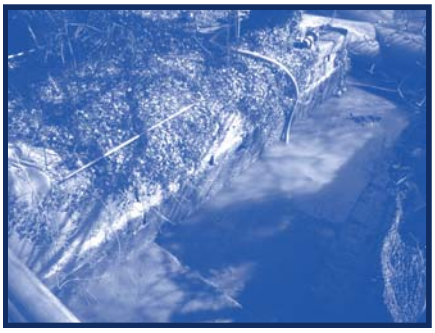
Towles Mill Sluice
Oxford



Archaeological Excavation and Watching Brief Report

oxfordarchaeology

Environment Agency

November 2007

Client: Environment Agency

Issue No: 3
OA Job No: 3496
NGR: SP 517 089

Archaeological Excavation and Watching Brief Report

TOWLES MILL SLUICE
OXFORD

SP 517 039

ARCHAEOLOGICAL EXCAVATION AND WATCHING BRIEF

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SUMMARY

From December 2006 to January 2007, Oxford Archaeology (OA) carried out an excavation at Towles Mill Sluice, Oxford (SP 517 039). The work was commissioned by Atkins Limited on behalf of the Environment Agency in advance of flood conveyance improvement works. The excavation revealed possible medieval alluvial deposits and some insubstantial structural remains associated with the 19th century mill.

Consequently, from February to March 2007, a watching brief was undertaken during the landscaping of the remodelled bypass channel and the augmentation of the sluice channel. The watching brief revealed the remnants of a timber revetment at the mouth of the bypass channel and further evidence for medieval alluviation. Dendrochronilogical samples from the timbers suggested that the structure was associated with the 15th century use of the mill. The mill race (now the sluice channel) was drained during the works and the exposed stone revetment and wheel pit appeared to relate to the 19th century phase of the mill.

1 INTRODUCTION

1.1 Location and scope of work

1.1.1 From December 2006 to March 2007, OA carried out an excavation and watching brief at Towles Mill sluice. The work was commissioned by Atkins Ltd on behalf of The Environment Agency (EA). The flood conveyance improvement works involved the remodelling of the bypass channel and the draining of the existing sluice channel and its subsequent consolidation with concrete. The excavation was carried out in advance of the works, whilst the watching brief monitored the landscaping of the overflow channel and drainage of the sluice channel. The scope of the work was laid out in a brief set by Steve Kemp (EA) and in a WSI agreed with Steve Kemp and Brian Durham of Oxford City Council (OCC).

1.2 Geology and topography

1.2.1 The site lies within the Thames Flood Plain upon riverine silts, that overlie natural gravels.

1.2.2 Towles Mill Sluice is situated on the Hinksey Stream of the Thames, south west of Oxford, close to South Hinksey (to the north west) and the suburb of New Hinksey (to the north). At this point along its course the Thames is split into two main channels; the Hinksey Stream and Weirs Mill Stream, which is to the east of the site. The Hinksey Stream itself splits into a number of courses forming an island now holding a Dairy to the north, and a Waste Reception Centre to the south. In addition there are a number of other leats and streams feeding into the Hinksey Stream in and around the site.

1.2.3 The main line rail track between Oxford and London Paddington passes to the west of the site. The historic Oxford to Abingdon road forms a right angle, crossing the railway and river in a south west - north east orientation and then heading north-west.

1.3 Archaeological [and historical] background

The following is a summary of background information presented in a Desk Based Assessment (DBA) carried out by OA in May 2006 (OA, 2006), full references can be found in that document

1.3.1 Towles Mill Sluice is on the site of a mill which has variously been known as Langford Mill, Hinksey Mill, New Hinksey Mill and Towles Mill. Langford mill is know to have been in existence by the beginning of the 12th century and is likely to have Saxon origins. It is described in Abingdon Cartulary as being close to 'Oxford Bridge', a reference to the Grandpont, the medieval causewayed bridge that crosses the study area as Abingdon Road.

1.3.2 The mill originated as a corn mill, but by Rocque's map of 1761 it had been converted to a paper mill. The sequence of historic maps plot the development of the mill complex including the mill itself straddling the main channel with various ancillary buildings and presumed millers residence adjacent on the west bank of the stream. The maps also illustrate the numerous watercourses within the study area and the evolution of engineered water management, especially to the south of the Grandpont bridge.

1.3.3 During the 19th century the mill was associated with John Towle, one time Mayor of Oxford, who sought to develop new markets for the mill's products by experimenting with the use of card as a building material. He constructed a house made from paper known as Paisley House which stood from 1844 to its demolition in 1996.

1.3.4 The mill ceased production in the early 1920's and its structures were largely demolished by 1960. Subsequent to this the few surviving buildings have been demolished and the only standing visible remains of the mill are the ashlar stone retaining walls of the narrowed main channel which marks the site of the mill. The managed watercourses of the site are another reminder of the mill's former presence.

Previous Archaeological Work

Summary of Archaeological Test-pitting

1.3.5 Test-pits along the line of the Bypass or Northern Channel revealed a consistent sequence of alluvium, overlain by subsoil itself overlain by topsoil. These test pits revealed a single undated feature and a probable path, running NW-SE - parallel with the Bypass Channel. This was probably associated with the later use of the mill.

1.3.6 Test-pit 11 demonstrated that extant structural elements of Towles Mill are currently hidden by ivy and undergrowth under the raised mound on the 'mill island'. These in-situ brick remains contain evidence of metal fittings that may pertain to gearing and drive mechanisms relating to mill operations. The position of the mound suggests that it was part of the core of mill buildings located on the northern side of the wheel race, which survives today as a stone lined element to the current southern channel (formerly the mill channel). The size of brick and the associated pottery finds date this structure and its use to the 18/19th century.

1.3.7 Beyond the limits of the mound, and as evidenced from Test-pits 1, 2, and 3 further to the north, there are buried structural remains relating to the same phase of 18/19th century activity.

1.3.8 The buried remains of a probable limestone foundation in TP 2 indicate the presence of non-brick structural elements probably relating to an earlier mill building. These could be of medieval date or later and may be contemporary with the stone wheel-race channel walls.

1.3.9 Other evidence of the mill's appearance is indicated by building materials found in TPs 2, 3, 7, 8 and 9 at some distance from its footprint. Ceramic peg tiles, commonly used in medieval and post medieval structures, indicated a roofing material, but also potentially may have hung, as a cladding, on half-timbered upper wall elements. The remains of coloured leaded window pointed to an aesthetic consideration to the building's appearance perhaps suggesting a domestic as well as practical function. Alternatively any of this material may have been imported to the site and have related to non-mill structures.

Summary of Geoarchaeological Borehole Report

1.3.10 The sediments recorded reflected the broad stages of floodplain development in the Holocene Upper Thames. Differences in sediment consistency and compaction across site were attributed to varying local depositional environments as well as the nature of the current stream. The proximity of the sample to the former watercourse and the degree of current waterlogging affected the character and thickness of the sedimentary unit.

1.3.11 The generalised sequence is summarised below (Table 1).

Table 1	
Topsoil	Moderately compact, dark brown/black sandy loam with a high organic content, occasional snails, occasional medium rounded - sub-rounded flint pebbles and heavy rooting. Contains 19th century and modern material
Subsoil	Soft, dark orange brown sandy/gritty clay loam with high organic content and heavy rooting. Contains 19th century and modern material
Man made deposits	Heavily rooted moderate/firm orange brown loam for landscaping and backfilling sometimes containing building material such as limestone and brick masonry
Alluvium	Firm, blue/grey clay and silty clay with frequent small fragments of mollusc shell and occasional, medium sub-angular limestone clasts
Organic alluvial clay	Soft dark brown/grey sandy clay with frequent fragments of mollusc shells
River terrace sands and gravels	Loose, grey/brown, clast supported sands and gravels in soft clay matrix

2 GENERAL AIMS OF THE EXCAVATION AND WATCHING BRIEF

2.1.1 The results from the test pitting suggested that the proposed scheme would only impact on ancillary features associated with the 19th century operation of the mill. However, the coverage of the site area by the test pits was relatively small, and there existed a potential for the survival of significant archaeological remains associated with earlier phases of occupation.

2.1.2 Consequently, the excavation sought to establish the presence or absence of archaeological remains or deposits in close proximity to the proposed location of the mill. The remainder of the impact area was subject to an archaeological watching brief, specifically along the line of the west bank of the 'bypass' channel, in an attempt to characterise features and deposits outside the projected extent of the mill buildings.

2.1.3 To preserve by record the extent, condition, nature, character, quality, date, depth below ground surface and depth of any archaeological remains present.

2.1.4 To make available the results of the investigation.

3 METHODOLOGY FOR THE EXCAVATION AND WATCHING BRIEF

3.1 Excavation

3.1.1 The precise area subject to controlled archaeological excavation was defined and agreed following tree and shrub clearance in advance of the works (Fig. 2).

3.1.2 The modern overburden of the agreed area was reduced by hand and excavation ceased the top of the first significant archaeological horizon. The surface was hand cleaned and a pre-excavation plan made prior to the hand excavation of a sondage through the alluvial sequence.

3.2 Watching Brief

3.2.1 The area impacted by the excavation of the new channel was subject to archaeological monitoring, this included the area that was subject to excavation by OA during December 2006 and January 2007. The area was sub-divided as indicated on Fig. 2 into priority and lesser priority zones.

3.2.2 The priority zone was considered to have a higher potential to contain archaeological remains pertaining to the mill structures than the lesser priority zone. In the priority area machining occurred in spits of no greater than 0.20m depth, until each significant archaeological horizon had been encountered and examined for archaeological features. Significant horizons from the top of the sequence down included:

- any structural remains within the topsoil;
- the top of the alluvial deposit;
- the organic layer at the base of the alluvial deposit;
- the top of the gravel.

3.2.3 The alluvial sequence was also sampled for environmental remains. Incremental and monolith samples were taken.

3.2.4 The draining of the sluice channel was also monitored.

3.3 General

3.3.1 All features and deposits were issued with unique context numbers, and context recording was in accordance with established OA practices (OA Field Manual, 1992). All contexts, and any small finds and samples from them were allocated unique numbers. Bulk finds were collected by context. Colour transparency and black-and-white negative photographs were taken of all trenches and archaeological features.

