

**EXCAVATION AT TOWN MILL,
HANBURY ROAD,
DROITWICH,
WORCESTERSHIRE**

ARCHIVE REPORT

**Andrew Mann, Laura Griffin, Derek Hurst, Elizabeth
Pearson, Suzi Richer and Martin Watts**



Excavation at Town Mill,
Hanbury Road,
Droitwich,
Worcestershire



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Excavation at Town Mill, Hanbury Road, Droitwich, Worcestershire

By Andrew Mann, Laura Griffin, Derek Hurst, Elizabeth Pearson, Suzi Richer and Martin Watts

With contributions by Roderick Bale, Nicholas Daffern, Geoffrey Hill, Peter Marshall, Nigel Nayling

Illustrations by Carolyn Hunt

Summary

An archaeological project (desk-based assessment, evaluation, excavation and watching brief) was undertaken at the site of Town Mill, Hanbury Road, Droitwich, Worcestershire (NGR 39050 26335). It was undertaken on behalf of CgMs Consulting working for McCarthy and Stone Retirement Lifestyles Ltd, who were developing the site (planning reference W/11/02666/PN) for housing.

Excavation was restricted to the footprint of the new build. Features relating to the mill and the canal (vaulted cellars, wharf side buildings and basin backfilled with early 20th century) were most in evidence. Five major medieval to later phases of mill construction were recorded, dating from the later 14th–20th century onwards, and could be correlated with the historical evidence for a mill at this location since at least the 17th century, being variously known as King's Mill (ie owned by the Crown), Frog Mill, and lastly Town Mill; historic building recording was also undertaken as part of this development on the surviving above ground remains. The lower levels of the site were waterlogged and this meant that the timber structures of the earlier mill buildings were well preserved. Though the floor levels of the earlier mills had been truncated by more modern mill phases, some of the principal components, especially the wheel/cog pits, and the mill pond, were much in evidence. Extensive sampling was undertaken for dendrochronology and radiocarbon dating, especially given the relative dearth of associated artefacts.

In addition, waterlogging ensured that there was a high potential for environmental investigation and so plant macrofossil and pollen analysis formed an integral part of the project, resulting in an unsuspected incidence of material indicating activities relating to textile working in this part of the medieval town. There was also a strong dung signature that might be best explained as arising from the mill being the focus for goods (ie grain/flour) being transported using horse haulage.

Mills are rarely tackled archaeologically as they are inherently difficult and also are usually protected from development by being on the flood plain and in the immediate path of the river. Such structures are also best regarded as machines rather than simply buildings and Droitwich Town Mill has, therefore, offered a relatively unusual opportunity to investigate mill workings evolving over time. The degree of preservation has enabled a picture to be reconstructed of a major structure in a constant state of repair and redesign, and, therefore, with investment to allow its valuable location on the edge of the town to be fully exploited as efficiently as possible.

Results will also be published in the Transactions of the Worcestershire Archaeological Society.

Report

1 Background

1.1 Reasons for the project

An archaeological excavation was undertaken at Hanbury Road, Droitwich, Worcestershire (NGR 39050 26335) (Fig 1). It was commissioned by CgMs Consulting (the Client; Cathy Patrick) on behalf of McCarthy and Stone Retirement Lifestyles Ltd, who intended to develop the site, for which a planning application had been submitted to Wychavon District Council (planning reference W/11/02666/PN).

A desk-based assessment (DBA) for the site had been prepared (CgMs 2012) which concluded that the site had a moderate potential to contain remains of Roman to post-medieval date, although that potential had been affected by the construction of the Droitwich Junction Canal in 1852. The archaeological background to the site is set out in the desk-based assessment and extant, post-medieval mill structures had undergone archaeological building recording prior to their demolition in 2012 (Tyler 2012).

