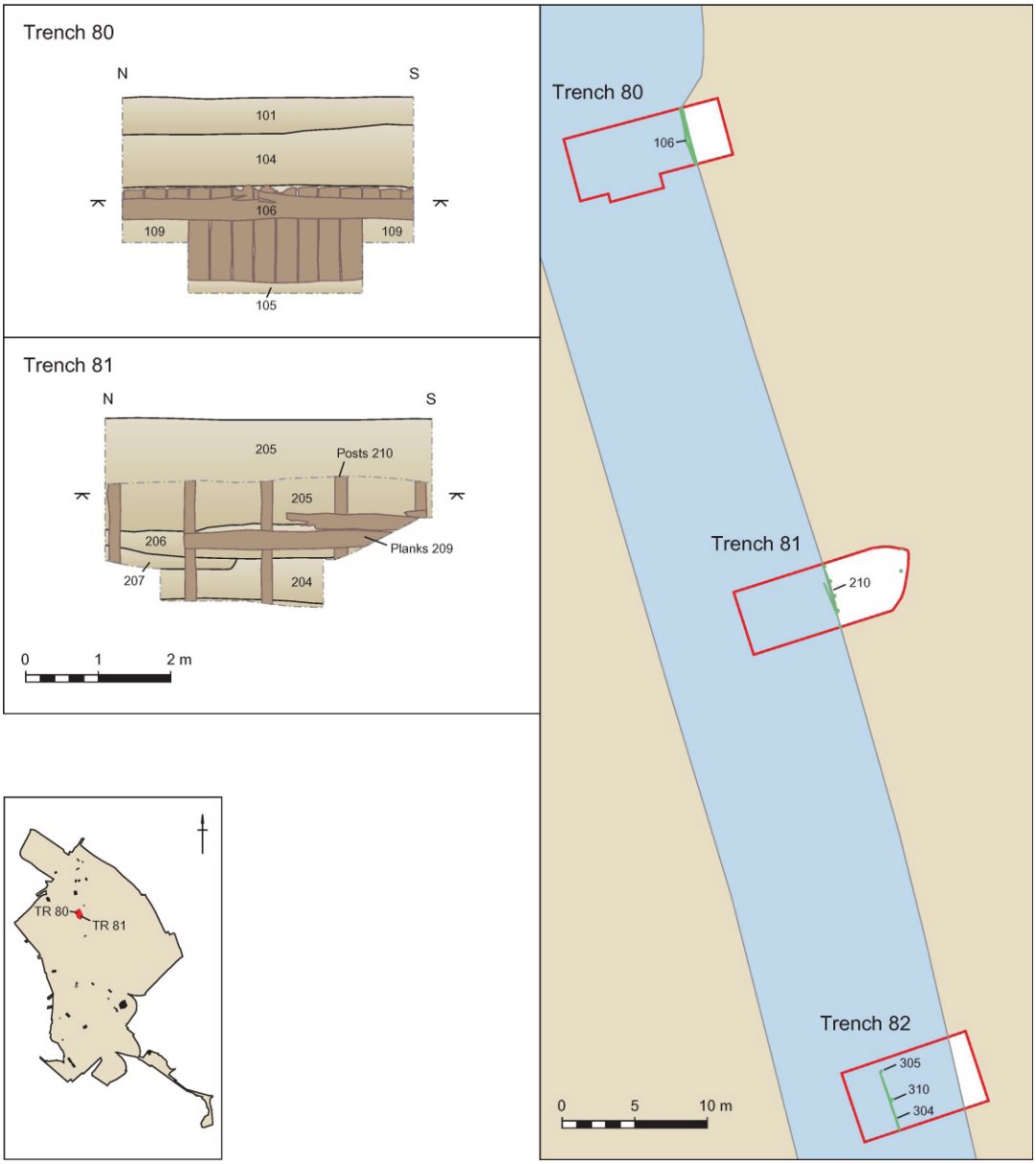