3.3.2 Site plans were drawn at an appropriate scale (1:20). Section drawings of features and sample sections of trenches will be drawn at a scale of 1:20. Full trench sections were not drawn as complex stratigraphy was not present, although a conjectured profile of the stratigraphic sequence was produced based on the data from the hand excavated sondage and the borehole survey.

3.4 Finds

3.4.1 Finds were recovered by hand during the course of the excavation and bagged by context. Finds of special interest were given a unique small find number.

3.5 Palaeo-environmental evidence

3.5.1 A monolith was taken through the alluvial sequence, this has been retained by Oxford Archaeology for analysis at a later date at the request of the client.

3.6 Presentation of results

3.4.1 The various deposits and structures encountered during the evaluation are described below in Sections 4 and 5, (a context inventory can be found as Appendix 1). The descriptive text in Section 5 is followed by the finds and environmental reports. A discussion and interpretation of this evidence can be found in Section 6.

4 RESULTS: GENERAL

4.1 Soils and ground conditions

4.1.1 As the top of the alluvial sequence (i.e. the first archaeological horizon) was below the water level of the bypass channel during the excavation, the site was subject to constant flooding. Additionally, the root systems from the recently felled willows were extensive and made excavation problematic. The majority of the deposits encountered within the excavation area had been heavily disturbed by the roots.

4.2 Distribution of archaeological deposits

5 RESULTS: DESCRIPTIONS

5.1 Description of deposits

Excavation

5.1.1 The majority of the excavation area was excavated to the top of the alluvial sequence (avg. 54.20 m OD). The floodplain gravel (1411) was revealed at *c* 53.04 m OD in the base of a sondage excavated in the north-west corner of the excavation area (Fig. 3). This was overlain by a *c* 0.22 m thick deposit of very dark grey clay (1410) with organic material throughout which is likely to correspond to the organic alluvial clay identified in the borehole survey (see Table 1 above). A trapezoidal iron bar was recovered from the organic material. The object lay horizontally at the base of the deposit and is unlikely to be a modern intrusion. This is discussed in further detail below (ref. 5.2.9 and 6.1.1). Deposit 1410 was overlain by a series of alluvial deposits (1409, 1408 and 1405) *c* 0.90 m deep, predominantly comprised of mid bluey grey clay (1409, 1405) but with sandy variations within the sequence (1408) and also identified in the borehole survey.

5.1.2 The top of the alluvial sequence (1405) was cut by a square structure (1403) comprising a brick floor defined by 2 courses of brick walling. The function of the structure was uncertain but, given its relationship with the overlying made ground (see below), is likely to relate to the 19th century mill structures.

5.1.3 Overlying the alluvial sequence and the brick structure was a 0.20 m thick layer of mixed made ground (1401), predominantly a friable mid brown clayey sand with *c* 5-10% gravel inclusions and 19th century material throughout, including chains and other metalwork likely to be associated with ?gearing mechanisms from the mill (ref. 5.2.6 to 5.2.9).

5.1.4 The possible path identified in the test pit evaluation (ref. 1.3.5) was also revealed within the excavation area. The 'path' comprised a north-south aligned line of kerb stones (1407) with a gravel rich 'surface' (1406) to the east and appeared to run parallel to the western bank of the bypass channel. Where present, the kerb stones appeared to mark the interface between deposit 1406 and made ground deposit 1401. The stones did not extend along the entire length of this interface, although it is likely that they are the remaining part of a longer 'structure', the rest of which is no longer extant.

5.1.5 Whilst it is possible that 1406 does represent a path along the edge of the bypass channel, the deposit was quite mixed, with the gravel rich elements indicative of a surface being fairly localised, particularly in the vicinity of the former test pit (TP3). The fact that the base of this deposit appeared to slope away towards the existing bypass channel may indicate that deposit 1406 is actually fill of a wider version of the channel, the edge of which is defined by the 'kerb' stones (1407).

5.1.6 Overlying the made ground deposit and directly beneath the topsoil was a circular configuration of bricks with an extant tree stump at their centre. This overlay the 19th century made ground and is likely to be a garden feature associated with the final phase of the mills' occupation.

Watching Brief

5.1.7 The monitoring of the landscaping of the new bypass channel confirmed the sequence suggested by the borehole survey and the excavation, and provided the opportunity to retrieve environmental samples from the alluvial material.

5.1.8 During the groundwork for the installation of a new weir at the mouth of the bypass channel, a north-south aligned row of timber posts was revealed. The posts were driven through the alluvial deposits and therefore post-date the deposition of same, although no further dating evidence was recovered. Two planks on the western side of the posts suggested a possible timber revetment at the mouth of the mill race (see Section 6), although it seems likely that the planks had originally performed a different function, particularly given the rebate cut into timber 1418 (Fig. 6). It was unclear whether the post (1417) to the west of the main revetment was part of the same structure or a later revetment at the mouth of the channel. Dendrochronological dating of the recovered timbers suggests a mid 14th century date for the planks and a late 15th century date for the post (1417), which on the face of it appears to suggest that 1417 is part of a later revetment. However, if the planks have been re-used, it is feasible that the recovered post, and those forming the row to the east (1416) are part of the same structure and that the earlier date of the planks reflects their re-use.

5.2 Finds

Pottery *by Paul Blinkhorn*

5.2.1 The pottery assemblage comprised 49 sherds with a total weight of 1401 g. It was mainly post-medieval or modern in date, although two sherds of medieval pottery were also present, with one appearing to be securely stratified.

5.2.2 It was recorded utilizing the coding system and chronology of the Oxfordshire County type-series (Mellor 1984; 1994), as follows:

OXAM: Brill/Boarstall ware, AD1200 – 1600. 1 sherd, 9 g.
OXBG: Surrey Whiteware. Mid 13th – mid 15th C. 1 sherd, 15 g,
OXDR, Red Earthenwares, 1550+. 18 sherds, 610 g.
OXFM, Staffordshire White-glazed English Stoneware, 1730–1800. 2 sherds, 41 g.
WHEW: Mass-produced white earthenwares, mid 19th - 20th C. 27 sherds, 626 g.

5.2.3 The pottery occurrence by number and weight of sherds per context by fabric type is shown in Table 1. Each date should be regarded as a *terminus post quem*.

	OXAM		OXBG		OXDR		OXFM		WHEW		
Context	No	Wt	No	Wt	No	Wt	No	Wt	No	Wt	Date
1400			1	15	18	610	2	41	26	620	19thC
1404									1	6	19thC
1405	1	9									13thC
	1	9	1	15	18	610	2	41	27	626	

Table 1: Pottery occurrence by number and weight (in g) of sherds per context by fabric type

Clay Pipe *by John Cotter*

Introduction

5.2.4 The excavation produced a total of 11 fragments of clay pipe weighing 44g from 2 contexts. These have been catalogued and recorded on an Excel spreadsheet. The catalogue records, per context, the spot-date, the quantity of stem, bowl and mouth fragments, the overall sherd count, weight, and comments on condition and any makers' marks or decoration present. See Table 2 below;

Context	**Spot-date**	**Stem**	**Bowl**	**Mouth**	**Tot sherds**	**Tot Wt**	**Comments**
1400	19C	5	2	1	8	25	Frags 2x 19C pipe bowls incl 1 bowl profile, poss mid 19C with trace of foliage seam and illegible maker's mark on spur - surname initial possibly 'P' ? Stem bores c1.25mm - 1.5mm. Fairly fresh

Context	Spot-date	Stem	Bowl	Mouth	Tot sherds	Tot Wt	Comments
1404	c1810-1840	1	2	0	3	19	1x complete bowl prob c1810-1840 (Oswald 1975, fig. 4.G.24) or late 18C? With narrow pointed stem prob with blundered maker's mark, stem bore c1.15mm. 1x prob 17-18C stem with trace of broad oval heel, SB c2.8mm, fairly worn. 1x 19C stem, SB c1.2mm
TOTAL		**6**	**4**	**1**	**11**	**44**	

Table 2: Clay Pipes

Date and nature of the assemblage

5.2.5 The assemblage is fairly fresh although moderate wear is visible on one or two pieces. Parts of four pipe bowls are present. These comprise three 19th-century pipes and one residual 17th- or 18th-century heel fragment. The 19th-century pipe bowls appear to have markers' marks on the heels but these are blundered or illegible.

Metalwork *by Ian Scott*

5.2.6 The assemblage comprises 80 pieces including 35 nails and 12 dogs or staples. All but three objects are iron. Thirteen pieces are from context 1400, 66 pieces from context 1401 and a single bar from 1411.

5.2.7 The assemblage includes a small pair of long-nose pliers and large iron wedge or gad, both from context (both context 1400), three tarpaulin eyelets (Lansdale & Sons, 37-38 Borough Road, London SE) and two hooks with suspension loops or eyes. The eyelets certainly and the hooks probably relate to transport (Table). The eyelets ere stamped 'LANSDALE, BOROUGH ROAD SE'. The firm is Lansdale and Sons, 37-38 Borough Road, London SE, tarpaulin manufacturers (*PO London County Suburbs Directory 1908, Part 1: Street, Commercial and Trades Directories*, p 835). There is a short length of chain comprising 3 links, which might be from a cart or wagon, might be used for hoisting sacks, or may simply be for security. Structural items include 35 nails, four large pins or nails and 12 staples or dogs. The latter have been used and most are distorted from being extracted.

Sum of Count	**Function**							
Context	**Tool**	**Transport**	**Security**	**Structural**	**Nails**	**Misc**	**Query**	**Totals**
1400	2	4		2			3	**13**
1401		1	1	14	[illegible]	7	10	**66**
1410				1				**1**
Grand Total	**2**	**5**	**1**	**17**	[illegible]	**7**	**13**	**80**

Table 3: Metalwork

5.2.8 There are seven miscellaneous pieces, including six short fragments of bar or rod and a large plain iron ring. Potentially the most interesting items are the 12 bands or collars of concave section externally. These were found in a range of sizes: 35mm (x 3), 45mm (x 3), 55mm (x 2), 65mm (x 1), 80mm (x 1), 85mm (x 1) and c 95mm (x 1) in diameter. These may have been parts of pulley wheels with wooden centres, or collars or linings. Finally there is a length strip with a series of close set holes, again of uncertain function.