A watching brief had been carried out in the central part of the site in 2012, which revealed the remains of the canal and mill pond (Wessex Archaeology 2012) and it was agreed with Mike Glyde (Historic Environment Planning Archaeologist, Worcestershire County Council) that an archaeological evaluation (3 trenches) of the western part of the site was appropriate to assess the survival of any archaeological remains (Fig 2). These identified remains of the canal and basin but also suggested that earlier remains of the town mill lay below the recently demolished post-medieval buildings. Detailed evaluation reporting was not undertaken due to construction timetable pressures, and so it was agreed between CgMs Consulting and Mike Glyde that a 20 x 20m excavation area be opened over evaluation Trench 3 based on a written scheme of investigation (Worcestershire Archaeology 2013), in order to target remains of the town mill where they fell within the building footprint of the proposed development. The excavation fieldwork was undertaken between 14 January to 23 February 2013 with a watching brief 25 February to 1 March 2013. This fieldwork has been registered by the Historic Environment Record with the reference WSM 47458. This report follows the completion of all the site fieldwork and follows an assessment stage (Worcestershire Archaeology 2014).

2 Aims

The aims of the excavation were:

- to excavate and record any archaeological remains within the footprint of the proposed building where they were likely to negatively impact on any buried mill structures.

3 Methods in general

The project was undertaken in accordance with the following requirements:

- *Standards and guidelines for archaeological projects in Worcestershire* (Historic Environment and Archaeology Service, dated December 2010);
- *Manual of Service Practice: Recording Manual*, 2012, Worcestershire Archaeology internal report, 1842. Of particular importance here are the Finds recovery policy, and Guidelines for environmental sampling;
- *Manual of Service Practice: archiving*, 2007 as amended, Historic Environment and Archaeology Service, Worcestershire County Council, internal report, 1582.

And the IfA standards and English Heritage (now Historic England) guidelines as cited below.

3.1 Documentary research

Prior to fieldwork commencing a desk-based assessment was undertaken by CgMs (2012). This included the results of a map regression exercise and Historic Environment Record (HER) search.

3.2 Fieldwork strategy

Following evaluation in late 2012 the area of excavation was centred on evaluation Trench 3, and its precise location was carefully considered based on existing archaeological information, the new building footprint and site constraints (Fig 2). The excavation area covered approximately 400m² and was based on a written scheme of investigation (Worcestershire Archaeology 2013), which was approved prior to implementation by the Planning Archaeologist for Worcestershire County Council.

Following removal of the overlying concrete slab and underlying hardcore by machine (the latter removal was undertaken using a toothless bucket and under archaeological supervision), excavation was undertaken on the basis that:

- clean surfaces were inspected;
- all deposits were fully or partially excavated to determine their nature and to retrieve artefactual material and environmental samples;
- recording of deposits was undertaken (however the speed of excavation and timetable to clear the site required a lot of the recording to be done later in the office); in general it followed standard Worcestershire Archaeology (WA; 2012) practice, and more specifically the standards of the Institute of Field Archaeologists and the guidelines of English Heritage as cited where relevant below;
- the sampling level for context excavation was undertaken to meet the aims of the Brief, subject to site conditions and safe/practical accessibility of deeper deposits (ie unstable ground was encountered due to the depth of deposits and the rapid ingress of water since the site was situated within the former river-bed and well beneath the water-table, and with the works being undertaken in the winter).

WA specialist staff in artefacts and environmental remains attended for on-site advice. Sampling on-site has been carried out on highly selective basis to ensure there should not be any archive deposition issues to contend with, and included on-site dendrochronological sampling by Nigel Nayling (University of Wales).

Exceptionally, for this project, great dependence has had to be placed on the photographic recording due to the need for rapid working in very difficult ground conditions, and this was supplemented by specialist photography (Adam Stanford), who created 3-D images of the main timber mill structures *in situ*, principally as an aid to analysis.

The Curator visited on several occasions, and the EH regional scientific advisor also made a visit at a time when *in situ* timber structures began to emerge in quantity (ie well beyond those seen during evaluation).

No reinstatement of the site was required.

Watching brief

On the completion of excavation a watching brief was maintained on subsequent groundworks in the vicinity of the excavation site when this was being prepared for piling. This mainly monitored the removal of the deeper brick foundations and the last (most modern) wheel pit.