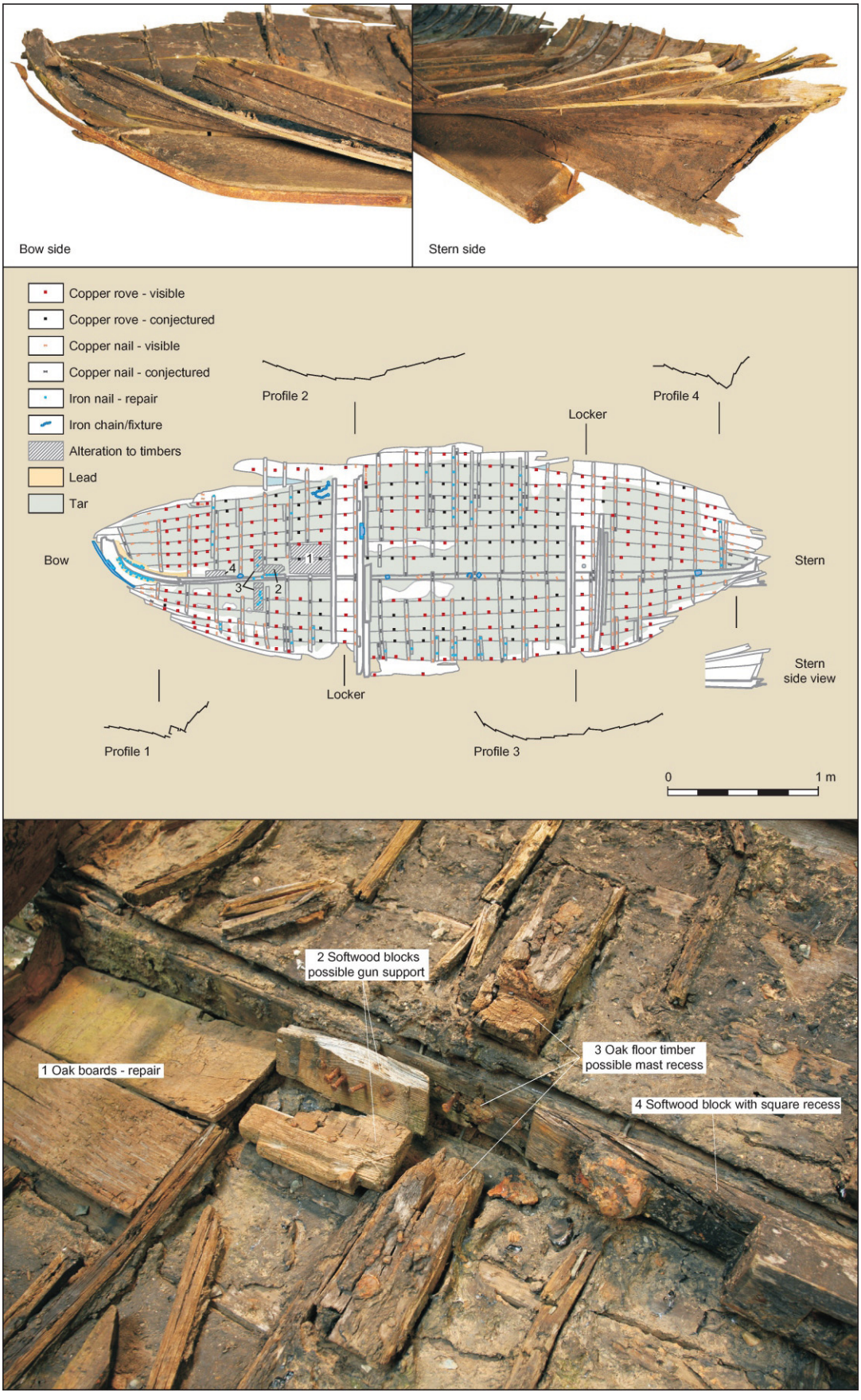