5.2.9 All of the ironwork would be appropriate to early industrial site with machinery or for transport. None of the material needs date to before the 19th century, although there was some uncertainty as to the date and function of the iron bar recovered from deposit 1410 (Fig. 4, Section 1400, Small Find (△) number 1). The iron was considerably dense and trapezoidal in section. Evidence for individual hammer blows and some irregularity in the dimensions of the object indicated that it was hand forged rather than cast. Whilst this does not definitively date the bar, the fact that it is not cast iron does not preclude the possibility that it may be medieval in origin. A number of parallel striations were visible on one face of the object, although these gave no indication of function and the purpose of the bar remains unclear.

Dendrochronological Summary Report (see Appendix 3 for full report)

5.2.10 Three timbers from a simple post and plank retaining structure, possibly a revetment or an earlier weir, were recovered during works near the existing weir on the upstream end of the mill island. Two planks were dated: Plank 1418 and Plank 1419 the tree from which these were derived was felled around the middle of the 14^{th} century. Post/ pile was felled during the summer or autumn of AD 1482.

5.3 Palaeo-environmental remains

5.3.1 A single column sample was taken through the alluvial sequence to the top of the gravels (this included the organic-rich layer at the base of the alluvium - see Fig. 4, Section 1406, sample numbers ( ) 1-4◇

6 DISCUSSION AND INTERPRETATION

6.1 Reliability of field investigation

6.1.1 The considerable root disturbance and post depositional movement of finds through the soft silts made the secure allocation of finds problematic. Although the iron bar recovered from deposit 1410 was not closely datable, it is possible that it is post-medieval in date. Whilst this is anomalous with the interpretation of the alluvial sequence as medieval (see below), it is feasible that the presence of the iron bar can be attributed to this post-depositional movement, particularly given the density of the iron. Alternatively, the object may be medieval in date, although if this is the case, its function remains unclear.

6.2 Overall interpretation

6.2.1 Although little datable artefactual material was recovered from the alluvial deposits overlying the gravel, the single sherd of pottery which was retrieved indicates a 13th century date for the final phase of deposition of this material (deposit 1405). With the exception of the iron bar recovered from deposit 1410 (the provenance of which is uncertain), no further artefactual evidence was recovered from the alluvial sequence, and the relationship between any extant evidence for a Saxon pre-cursor to the medieval mill and the majority of the alluvial sequence remains unclear. No evidence for Saxon occupation of the site was recovered during the excavation or watching brief.

6.2.2 The precise function of the timber structure identified during the watching brief is uncertain, although it almost certainly relates to the configuration of the 15th century water management system at the upstream end of the island.

6.2.3 As the alignment of the posts corresponds roughly to that of the existing stone revetment along the north-eastern edge of the mill race (see Fig. 2), one possible interpretation is that this is a medieval pre-cursor to the existing ashlar revetment further downstream.

6.2.4 However, as the planking is positioned on the upstream side of the posts/piles, it seems unlikely that the structure was designed to retain part of the island to form a managed channel edge. If it was intended to retain this material, it would seem likely that the planks would have been placed between the posts and the material they were intended to retain. As found, it seems unlikely that the fixing nails and wooden pegs would have proved sufficient to retain the bank material, although it is feasible that they were intended to prevent erosion at the mouth of the channel, rather than retain the bank material.

6.2.5 Despite the similarity in the alignment of the timber posts and the existing channel edge, the simple timber post and plank structure is likely to be part of a crude weir rather than a channel bank revetment structure, installed after AD 1482, but also incorporating reused structural timbers from an earlier structure. If this is the case it would imply that at least the mouth of the overflow channel has subsequently migrated to the north, and that the structure revealed during the watching brief is a medieval antecedent of the recently removed concrete weir.

6.2.6 The remaining structural remains recorded during the excavation works almost certainly relate to the later phases of the mill and are likely to have been on the periphery of the mill complex.

APPENDICES

APPENDIX 1 ARCHAEOLOGICAL CONTEXT INVENTORY

Ctxt No	*Type*	*Thick (m)*	*Description*	*Comment*	*Finds*	*Date*
EXCAVATION						
1400	deposit	0.25-0.45	friable, dark brownish grey, clayey silt	topsoil		20thC
1401	deposit	avg. 0.20	predominantly friable, mid brown, clayey sand	made ground		19thC
1402	structure		circular configuration of bricks	garden feature/tree planter		20thC
1403	structure		brick built square structure	brick structure of uncertain function		19thC
1404	fill	0.18	soft, dark brownish grey, clayey silt	fill of structure 1403		19thC
1405	deposit	avg. 0.25	compact mid blueish grey, clay	top of alluvial sequence - heavily disturbed by roots		17thC?
1406	deposit	0.35 max	mixed deposit of gravel, mortar, sand and stone	made ground/surface		19thC
1407	structure		row of limestone blocks	'kerb' stones		19thC
1408	deposit	0.30	mid olive brown sandy clay	sandy variation in alluvial sequence		
1409	deposit	0.55	mid blueish grey clay with shell throughout	shelly variation in alluvial sequence		
1410	deposit	0.22	dark grey silty clay with organic material throughout	organic deposit at base of alluvial sequence		
1411	layer		sand and gravel	floodplain gravel		
WATCHING BRIEF						
1412	layer		same as 1411	floodplain gravel		
1413	deposit	0.36	dark reddish brown clayey sand with organic material throughout	organic deposit at base of alluvial sequence		
1414	deposit	0.30	light blueish grey silty clay with patches of dark grey clay and c 1% shell inclusions	shelly variation in alluvial sequence		
1415	deposit	0.38	mid olive brown sandy clay	sandy variation in alluvial sequence		
1416	structure		timber revetment	timber strucuture		
1417	timber		timber post	timber post		

APPENDIX 2 BIBLIOGRAPHY AND REFERENCES

The references pertaining to the dendrochronilogical report are presented in Appendix 3

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APPENDIX 3 DENDROCHRONOLOGICAL REPORT

Oxford Dendrochronology Laboratory
Interim Report 2007/13

The Tree-Ring Dating of Timbers from Towles Mill Sluice, Oxford

Dr D W H Miles FSA

Summary:

OXFORD, Towles Mill Sluice (SP 517 039)
(a) Re-used planks *Felling date range:* **After 1301** and **after 1333**
(b) Pile *Felling date:* **Summer 1482**
(a) Re-used planks 1299+3NM, +25 NM; (b) Pile 1481(20½C). *Site Masters* (a) 1177-1299 ox14189 (t = 8.2 DAUNTSEY; 7.8 WNTERBRN; 7.8 MASTERAL); (b) 1417-1481 ox1417 (t = 7.1 KNGHSQ01; 5.8 BRYNCAM; 5.7 GORC_T17).

Towles Mill Sluice is situated on the Hinksey Stream of the Thames to the south west of Oxford. The mill has been known by a number of names throughout its history including Langford Mill, Hinksey Mill, New Hinksey Mill, and Towles Mill. Research confirmed the likelihood that the site is the location of the medieval Longford Mill, recorded by the beginning of the 12th century with probable Saxon origins. It is described as being located close to 'Oxford Bridge', a reference to the Grandpont, the medieval causewayed bridge that led to Oxford from the south. Three timbers excavated on the site of the sluice relating to the mill produced three dates: two probably felled around the middle of the 14th century, and reused in a structure with a pile which was felled during the summer or autumn of 1482.

Date sampled: April 2007

Commissioner: Oxford Archaeology

Historical Research: Desk Based Assessment (OA, 2006 - see above)

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May 2007

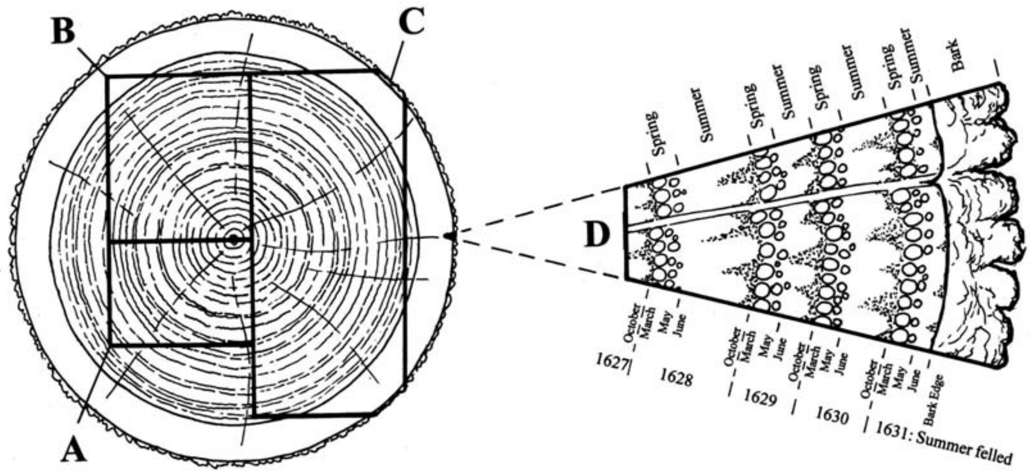
How Dendrochronology Works

1.1.1 Dendrochronology has over the past 20 years become one of the leading and most accurate scientific dating methods. Whilst not always successful, when it does work, it is precise, often to the season of the year. Tree-ring dating is well known for its use in dating historic buildings and archaeological timbers to this degree of precision. However more ancillary objects such as doors, furniture, panel paintings, and wooden boards in medieval book-bindings can sometimes be successfully dated.

1.1.2 The science of dendrochronology is based on a combination of biology and statistics. Fundamental to understanding how dendrochronology works is the phenomenon of tree growth. Essentially, trees grow through the addition of both elongation and radial increments. The elongation takes place at the terminal portions of the shoots, branches, and roots, while the radial increment is added by the cambium, the zone of living cells between the wood and the bark. In general terms, a tree can be best simplified by describing it as a cone, with a new layer being added to the outside each year in temperate zones, making it wider and taller.