Standards

The fieldwork was in accordance with the *Standard and guidance for archaeological excavation* (IfA 2012), and the *Standard and guidance for an archaeological watching brief* (IfA 2008).

3.3 Personnel

The project was led in the field by Andrew Mann, and managed by Derek Hurst, who edited the report.

3.4 Statement of confidence in the methods and results

Although it is felt the report has established a reasonably accurate model for the life of Droitwich Mill, a number of important archaeological sequences were difficult to establish on site and during post-excavation analysis. Due to the conditions and limited time on site it is also possible that a number of important archaeological features and relationships were missed during the excavation. Having undertaken the project the following comments may be made with regard to the methods adopted.

- By not completing the evaluation report it is felt that the potential of the site and complexity of the area was not fully established early on. This obviously had implications during the excavation which proved far more complex and extensive (both physically and temporally) than had been thought.
- It was also felt that, by confining the excavation into the set building programme, this limited the available time on site, as it hampered the reassessment of the excavation strategy in response to the increasingly complex stratigraphy under difficult excavation conditions.
- By confining the excavation area to the limits of the proposed new building footprint and, therefore, to the impacts of the new build, the interpretation of the structures became impeded. Although on many excavations this method is often employed, for watermills the buildings and structures are inherently linked and can only be fully understood in association with more extensive water management systems. By only focusing on the main mill building, this focussed archaeological attention on where truncation and disturbance was potentially at its greatest, and limited the chance to offset this by understanding better the integral and evolving water management systems over time. However, the wider area beside the watercourse has not been impacted by the new build and may, therefore, be investigated during any future development. Though it can be suggested that, in future, excavation at mill sites should deliberately include the wider area around the mill building itself, so that more associated structures (channels etc) can be investigated in greater detail.

4 Site background

The site is situated between Hanbury Road to the south and the River Salwarpe to the north and is underlain by Mercian Mudstone, and lies at 28.80m AOD, c 2m higher than the adjacent River Salwarpe (Fig 1). Geotechnical survey identified up to 3m of soft alluvial clays in the south-west corner of the site. It lies in the designated Conservation Area of the Droitwich link Canal and also forms part of the historic town core. Historically it lay either in a detached part of Dodderhill parish or in Witton St Peter's parish (*vide* Bassett 2008, 222, fig 2; the former detached area, given its shape, being an island in the river, mostly likely formed by a channel associated with a mill).

There is no HER record of earlier prehistoric activity in the immediate area but waterlogged peat deposits, dating from the Mesolithic, have been identified approximately 600m to the east. Iron Age and Roman and later remains, which are often associated with salt production, are widely

encountered in Droitwich. During the Roman period the administrative centre for the salt industry appears to have been at the Bays Meadow villa complex, approximately 600m to the west. Evidence for pre-medieval activity survives particularly well in Droitwich as alluvium laid down by the Salwarpe from the 7th century has buried earlier remains providing good preservation, including widespread waterlogging of deposits.

A mill is first recorded here from the medieval period when it was known as 'Frog Mill' (also by the alias, 'King's Mill', indicating its royal status), and it was situated at the eastern edge of the town, the main urban core being along High Street and Friar Street. Since 1786 a good cartographic record of the site was available, showing the mill expansion and arrangement of associated buildings. The cartographic evidence reveals a major phase of redevelopment affecting the mill and the River Salwarpe when the Droitwich Junction Canal was constructed in 1852.

The site, therefore, could be demonstrated to lie in close proximity to known archaeological remains, the high quality of some of which was reflected by scheduling by English Heritage.

5 Structural evidence (by Andrew Mann)

5.1 Methods of structural analysis

Field records were all checked and a stratigraphic matrix produced. However, the analysis stage was generally associated with a far higher level of uncertainty than usual, as there were very few contexts with *terminus post quem* (*tpq*) dates based on artefactual data. These dating limitations were also hindered by difficulties encountered with the scientific dating programme, as some radiocarbon samples failed to date on repeated occasions (potentially revealing a previously unobserved impact of the saline conditions). Numerous dendrochronological samples also failed to date, partly because many proved to be elm, but also because there was a high incidence of undatable oak despite the massive size of some of these timbers. Overcoming these issues as far as possible has meant that dating the archaeological sequence has taken longer than usual to realise during post-excavation analysis. None of these specific dating issues could have been predicted during the assessment stage, though future projects may now be able to take advantage of this experience when planning similar projects in future.