Figure 21: Late 19th/early 20th century revetments, Trenches 80–1

Date:	06/07/12	Revision Number:	0
Scale:	N/A	Illustrator:	KMN
Path:	Y:\PROJECTS\74508\Drawing Office\Report Figs\ADS-OnlineReports\6_Wood		

Wessex Archaeology




Copper rove


Copper rove bent over


Copper rove and iron nail

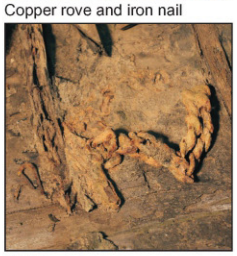

Chain

Figure 22: 19th century 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)

Date:	06/07/12	Revision Number:	0
Scale:	N/A	Illustrator:	KMN
Path:	Y:\PROJECTS\74508\Drawing Office\Report Figs\ADS-OnlineReports\6_Wood		

Wessex Archaeology

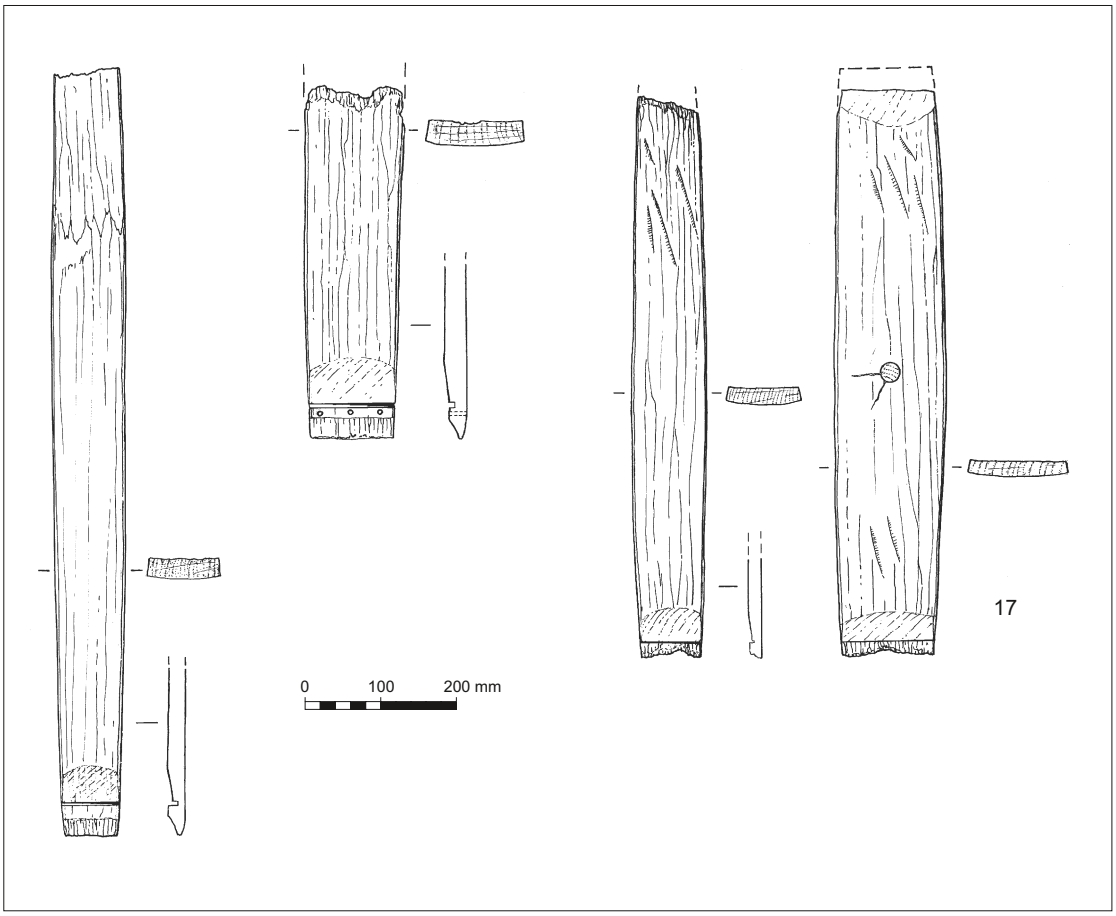


Figure 23: **17**.Oak cask staves, post-medieval. Timber 2003, Trench 59

Date:	06/07/12	Revision Number:	0
Scale:	N/A	Illustrator:	KMN
Path:	Y:\PROJECTS\74508\Drawing Office\Report Figs\ADS-OnlineReports\6_Wood		

Wessex Archaeology

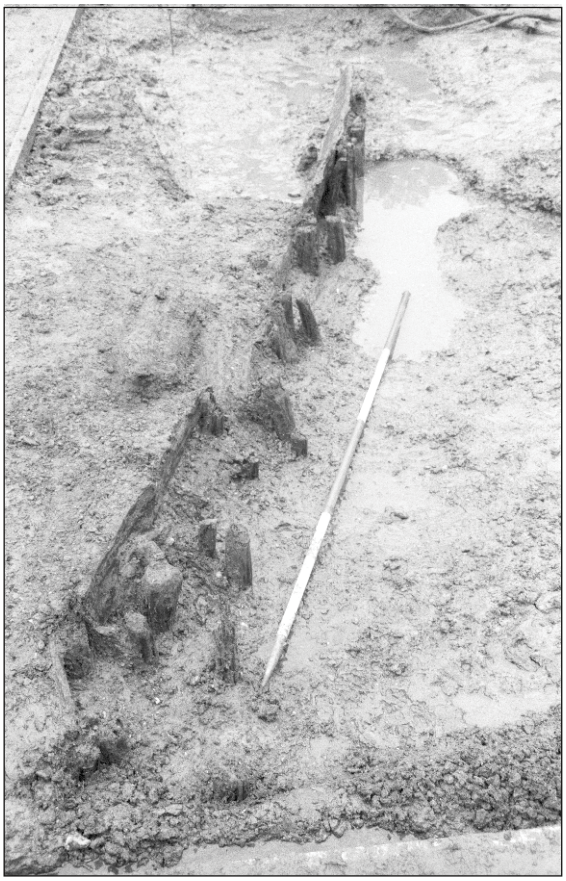


Plate 1: Romano-British post-and-plank structure 42, Trench 58

Plate 2: Post-medieval wattle revetment 114, Trench 58

Date:	06/07/12	Revision Number:	0
Scale:	N/A	Illustrator:	KMN
Path:	Y:\PROJECTS\74508\Drawing Office\Report Figs\ADS-OnlineReports\6_Wood		

Wessex Archaeology

Plate 3: Post-medieval timber-lined channel, Trench 75

Date:	06/07/12	Revision Number:	0
Scale:	N/A	Illustrator:	KMN
Path:	Y:\PROJECTS\74508\Drawing Office\Report Figs\ADS-OnlineReports\6_Wood		

Wessex Archaeology

Plate 4: 19th century clinker built boat, Trench 59

Date:	06/07/12	Revision Number:	0
Scale:	N/A	Illustrator:	KMN
Path:	Y:\PROJECTS\74508\Drawing Office\Report Figs\ADS-OnlineReports\6_Wood		

Wessex Archaeology

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

This is one of the
6 specialist reports
provided with
the above publication.

Wessex Archaeology
Monograph 29

ISBN 978-1-874350-59-0

Other reports in this series are available from the ADS website