1.1.3 An annual ring is composed of the growth which takes place during the spring and summer until about November when the leaves are shed and the tree becomes dormant for the winter period. For the European oak (*Quercus robur* and *Q. petraea*), as well as many other species, the annual ring is composed of two distinct parts - the spring growth or early wood, and the summer growth, or late wood. Early wood is composed of large vessels formed during the period of shoot growth which takes place between March and May, which is before the establishment of any significant leaf growth, and is produced by using most of the energy and raw materials laid down the previous year. Then, there is an abrupt change at the time of leaf expansion around May or June when hormonal activity dictates a change in the quality of the xylem and the summer, or late wood is formed. Here the wood becomes increasingly fibrous and contains much smaller vessels. Trees with this type of growth pattern are known as ring-porous, and are distinguished by the contrast between the open, light-coloured early wood vessels and the dense, darker-coloured late wood.

1.1.4 Dendrochronology utilises the variation in the width of the annual rings as influenced by climatic conditions common to a large area, as opposed to other more local factors such as woodland competition and insect attack. It is these climate-induced variations in ring widths that allow calendar dates to be ascribed to an undated timber when compared to a firmly-dated sequence. If a tree section is complete to the bark edge, then when dated a precise date of felling can be determined. The felling date will be precise to the season of the year, depending on the degree of formation of the outermost ring. Therefore, a tree with bark which has the spring vessels formed but no summer growth can be said to be felled in the spring, although it is not possible to say in which particular month the tree was felled.



Section of tree with conversion methods showing three types of sapwood retention resulting in **A** *terminus post quem*, **B** a felling date range, and **C** a precise felling date. Enlarged area **D** shows the outermost rings of the sapwood with growing seasons (Miles 1997, 42)

1.1.5 Another important dimension to dendrochronological studies is the presence of sapwood. This is the band of growth rings immediately beneath the bark and comprises the living growth rings which transport the sap from the roots to the leaves. This sapwood band is distinguished from the heartwood by the prominent features of colour change and the blocking of the spring vessels with tyloses, the waste products of the tree's growth. The heartwood is generally darker in colour, and the spring vessels are blocked with tyloses. The heartwood is dead tissue, whereas the sapwood is living, although the only really living, growing, cells are in the cambium, immediately beneath the bark. In European oak (*Quercus robur* sp), the difference in colour is generally matched by the change in the spring vessels. Generally the sapwood retains stored food and is therefore attractive to insect and fungal attack once the tree is felled and therefore is often removed during conversion.

1.1.6 Sapwood in European oaks tends to be of a relatively constant width and/or number of rings. By determining what this range is with an empirically or statistically-derived estimate is a valuable aspect in the interpretation of tree-ring dates where the bark edge is not present (Miles 1997). The narrower this range of sapwood rings, the more precise the estimated felling date range will be.

Methodology: The Dating Process

1.1.7 All timbers sampled were of oak (*Quercus* spp.) from what appeared to be primary first-use timbers, or any timbers which might have been re-used from an early phase. Those timbers which looked most suitable for dendrochronological purposes with complete sapwood or reasonably long ring sequences were selected. In situ timbers were sampled through coring, using a 16mm hollow auger. Details and locations of the samples are detailed in the summary table.

1.1.8 The dry samples were sanded on a linisher, or bench-mounted belt sander, using 60 to 1200 grit abrasive paper, and were cleaned with compressed air to allow the ring boundaries to be clearly distinguished. They were then measured under a x10/x30 microscope using a travelling stage electronically displaying displacement to a precision of 0.01mm. Thus each ring or year is represented by its measurement which is arranged as a series of ring-width indices within a data set, with the earliest ring being placed at the beginning of the series, and the latest or outermost ring concluding the data set.

1.1.9 The principle behind tree-ring dating is a simple one: the seasonal variations in climate-induced growth as reflected in the varying width of a series of measured annual rings is compared with other, previously dated ring sequences to allow precise dates to be ascribed to each ring. When an undated sample or site sequence is compared against a dated sequence, known as a reference chronology, an indication of how good the match is must be determined. Although it is almost impossible to define a visual match, computer comparisons can be accurately quantified. Whilst it may not be the best statistical indicator, Student's (a pseudonym for W S Gosset) *t*-value has been widely used amongst British dendrochronologists. The cross-correlation algorithms most commonly used and published are derived from Baillie and Pilcher's CROS programme (Baillie and Pilcher 1973), although a faster version (Munro 1984) giving slightly different t-values is sometimes used for indicative purposes.

1.1.10 Generally, *t*-values over 3.5 should be considered to be significant, although in reality it is common to find demonstrably spurious t-values of 4 and 5 because more than one matching position is indicated. For this reason, dendrochronologists prefer to see some *t*-value ranges of 5, 6, or higher, and for these to be well replicated from different, independent chronologies with local and regional chronologies well represented. Users of dates also need to assess their validity critically. They should not have great faith in a date supported by a handful of *t*-values of 3's with one or two 4's, nor should they be entirely satisfied with a single high match of 5 or 6. Examples of spurious *t*-values in excess of 7 have been noted, so it is essential that matches with reference chronologies be well replicated, and that this is confirmed with visual matches between the two graphs. Matches with *t*-values of 10 or more between individual sequences usually signify having originated from the same parent tree.

1.1.11 In reality, the probability of a particular date being valid is itself a statistical measure depending on the *t*-values. Consideration must also be given to the length of the sequence being dated as well as those of the reference chronologies. A sample with 30 or 40 years growth is likely to match with high *t*-values at varying positions, whereas a sample with 100 consecutive rings is much more likely to match significantly at only one unique position. Samples with ring counts as low as 50 may occasionally be dated, but only if the matches are very strong, clear and well replicated, with no other significant matching positions. This is essential for intra-site matching when dealing with such short sequences. Consideration should also be given to evaluating the reference chronology against which the samples have been matched: those with well-replicated components which are geographically near to the sampling site are given more weight than an individual site or sample from the opposite end of the country.

1.1.12 It is general practice to cross-match samples from within the same phase to each other first, combining them into a site master, before comparing with the reference chronologies. This has the advantage of averaging out the 'noise' of individual trees and is much more likely to obtain higher *t*-values and stronger visual matches. After measurement, the ring-width series for each sample is plotted as a graph of width against year on log-linear graph paper. The graphs of each of the samples in the phase under study are then compared visually at the positions indicated by the computer matching and, if found satisfactory and consistent, are averaged to form a mean curve for the site or phase. This mean curve and any unmatched individual sequences are compared against dated reference chronologies to obtain an absolute calendar date for each sequence. Sometimes, especially in urban situations, timbers may have come from different sources and fail to match each other, thus making the compilation of a site master difficult. In this situation samples must then be compared individually with the reference chronologies.

1.1.13 Therefore, when cross-matching samples with each other or against reference chronologies, a combination of both visual matching and a process of qualified statistical comparison by computer is used. The ring-width series were compared on an IBM compatible computer for statistical cross-matching using a variant of the Belfast CROS program (Baillie and Pilcher 1973). A version of this and other programmes were written in BASIC by D Haddon-Reece, and re-written in Microsoft Visual Basic by M R Allwright and P A Parker.

Ascribing and Interpreting Felling Dates

1.1.14 Once a tree-ring sequence has been firmly dated in time, a felling date, or date range, is ascribed where possible. For samples which have sapwood complete to the underside of, or including bark, this process is relatively straight forward. Depending on the completeness of the final ring, i.e. if it has only the early wood formed, or the latewood, a *precise felling date and season* can be given. If the sapwood is partially missing, or if only a heartwood/sapwood transition boundary survives, then an *estimated felling date range* can be given for each sample. The number of sapwood rings can be estimated by using a statistically derived sapwood estimate with a given confidence limit. A review of the geographical distribution of dated sapwood data from historic building timbers has shown that a 95% range of 9-41 rings is most appropriate for the southern counties of England (Miles 1997), which will be used here. If no sapwood or heartwood/sapwood boundary survives, then the minimum number of sapwood rings from the appropriate sapwood estimate is added to the last measured ring to give a *terminus post quem* (*tpq*) or *felled after* date.

1.1.15 An alternative method of estimating felling date ranges has recently been developed (Miles 2005) which runs as a function under OxCal (Bronk Ramsey 1995; Miles and Bronk Ramsey *in prep*). Instead of using a simple empirical estimate for a particular geographical location, one model was found to be suitable for the whole of England and Wales. With the methodology set out by Millard (2002), Bayesian statistical models are used to produce individual sapwood estimates for samples using the variables of number of heartwood rings present, the mean ring width of those heartwood rings, the heartwood/sapwood boundary date, and the number of any surviving sapwood rings or a count of those lost in sampling. Using the suite of calculation and graphical plotting functions in OxCalInput and OxCalPlot (Bronk Ramsey *in prep*), the area of highest probability density for each sample can be graphically displayed to any of three confidence levels. The addition of surviving sapwood to the equation narrows the felling date range for each sample, although the outer end of the range shifts slightly later, more noticeably on those samples with higher sapwood counts. An empirically-derived stock-piling factor added to the ranges produced also helps to make the estimated felling date ranges more representative for the actual latest common felling date, from which a construction date can then be extrapolated.

1.1.16 This new method of predicting sapwood ranges has resulted in over 94% of the samples tested producing felling date ranges narrower than the 36-year empirical estimate currently used. About a quarter of the samples tested showed an improvement with a range of 24 years or less. Conversely, some 4.5% of the samples tested produced a range larger than the empirical range, but again these ranges are more representative of the actual sapwood found.

1.1.17 However, it has been found that some unusual samples do not fit the model well. These include samples which have exceptional or sudden variation in mean ring width, such as might be found in pollarded or managed timber. Sometimes a tree will exhibit a sudden drop in mean ring width toward the end of its life, resulting in more sapwood rings being present then might be suggested in the faster-grown heartwood. Additionally, samples which have come from small timbers converted from larger, slow-grown trees would have a much larger number of heartwood rings then were actually present in the sample. Some examples of heartwood ring counts of 25 years or less with a narrow mean ring width are good indicators of this situation, as were observations made during sampling. Samples with these characteristics should be excluded from such analysis.

1.1.18 A particularly useful feature of OxCalPlot is the ability of producing combined felling date ranges for a group of samples comprising a single phase of building. Here, two samples combined can reduce the individual felling date ranges from about 30 to about 20 years. By including more samples within the combined phase, this 20-year range can be reduced to half or even less, depending on the number of samples in the phase. Thus felling date ranges for combined building phases have the potential to being reduced by as much as a two-thirds or even three-quarters of the individual empirically-derived felling date ranges (Miles 2005).