The scientific dating programme at Hanbury Road has comprised both radiocarbon and dendrochronological dating. All radiocarbon determinations have been calibrated using the intercept method to provide a single date range at 95% probability, and these calibrated dates are used throughout the text. The original measurements are found in Appendix 3. A further stage of Bayesian chronological modelling has been undertaken in situations where we have additional 'prior' information, such as stratigraphic relationships, or known numbers of tree-rings between samples. The models allow 'posterior density estimates' to be produced, which at a basic level are more precise date estimates (Bayliss 2009). Any modelled dates are presented in italics throughout the text. Details concerning the calibration and modelling undertaken are presented in Table 7.

The main timber structures were context grouped (CG) and where possible assigned to a numbered mill sequence (schematically explained in Fig 64), and other features are referenced below by their cut/layer numbers. All structures are shown combined on Figure 3.

5.2 Phase 1: Pre-medieval evidence/?Bronze Age

The earliest remains were re-deposited pottery sherds of Bronze Age and Roman date. A single sherd of Bronze Age pottery was found in an alluvial deposit (506) between palaeochannels (505) and (472) on the north side of the excavation area (Figs 4 and 11), and potentially in context. Other pre-medieval artefacts were residual Roman pottery sherds (heavily rolled by water action) in a number of fluvial deposits of medieval/post-medieval date.

5.3 Phase 2: water management (late Saxon/Saxo-Norman)

The earliest feature was a channel (505; 2.40m wide (min) and 1.05m deep) which was aligned north-east to south-west in the north-east corner of the excavation (Figs 4 and 11). Only its southern edge was visible, and this was near-vertical, breaking sharply to a flattish base, suggesting it was man-made. A single roundwood, chisel point, stake (510) was driven into the natural clays (616) and gravels (615). The channel was filled with soft, but cohesive, greyish brown silty, organic clays of fluvial origin. Radiocarbon dates show the channel infilling between cal AD 970–1150 (504 ie base) and cal AD 1320–1440 (502 ie top) (95.4% probability).

This channel suggests that some form of water control and management was ongoing from about the late 10th–12th century. Without further evidence it is difficult to suggest a definite purpose, however, given the presence of later mill structures at this location, this channel seems very likely to have been a leat or diversion channel for an earlier, unidentified, mill preceding Mill 1.

5.4 Phase 3: Mill 1 (CG1; later 14th century) and its use (to 16th century)

The partially surviving ground-frame of a timber-framed building (CG1; Figs 5–8) was the earliest structure on site, and was dated dendrochronologically to spring AD 1371 (timber 523). Given its position, this was interpreted as part of a mill situated on the north side of a channel (535; ?former course of the River Salwarpe) flowing east to west through the site. Though this channel was not certainly assigned to this phase, it fitted the stratigraphic sequence as a distinct possibility, as the terracing seemed to be aimed at locating a structure on its edge.

The terracing (472) on the north edge the main channel (535) was between 2.60–4.00m wide east–west, with a near-vertical north edge that broke sharply to a flat base, indicative of having been hand-dug (Figs 4 and 11), and was widest around Mill 1, suggesting they were contemporary, the channel edge, therefore, having been modified at this location to provide a flat platform for building on. The platform and Mill 1 were c 0.70m above the latest position of the base of channel (535 ie the basal fills were at least 100 years younger than Mill 1 and so the channel may have been modified/deepened in the intervening period).