1.1.19 Some caution must be used in interpreting solitary precise felling dates. Many instances have been noted where timbers used in the same structural phase have been felled one, two, or more years apart. Whenever possible, a *group* of precise felling dates should be used as a more reliable indication of the *construction period*. It must be emphasised that dendrochronology can only date when a tree has been felled, not when the timber was used to construct the structure under study. However, it is common practice to build timber-framed structures with green or unseasoned timber and that construction usually took place within twelve months of felling (Miles 2006).

Details of Dendrochronological Analysis

1.1.20 The results of the dendrochronological analysis for the building under study are presented in a number of detailed tables. The most useful of these is the summary **Table A1**. This gives most of the salient results of the dendrochronological process, and includes details for each sample, its location, and its felling date or date range, if successfully tree-ring dated. This last column is of particular interest to the end user, as it gives the actual year and season when the tree was felled, if bark is present, or an estimated felling date range if the sapwood is incomplete. Occasionally it will be noted that the felling date ranges may not coincide with the precise felling dates. This is nothing to be overly concerned about so long as these are not too far apart. It must be remembered that the estimated felling date ranges are calculated at a 95% confidence level, which means that statistically one sample in 20 will have felling dates which actually fall *outside* the predicted range.

1.1.21 It will also be noticed that often the precise felling dates will vary within several years of each other. Unless there is supporting archaeological evidence suggesting different phases, all this would indicate is either stockpiling of timber, or of trees which have been felled or died at varying times but not cut up until the commencement of the particular building operations in question. When presented with varying precise felling dates, one should always take the *latest* date for the structure under study, and it is likely that construction will have been completed for ordinary vernacular buildings within twelve or eighteen months from this latest felling date (Miles 1997).

1.1.22 **Table A2** gives an indication of the statistical reliability of the match between one sequence and another. This shows the *t*-value over the number of years overlap for each combination of samples in a matrix table. It should be born in mind that *t*-values with less than 80 rings overlap may not truly reflect the same degree of match and that spurious matches may produce similar values.

1.1.23 First, multiple radii have been cross-matched with each other and combined to form same-timber means. These are then compared with other samples from the site and any which are found to have originated from the same parent tree are again similarly combined. Finally, all samples, including all same timber and same tree means are combined to form one or more site masters. Again, the cross-matching is shown as a matrix table of *t*-values over the number of years overlaps. Reference should always be made to **Table A1** to clearly identify which components have been combined.

1.1.24 **Table A3** shows the degree of cross-matching between the site master(s) with a selection of reference chronologies. This shows the county or region from which the reference chronology originated, the common chronology name together with who compiled the chronology with publication reference and the years covered by the reference chronology. The years overlap of the reference chronology and the site master being compared are also shown together with the resulting *t*-value. It should be appreciated that well replicated regional reference chronologies, which are shown in **bold**, will often produce better matches than with individual site masters or indeed individual sample sequences.

1.1.25 **Figures** include a bar diagram which shows the chronological relationship between two or more dated samples from a phase of building. The site sample record sheets are also appended, together with any plans showing sample locations, if available.

1.1.26 **Publication** of all dated sites are published in *Vernacular Architecture* annually, and the entry, if available, is shown on the summary page of the report. This does not give as much technical data for the samples dated, but does give the *t*-value matches against the relevant chronologies, provide a short descriptive paragraph for each building or phase dated, and gives a useful short summary of samples dated. These summaries are also listed on the web-site maintained by the Laboratory, which can be accessed at www.dendrochronology.com. The Oxford Dendrochronology Laboratory retains copyright of this report, but the commissioner of the report has the right to use the report for his/her own use so long as the authorship is quoted. Primary data and the resulting site master(s) used in the analysis is available from the Laboratory on request by the commissioner and bona fide researchers. The samples form part of the Laboratory archives.

Summary of Dating

1.1.27 Three timbers recovered during the excavations were sampled by sectioning. One timber was sampled twice as there was oblique grain and two sections would give a greater number of rings (**ox1419a** and **ox1419b**). These two samples were first cross-matched together with a *t*-value of 13.05 and combined to form the mean **ox1419** with 123 rings. This was found to match with sample **ox1418** with a *t*-value of 7.90 and were combined to form the site master ox14189. The third sample (**ox1417**) failed to match either **ox1418**, **ox1419**, or the master **ox14189**. Therefore this sample was processed separately.

1.1.28 The mean of the two planks, **ox14189**, was compared with a large selection of dated reference chronologies and was dated, spanning the years 1177-1299. Thus, timber **ox1418** had a last measured ring date of 1292, and **ox1419** had a last measured ring date of 1299. As neither sample had a heartwood/sapwood transition, only a *terminus post quem* date could be given for both timbers. Therefore sample **ox1418** had a last measured ring date of 1292, and by adding the minimum number of sapwood rings, which is 9 years, a felling date no earlier than 1301 can be ascribed to this timber. However, sample **ox1419b** from which the mean **ox1419** was constructed had an additional 25 rings which were unmeasurable. This gave a real last present ring on the sample of 1324. By applying the same sapwood estimate, a felling date no earlier than 1333 could only be ascribed to this timber. Therefore it is suggested that both of these planks originated from an earlier structure dating to sometime around the middle of the fourteenth century.

1.1.29 The sequence from the pile, **ox1417**, dated well despite having only 65 rings, spanning the years 1417-1481. This timber retained complete sapwood, including the partially-formed summer growth for the year 1482. Thus a precise felling date of summer/autumn 1482 can be given for this timber.

Acknowledgements

1.1.30 The dendrochronology was commissioned by Ben Ford of Oxford Archaeology for the client, Atkins Limited. The timbers were recorded and slices cut by Robin Bashford. Michael Worthington prepared the bar diagram, and acknowledgements are given to other dendrochronologists for both published and unpublished reference chronologies.

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Table A1: Summary of Tree-Ring Dating

TOWLES MILL SLUICE, OXFORD

Sample number & type		Timber and position	Dates AD spanning	H/S bdry	Sapwood complement	No of rings	Mean width mm	Std devn mm	Mean sens mm	Felling seasons and dates/date ranges (AD)
ox1417	s	Pile OXTOW06 1417	1417-1481	1461	20½C	65	1.32	0.77	0.293	Summer 1482
* **ox1418**	s	Re-used plank OXTOW06 1418	1190-1292			103	2.35	0.71	0.218	After 1301
ox1419a	s	Re-used plank OXTOW06 1419	1177-1299			123+25NM	1.12	0.35	0.209	
ox1419b	s	ditto	1183-1299			117+3 NM	1.38	0.39	0.191	
* **ox1419**		Mean of **ox1419a** + **1419b**	1177-1299			123+25NM	1.25	0.35	0.195	After 1333
*** = ox14189**		**Mean of ox1418 + 1419**	**1177-1299**			**123+25 NM**	**1.71**	**0.46**	**0.210**	**After 1333**

Key: *, †, § = sample included in site-master; c = core; mc = micro-core; s = slice/section; g = graticule; p = photograph; ¼C, ½C, C = bark edge present, partial or complete ring: ¼C = spring (last partial ring not measured), ½C = summer/autumn (last partial ring not measured), or C = winter felling (ring measured); H/S bdry = heartwood/sapwood boundary - last heartwood ring date; std devn = standard deviation; mean sens = mean sensitivity

Explanation of terms used in Table A1

The summary table gives most of the salient results of the dendrochronological process. For ease in quickly referring to various types of information, these have all been presented in Table A1. The information includes the following categories:

Sample number: Generally, each site is given a two or three letter identifying prefix code, after which each timber is given an individual number. If a timber is sampled twice, or if two timbers were noted at time of sampling as having clearly originated from the same tree, then they are given suffixes '**a**', '**b**', etc. Where a core sample has broken, with no clear overlap between segments, these are differentiated by a further suffix '**1**', '**2**', etc.

Type shows whether the sample was from a core 'c', or a section or slice from a timber's'. Sometimes photographs are used 'p', or timbers measured *in situ* with a graticule 'g'.

Timber and position column details each timber sampled along with a location reference. This will usually refer to a bay or truss number, or relate to compass points or to a reference drawing.

Dates AD spanning gives the first and last measured ring dates of the sequence (if dated),

H/S bdry is the date of the heartwood/sapwood transition or boundary (if present). This date is critical in determining an estimated felling date range if the sapwood is not complete to the bark edge.

Sapwood complement gives the number of sapwood rings. The tree starts growing in the spring during which time the earlywood is produced, also known also as spring growth. This consists of between one and three decreasing spring vessels and is noted as *Spring* felling and is indicated by a ¼ C after the number of sapwood ring count. Sometimes this can be more accurately pin-pointed to very early spring when just a few spring vessels are visible. After the spring growing season, the latewood or summer growth commences, and is differentiated from the proceeding spring growth by the dense band of tissue. This summer growth continues until just before the leaves drop, in about October. Trees felled during this period are noted as *summer* felled (½ C), but it is difficult to be too precise, as the width of the latewood can be variable, and it can be difficult to distinguish whether a tree stopped growing in autumn or *winter*. When the summer growth band is clearly complete, then the tree would have been felled during the dormant winter period, as shown by a single C. Sometimes a sample will clearly have complete sapwood, but due either to slight abrasion at the point of coring, or extremely narrow growth rings, it is impossible to determine the season of felling.

Number of rings: The total number of measured rings present on the samples analysed.

Mean ring width: This, simply put, is the sum total of all the individual ring widths, divided by the number of rings, giving an average ring width for the series.

Mean sensitivity: A statistic measuring the mean percentage, or relative, change from each measured yearly ring value to the next; that is, the average relative difference from one ring width to the next, calculated by dividing the absolute value of the differences between each pair of measurements by the average of the paired measurements, then averaging the quotients for all pairs in the tree-ring series (Fritts 1976). Sensitivity is a dendrochronological term referring to the presence of ring-width variability in the radial direction within a tree which indicates the growth response of a particular tree is "sensitive" to variations in climate, as opposed to complacency.

Standard deviation: The mean scatter of a population of numbers from the population mean. The square root of the variance, which is itself the square of the mean scatter of a statistical population of numbers from the population mean. (Fritts 1976).

Felling seasons and dates/date ranges is probably the most important column of the summary table. Here the actual felling dates and seasons are given for each dated sample (if complete sapwood is present). Sometimes it will be noticed that often the precise felling dates will vary within several years of each other. Unless there is supporting archaeological evidence suggesting different phases, all this would indicate is either stockpiling of timber, or of trees which have been felled or died at varying times but not cut up until the commencement of the particular building operations in question. When presented with varying precise felling dates, one should always take the *latest* date for the structure under study, and it is likely that construction will have been completed for ordinary vernacular buildings within twelve or eighteen months from this latest felling date (Miles 2006).

Felling date ranges are produced using an empirical estimates using the appropriate estimate (Miles 1997). However, these can sometimes be reduced using a new sapwood estimation methodology which uses the mean ring width, number of heartwood rings, known H/S boundary date, and the number of surviving sapwood rings, if present (Miles 2006). These are used after the empirical range and are shown in brackets (OxCal followed by date range). Combined felling date ranges for a phase of building is shown at the end of the phase to which it relates.

Table A2: Matrix of *t*-values and overlaps for same-timber means and site masters

Components of timber **ox1419**

Sample:	**ox1419b**
Last ring date AD:	1299
ox1419a	13.05 117

Components of site master **ox14189**

Sample:	**ox1419**
Last ring date AD:	1299
ox1418	7.90 103

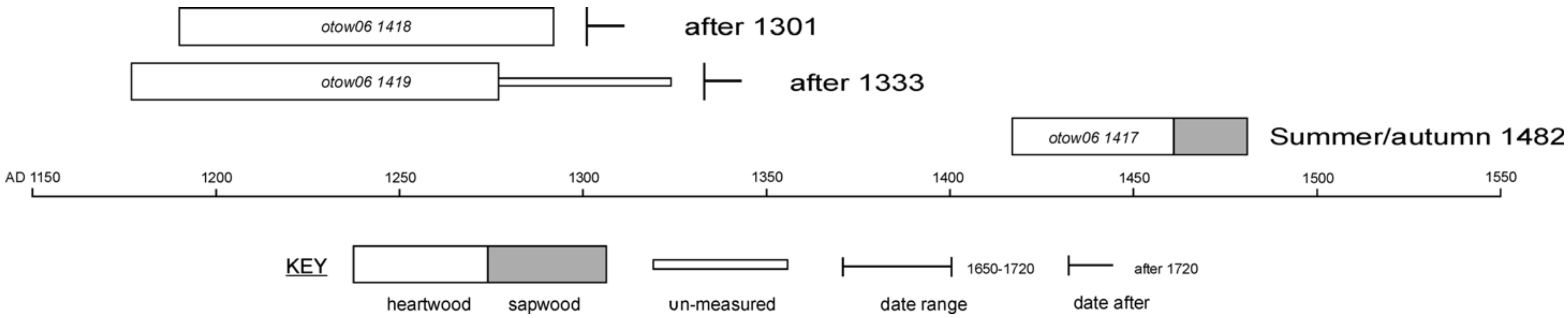
Table A3a: Dating of site master **ox14189** (1177-1299) against reference chronologies at 1299

County or region:	*Chronology name:*	*Short publication reference:*	*File name:*	*Spanning:*	*Overlap:*	t-*value:*
Hampshire	Hampshire Master Chronology	(Miles 2003)	***HANTS02***	443-1972	123	6.61
Oxfordshire	Oxfordshire Master Chronology	(Haddon-Reece *et al* unpubl)	OXON	1043-1987	123	6.62
Hampshire	Old Church House, Odiham	(Miles and Haddon-Reece 1996)	OLDCHRCH	1177-1365	123	6.69
Southern England	Southern England Master	(Bridge 1998)	***SENG98***	944-1790	123	6.84
Somerset	Somerset Master Chronology	(Miles 2004)	**SOMRST04**	770-1979	123	7.16
Shropshire	St Cuthbert's, Clungunford	(Worthington and Miles 2001)	STCTHBRT	1120-1338	123	7.47
London	London Master Chronology	(Tyers *pers comm*)	***LONDON***	413-1728	123	7.54
Great Britain	British Isles Master Chronology	(Haddon-Reece and Miles 1993)	**MASTERAL**	404-1987	123	7.80
Gloucestershire	Winterborne Tithe Barn	(Miles and Worthington 2000)	WNTERBRN	1177-1341	123	7.83
Wiltshire	Doom Panel, St James Church	(Tyers 2006)	DAUNTSEY	1154-1349	123	8.20

Table A3b: Dating of site master **ox1417** (1417-1481) against reference chronologies at 1481

County or region:	*Chronology name:*	*Short publication reference:*	*File name:*	*Spanning:*	*Overlap:*	t-*value:*
Oxfordshire	Oxford Prison	(Miles and Haddon-Reece 1995)	OXPRISON	1411-1551	65	4.90
Worcestershire	Old School Ho., Bayton	(Bridge 1996)	BAYTON	1348-1525	65	5.02
Cheshire	Combermere Abbey, Whitchurch	(Howard et al 2003)	CBMASQ01	1371-1564	65	5.14
Southern England	Southern England Master	(Bridge 1998)	***SENG98***	944-1790	65	5.17
Warwickshire	Saltisford	(Howard et al 1996)	SALTIS	1412-1499	65	5.19
Shropshire	High Street, Whitchurch	(Miles and Worthington 2001)	WHGHWHIT	1416-1596	65	5.49
Essex	Magdalen Laver	(Tyers and Boswijk 1998)	MLAVER	1411-1534	65	5.64
Warwickshire	Gorcott Hall	(Nayling 2006)	GORC_T17	1385-1531	65	5.67
Shropshire	Bryn Cambric, Clun	(Worthington and Miles 2003)	BRYNCAM	1371-1500	65	5.77
Warwickshire	Kingsbury Hall	(Arnold *et al* 2006)	KNGHSQ01	1391-1564	65	7.06

Bar diagram showing dated timbers in chronological position



APPENDIX 4 SUMMARY OF SITE DETAILS

Site name: Towles Mill Sluice, Oxford
Site code: OXTOW'06
Grid reference: SP 517 039
Type of evaluation: Excavation and Watching Brief
Date and duration of project: December 2006-March 2007
Summary of results: From December 2006 to January 2007, Oxford Archaeology (OA) carried out an excavation at Towles Mill Sluice, Oxford (SP 517 039). The work was commissioned by Atkins Limited on behalf of the Environment Agency in advance of flood conveyance improvement works. The excavation revealed possible medieval alluvial deposits and some insubstantial structural remains associated with the 19th century mill.
Consequently, from February to March 2007, a watching brief was undertaken during the landscaping of the remodelled bypass channel and the augmentation of the sluice channel. The watching brief revealed the remnants of a timber revetment at the mouth of the bypass channel and further evidence for medieval alluviation. Dendrochronilogical samples from the timbers suggested that the structure was associated with the 14th century use of the mill. The mill race (now the sluice channel) was drained during the works and the exposed stone revetment and wheel pit appeared to relate to the 19th century phase of the mill.
Location of archive: The archive is currently held at OA, Janus House, Osney Mead, Oxford, OX2 0ES, and will be deposited with Oxfordshire County Museums Service in due course, under the following accession number: TBC

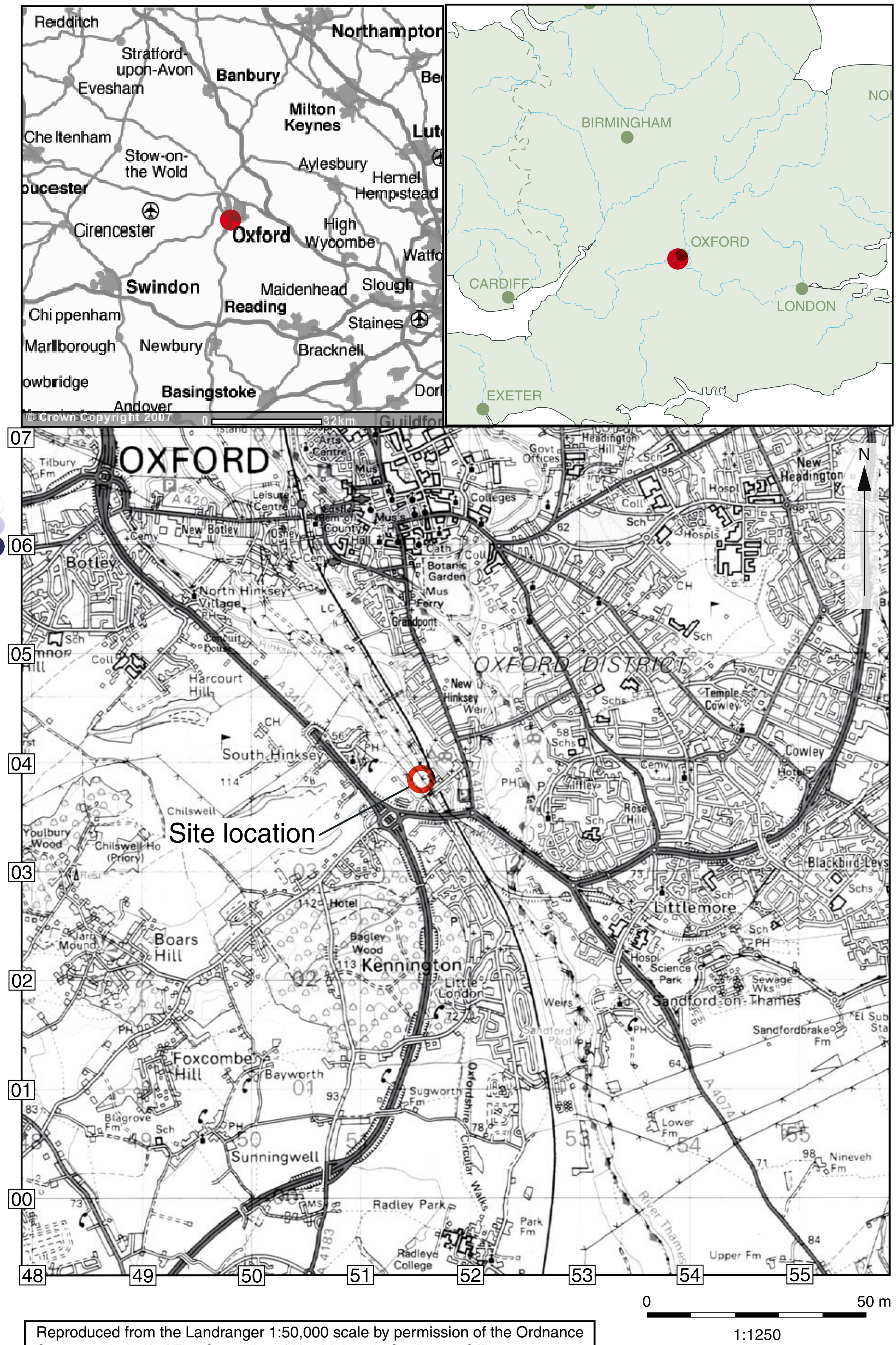


Figure 1: Site location

X:\Towles Mill hinksey\Fieldwork\010Geomatics\CAD\001current\OXTOWEX_100107.dwg(Figure 2)****evangelia.kappa* 15 Jun 2007