The timber ground-frame (CG1) consisted of two sill beams (520 and 523) forming a right-angle at the north-western corner (Fig 5) and, therefore, being a remnant of a rectangular ground-frame (now truncated – see below). The shorter sill beam to the west (520) appeared to have been secured in place with a vertical, quartered, pencil point stake (521). Displaced timbers (518 and 519) located to the south-east of CG1 may have been associated with this structure (ie disturbed during the construction of Mill 2). On the top side of the ground-frame there were two vertical squared posts on the northern side of the structure, one on the north-west corner (522) and one (524) 2.15m to the east. Both had been jointed using unpegged mortice and tenon joints, and the two sill beams (520 and 523) and corner post (522) were joined using a bare-faced lap dovetail and a notched tenon (comparable to a wall plate/tie beam/wall post configuration). The main ground-frame timbers (520, 522, 523 and 524) were all oak of box heart conversion and other than secondary axe marks at the eastern end of timber (523), where it had been cut through during dismantling, no other tool marks were recorded. The footprint of the surviving ground-frame measured 4.25m long x 1.03m wide (internal), but these are just minimum dimensions as the structure was truncated to the east and south. The main structure was relatively flat although there was an approximate 250mm drop from the east to the west, creating a 1:18 slope, and so it seems to have been deliberately sloped during construction.

At the base of the ground frame gravel was observed to have moved: firstly under the front of the surviving frame some scouring had removed gravel at its upstream end, whereas a bank of gravel (630) had built up at the down-stream end up against the mill during high energy flooding. These observations may give a clue to the ultimate demise of this mill.

Leat 505

Dating from the upper level of the infilling of this channel implies that it finally went out of use soon after the commissioning of Mill 1, presumably because other arrangements were made at the same time to bypass this new mill in keeping with a new position/design.

Feature 472

A large cut immediately upstream of and around Mill 1 was also infilled with deposits of similar date to the final infilling of leat 505 based on a combination of finds and radiocarbon dates. Only one edge of this large feature (472) was observed in section (Fig 21), and it is suggested that its infilling was contemporary with Mill 1 construction, and part of it, presumably to stabilise this part of the structure.

Main river channel and possible position of water wheel

Stratigraphically, and in light of the limited dating available, it is most likely that channel (535) was active during the life of Mill 1 and fed its water wheel (Figs 9, 11, 21, and 64). It was a maximum of 1.90m deep (bgs) and was filled with waterlogged dark greyish brown organic silty clays containing occasional organic material. The base of the channel was undulating and sloped down to the east (ie upstream), dropping approximately 0.35m over 5.00m suggesting that its base may also have been artificially deepened in an effort to generate more power, cutting through both the natural sand and gravels (615) and underlying reddish orange clay natural (616). The dimensions of channel (535) suggest it could have accommodated a water wheel of c 1m width, which would have been attached to a mill c 5m across (N–S) given the known ground frame position.

However, the basal fills of this channel would necessarily represent decline/disuse of Mill 1 and given their location might be deliberate fills associated with Mill 2 construction or at least supplemented for this purpose - they provide a *tpq* of about 16th century - and so are discussed in more detail in phase 4.

Discussion of Mill 1 building use

Though the ground-frame of a late 14th century mill was identified, the mechanisms behind its use remained somewhat unclear, as the frame only very partially survived and no definitive timber-lined head or tail race structures were seen. As a result it was also not possible to confirm the position of the water wheel during this phase. It remains unclear as to whether water would have fed a wheel internal to this structure, or whether the wheel was outside this frame, and so within channel (535) or a precursor to the south. With the latter scenario the frame would represent the ground floor, or a sunken cellar, or the sunken structure could have been intended to anchor the mill building, as in the case of its successor, Mill 2, which had been partially sunk into the fluvial clays, probably to aid water flow but also possibly to reduce the chances of the whole mill being swept away in a flood.