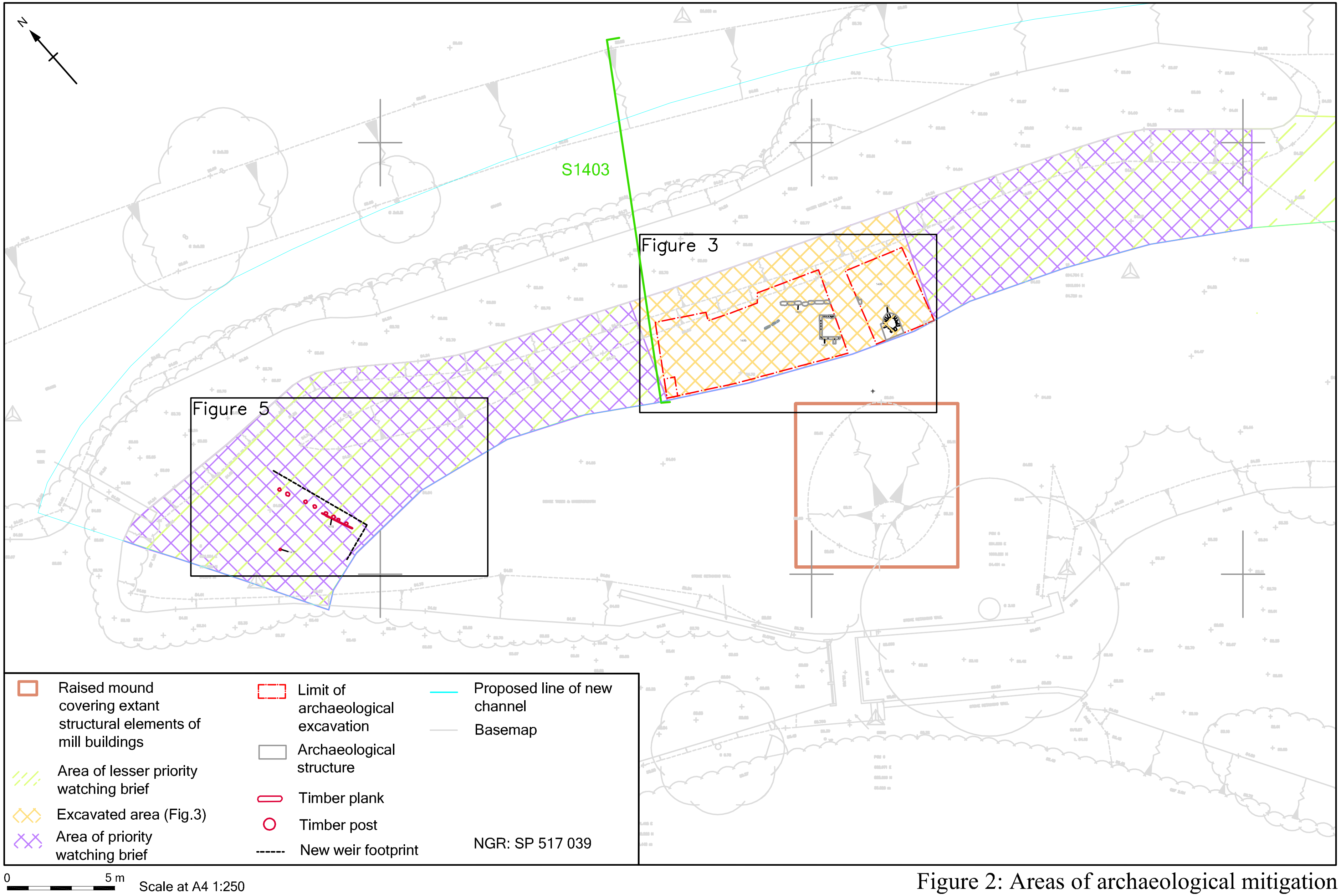


Figure 2: Areas of archaeological mitigation

X:\Towles Mill hinksey\Fieldwork\010Geomatics\CAD\001current\OXTOWEX_100107.dwg(Figure 3)****evangelia.kappa* 15 Jun 2007

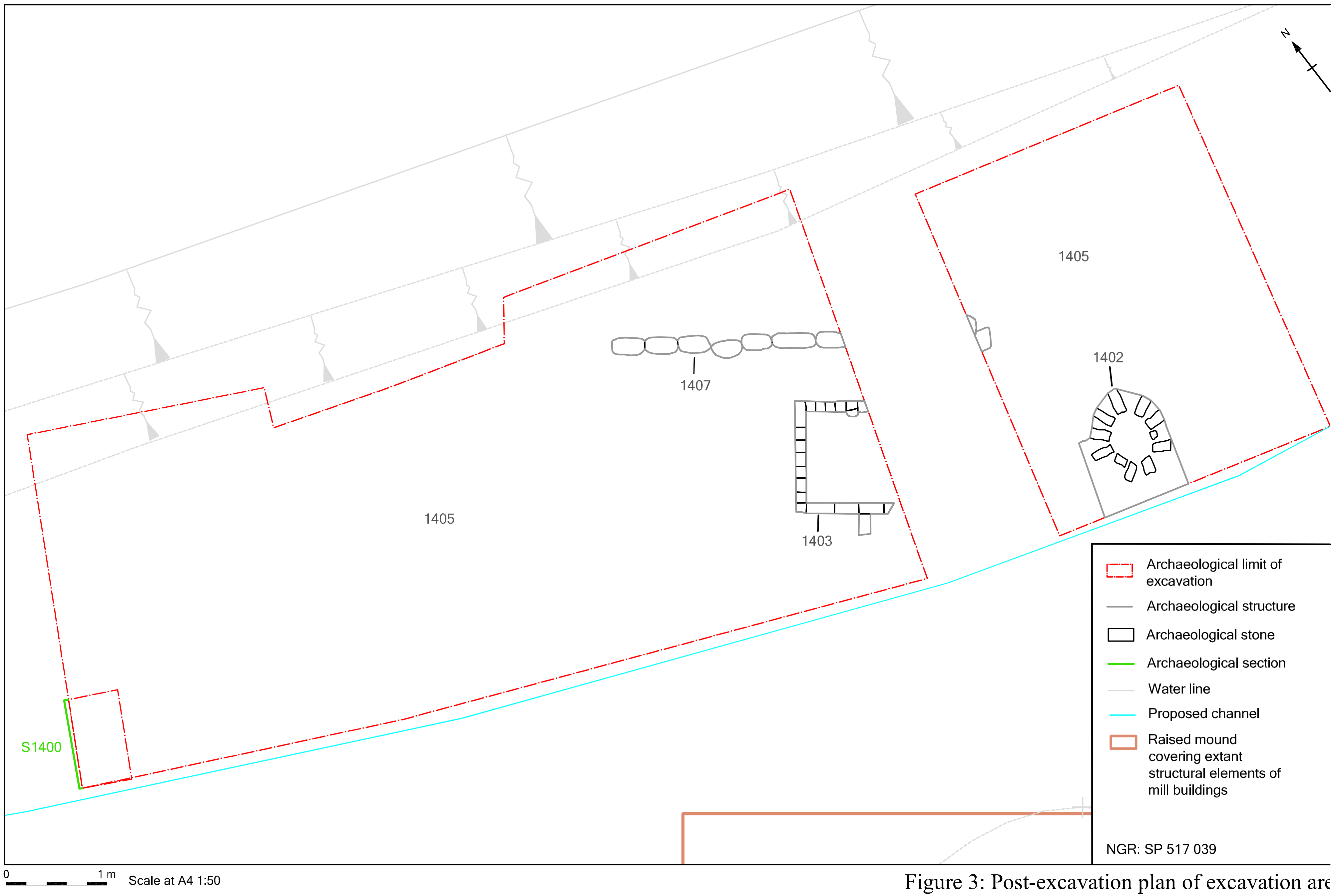


Figure 3: Post-excavation plan of excavation are

X:\Towles Mill hinksey\Fieldwork\010Geomatics\CAD\001current\OXTOWEX_100107.dwg(Figure 5)****evangelia.kappa* 15 Jun 2007