These two scenarios may be summarised as follows:

1. That the fill of channel (472) represented the continuation of what sealed the ground frame and had been re-deposited around Mill 1 to anchor it in position. In this scenario the water wheel would have been external to the main structure, in the main southern channel (535). This is considered here to be the more likely, as the mill will have needed firm foundations to avoid being moved during operation and to resist the effects of flooding, and, indeed, the same principal was applied in Mill 2 (see below), which, to make the point, is set on even larger and deeply sunk timber foundations.
2. That both ground frame and channel (472) were open throughout and eventually became buried by the silting of fluvial deposits. The close correlation between the dendrochronological date of timber (523; Spring AD 1371) and the lowest radiocarbon date from fill (475) (cal AD 1400–1470) could, in this case, suggest that natural silting of the channel began soon after the mill was constructed in the 14th century, which would suggest a very poor design or at least poorly maintained mill. An internal wheel would be more likely in this case, as there was no hindrance to water flowing straight through. In terms of the known mill sequence this would

also necessitate a long hiatus before Mill 2 was built, and seems inherently unlikely given the favoured location of this mill at a busy town.

5.5 Phase 4: Mill 2 (CG3) and its use (late 16th/early 17th to late 17th/early 18th century)

It is clear that Mill 2 construction (CG3) severely truncated Mill 1, which was largely removed as it occupied much the same position as the new mill. It comprised two mill elements, the mill building and the wheel trough which, together, formed the most extensive surviving timber mill structure on the site.

The specific sequence of events between Mills 1 and 2, however, could not be fully elucidated with certainty. For instance, it remains unclear how much material had been deposited in channel (535) prior to the digging of a large construction cut (489) to accommodate Mill 2. It is however known that this construction cut penetrated to the full depth of the deposits in channel (472), thereby necessitating the removal of the majority of Mill 1, except where they lay beyond the footprint of the new mill. This construction cut (489; Figs 9–21) was only observed in a couple of isolated places during the excavation but it appeared to have vertical sides and a flat base and measured a minimum of 10.0m long (E-W), 6.5m wide (N-S) and up to 1.20m deep. The basal fills (534/497 and 577/600) of channel (535) do not appear to have been removed as part of this construction, although they are likely to have been heavily disturbed during the construction process (Figs 11 and 21). They incorporated non-structural timber 590 (dendrochronological date AD 1469–1505 from the base of the channel) and pot with a 16th century *tpq* date, which was all compatible with the dating of *cal* AD 1570–1635 (95% probability; *felling*) for the new structure based on chronological modelling (Table 8).

Mill building

In the base of construction cut (489), straddling channel (535) and sitting on the natural clay (616; ie this structure was founded on the stratum below (615) gravels), there were two long elm timbers (525 and 526) aligned north to south (Figs 10, 13–14 and 19). These were 6.37m long and box hearted, but had received minimal finishing to square them (other than on their top side and along the faces) which had been joined using three oak pegged slip tenons, creating a combined width of 0.65m. They are thought to have acted as support timbers for the new ground-frame and the building above, stopping these from sinking into the soft channel fills and clays. They may also have been carefully positioned so that the eastern end of the timber frame was higher to give a fall of water to drive an undershot wheel. As the lower fills of channel (535) were not removed during the construction of Mill 2 it is thought that this channel had been abandoned and was no longer suitable to feed a water wheel.

The ground-frame of Mill 2 (CG3) consisted of three sill beams (488, 568 and 570), the eastern end of which rested on the support timbers (525 and 526) mentioned above. The ground-frame was aligned east to west and measured internally 6.18 long (E-W) x 5.57m wide (N-S) (Fig 10). The two north to south aligned sill beams (568 and 570) were oak and were joined by a slightly smaller elm sill beam (488). The latter sill beam had been chamfered on the inner upper arris and formed the north side of the ground-frame. The southern limits of this building are not known as the southern side of the ground-frame appears to have been removed during the construction of later buildings. The two north to south aligned timber sill beams (568 and 570) were very large, measuring 4.43m and 6.0m long respectively and 0.59m wide and 0.59m thick (Fig 20), although (570) was not fully exposed, as it remained beneath a brick wall (408) and was left *in situ*. The timbers of the ground-frame were joined at the north-east and north-west corners by unpegged slip dovetail tenons, of elm, that remained attached to timber sill (488) when the frame was dismantled.

On the top side of these timbers were a number of mortices that would have held square posts, three of which (516, 517 and 566) survived *in situ*, around 2.00m apart, along the northern side of the ground-frame. Other mortices, to hold posts, were positioned on the top side of timber (568). The first was located 1.20m from the north-east corner, and further south two others were spaced

0.52m apart (Fig 10). Between these three deeper mortices there were shallower and longer mortices of unknown function. On the inner side of timber (568) there were four corresponding mortices at the same spacing as those on the top side. The northerly mortice held sill beam (488) and the remaining three are thought to have held floor joists, no longer *in situ*. Opposing mortices to hold the floor joists were also present, on the inner side of the opposing sill beam (570). Although not observed, due to this timber remaining *in situ* beneath a wall, it is expected that similar spaced mortices would have also been present on the top side of timber (570).

The internal floor joists would have rested on reused oak timber (551) which has been dendrochronologically dated to AD 1553 (Figs 10, 13 and 19). The timber had been reworked to provide beds for the joists to sit on. Other peg holes and mortices in this timber were also observed but no longer functioned with the timber in its final position, showing that it had been re-used.

Across the top of northern sill beam (488), between posts (566, 516 and 517) there was a greyish blocky sandstone, regularly coursed wall, bonded with clay (432) (Figs 15–18,). This had been faced on the inside and was undressed on the northern outside edge. The outside face of the wall had been pushed into fills (473, 474 and 475) of channel (472) for added support. This also implies that the building ground-frame and lower walls were subterranean, probably for strength and solidity. It remains unclear however whether all of the walls of this structure were constructed of stone in the same way as (432).

Wheel pit

The spacing of the mortices on the top side of this ground-frame suggests that there was an internal wheel trough on the northern side of the mill (Fig 64). The gap between the northern wall and the first southerly post/floor joists mortices suggests that this trough was 1.20m wide. The lack of a substantial east to west aligned sill beam on the southern half of this proposed wheel pit suggests that this wall would have been constructed of timber rather than stone. The lack of associated breast-work (a structure to raise the water level in relation to the bottom of the wheel) also suggests that the water would have flowed directly into the trough to an undershot wheel. The incline of the ground-frame which drops 0.30m over the length of the building, approximately 1:18 (the same as Mill 1) would have sped up water flow through the trough (Fig 15).

Disuse

The presence of fluvial deposits (484, 485, 486 and 487) within Mill 2 and its probable wheel pit suggest that it had become abandoned. These deposits contained pottery and CBM of 16th and 17th century date providing a *tpq* for the erection of Mill 3 (see below) whose construction trench cut through these deposits (Fig 21).

5.5.1 Mill2/3 association uncertain

Timber 588

Approximately 0.50m to the east of Mill 2 (CG 3) structure lay elm timber (588; 3.7m long and 0.25 wide) (Figs 23–4) at the same depth as the timber sill (568) of Mill 2 (CG 3) and also aligned north to south. On its top side were four half mortices for bare faced tenons, spaced 0.90m apart. At the base of these mortices on the western side was a single red snap line, probably of chalk, that ran the length of the timber to mark the depth of the mortice cuts. No mortices were visible on any other side of the timber, so it is unclear how it was jointed to other timbers. It is also unclear whether this timber was *in situ*; it may be a reused and related to CG3, perhaps forming part of a bridge or debris grille.

Timber 569

A single sill beam, box-hearted oak timber (569; 3.20m x 0.27x 0.25m) with flanking stakes only partially survived (Figs 23 and 25) orientated on a different alignment to other timbers. On its side there was a 0.04m wide, 0.10m deep stave groove had been cut with right angled sides to allow vertical planks to be inserted, to form a wall. On its eastern side there were three mortices to hold unpegged timbers (joists) at right angles to the wall. The mortices had been numbered with

carpenter's marks 'I', 'II' and 'III' suggesting that it was constructed away from site and marked for site assembly. On the western side towards the southern end of the timber was an angled slot, a halving to holding a timber (possibly a passing brace) at 45°, again with no peg holes. The spacing of the mortices, the length of the stave slot, and the lack of a corresponding angled slot on the northern end of the timber suggest this end had been cut away. This timber appears to have been fixed in position by five small round wood stakes (582, 562, 563, 564 and 617) running along the western and eastern sides of the timber, suggesting it was *in situ*, though it was clearly being re-used. It appeared to be a sill beam of a dismantled ground-frame, and may pre- or post-date CG2, but given how little survives it is likely to pre-date it. The building technique evidenced may also support its earlier dating.