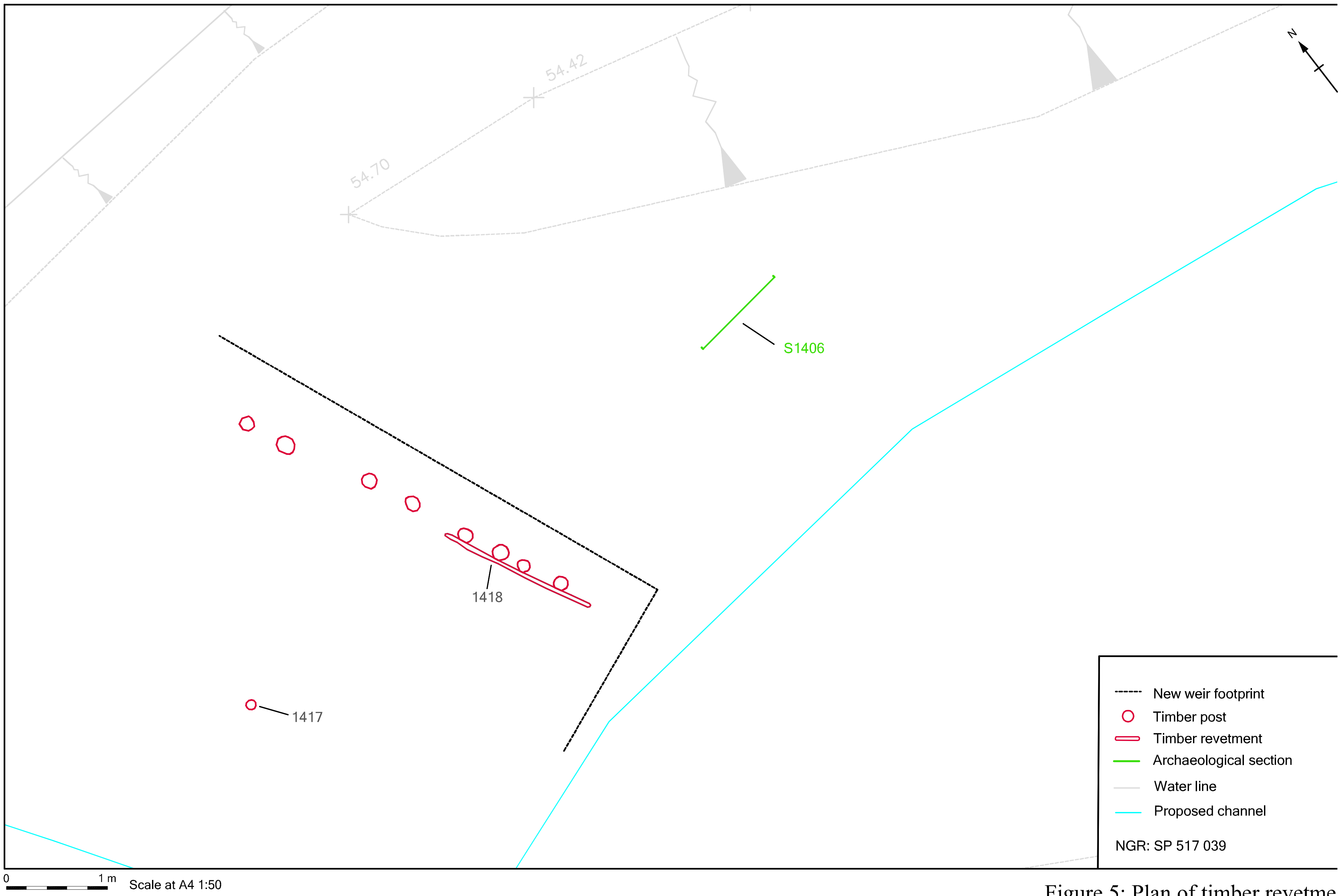


Figure 5: Plan of timber revetme

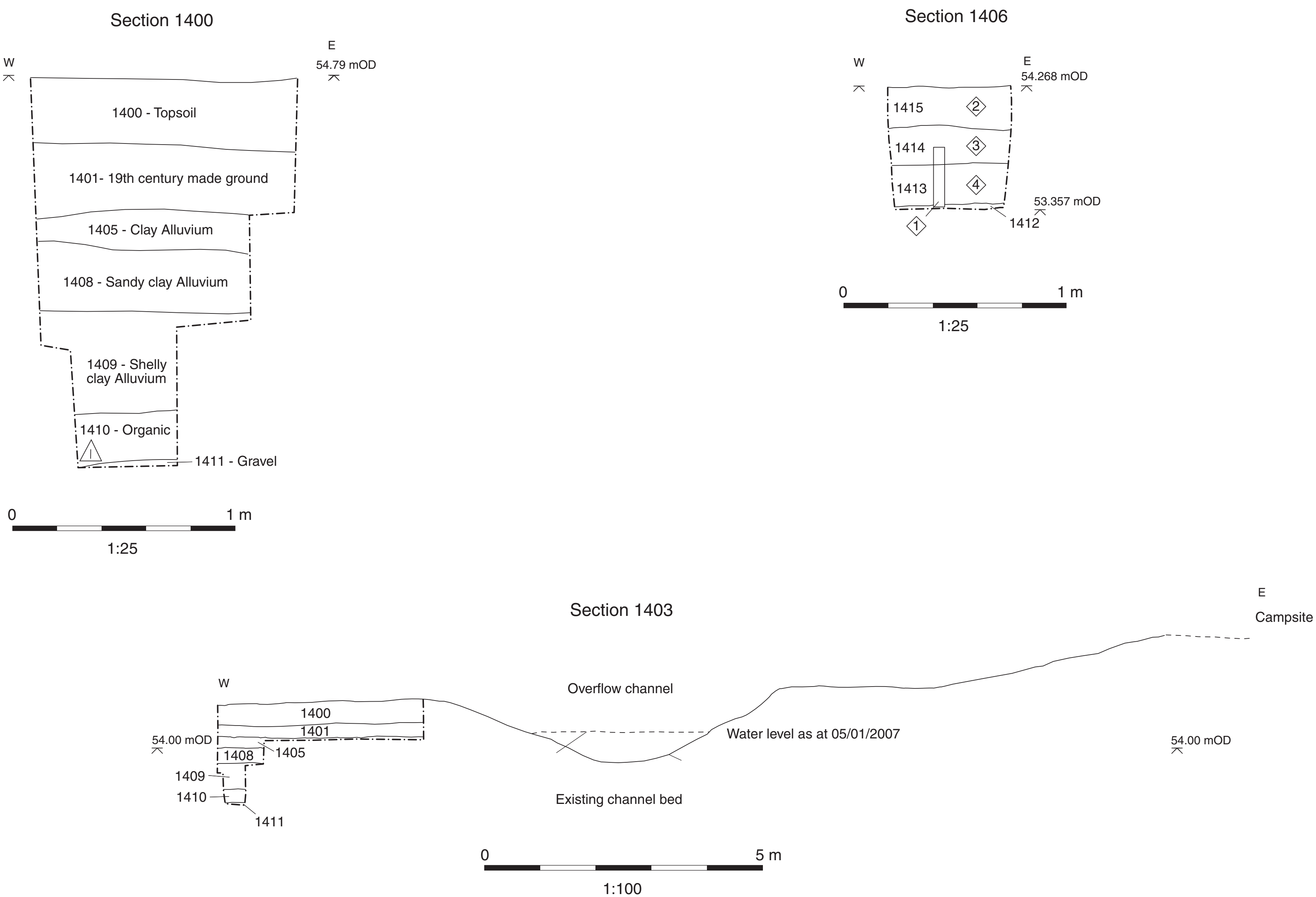


Figure 4: Section through Alluvial sequence and profile

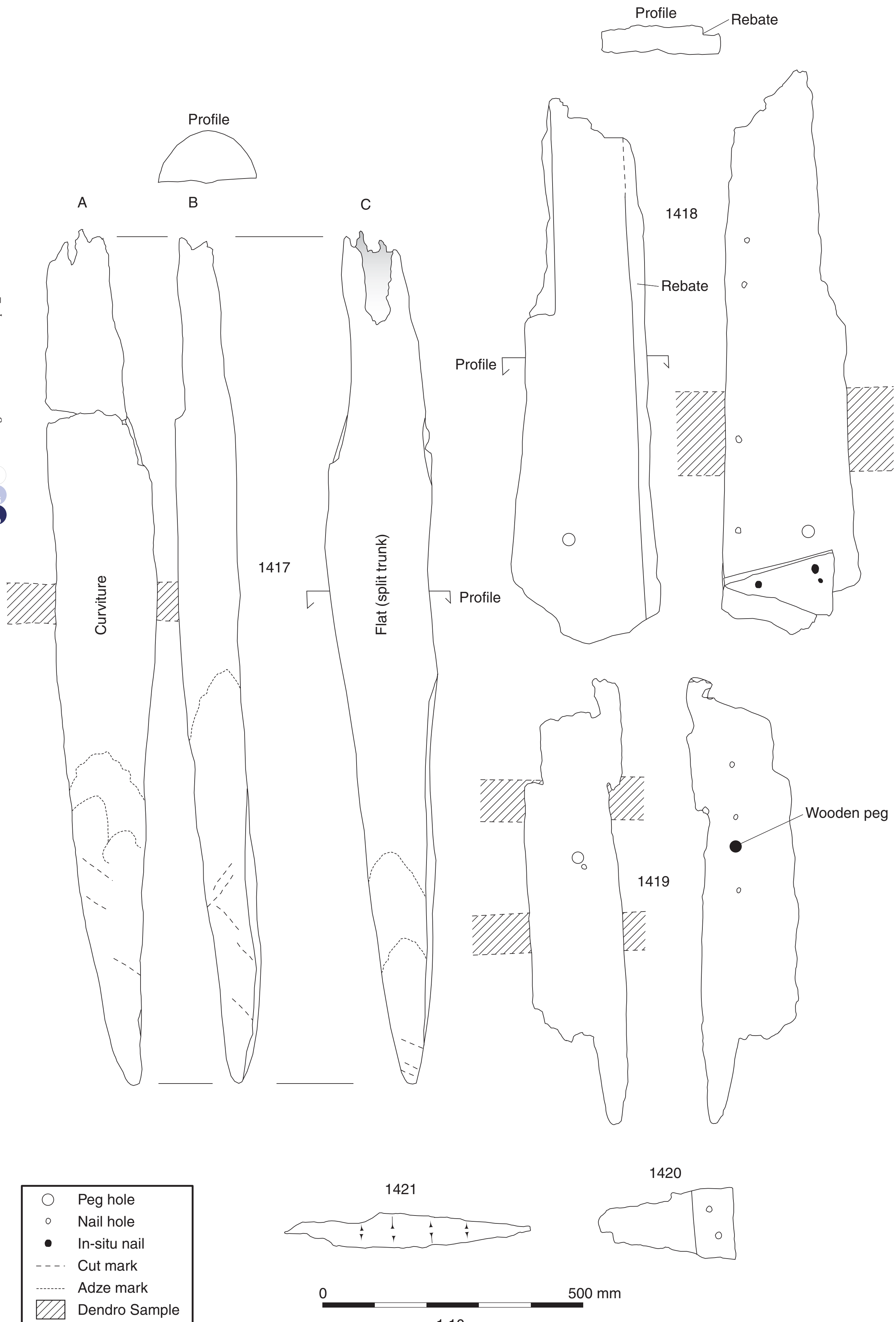


Figure 6: Timbers

Plate 1: Mill race, drained prior to deposition of concrete

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