Timbers 550, 545 and 546

The largest (550) of 3 timbers (550, 545 and 546) was aligned in an east to west direction towards the south of the excavation area (Figs 23 and 26–8). It had clearly been disturbed from its original position and was a reused timber, as there were four mortices on the bottom side of this timber that could no longer function in its final position. On its top side there was a long mortice that may have originally held a timber brace, but in its current position it held a smaller tenon of a vertical post (549) (Fig 26). At the northern end of (550) half of the timber had been cut away to form an unpegged bare faced tenon or half-lap joint. Although clearly reused the timber had been levelled and supported by two elm blocks (545 and 546) at its eastern end (Fig 27). Phasing of this timber is again difficult, although as timbers (545 and 546) rest on the support timbers (525 and 526) of Mill 2 it must post-date the demolition of Mill 2.

A few centimetres below this timber was also another timber (548), again not *in situ*, that may also have been used as support for timber (550). This had a long, longitudinal mortice through the centre of the timber and six wedges at the southern end (Fig 66). It is possible this formed part of the mills internal mechanism, possible part of a tenter beam frame (Fig 29). The pegs in the mortice would have been used to adjust the height of the runner stone. Timbers (550), (549) and (548) have all provided similar dendrochronological dates of the mid 15th century and it is likely they originate from the same structure, possibly Mill 2, although it is unclear quite when they were moved to their final position.

5.6 Phase 5a; Mill 3 (CG7) (17th to later 18th century)

During this phase there is a move away from timber-frame construction and the mill was now built using sandstone ashlar blocks (Fig 30), at least for its lower part (ie a sill wall could still have supported a timber-framed building above). It is likely that during this phase the majority of the outer posts, walls and internal timber floors of Mill 2 were removed, to allow for rebuilding in stone. In width the new mill retained the same dimensions as Mill 2, but it is uncertain whether this was the case N–S, as too much of Mill 3 had been truncated.

It is also possible that Mill 3 incorporated elements of Mill 2, specifically wall (432). As at this time the wall appears to have been repaired on the north-east corner after the removal of the corner post of the Mill 2. The full extents of Mill 3 were not established due to later disturbance but it is estimated to be around 7.50m long (N–S) x 4.40m wide (E–W). Four main parts of the mill survived: a wheel pit, an eastern wall, a mill pond and a tail pond. This time a new design was used where power was generated from a head of water rather than just the flow in the river channel.

Wheel pit

The best preserved part of Mill 3 was the wheel pit, which had survived truncation from the construction of the later brick mills, as it was sunk deeper than the rest of the building. The original cut for the wheel pit had vertical sides and a flat base and measured 1.90m wide and 1.30m deep. Across the base of the cut was a heavily compact clay and gravel bedding layer (480); up to 0.10m

thick) for a flagstone floor 0.08m thick (507) (Fig 21). This floor also acted as a foundation for the construction of the wheel pit walls which were made of unbonded green sandstone ashlar blocks up to 0.45m thick. In places later repairs or additions to the wheel pit used red sandstone blocks which in places had been bonded with clay (Fig 29, 32–3). Only the southern wall (453) of this wheel pit survived intact and only the eastern (597) and western (607) ends of the northern wall survived (Fig 34). At its deepest the wheel pit was 1.12m deep (min), 1.32m wide and a minimum of 6.20m long (measuring from the top of the breast work to the western limit of excavation). The northern ashlar wall (453 and 597) appears to have been located above the projected alignment of the southern wheel pit wall of Mill 2, suggesting it may have replaced an earlier timber wall.

At the eastern entrance to the wheel pit, at right angles to it, there were two unjointed timbers resting upon each other marking the beginning of the breast work. The lowest of these (543) rested on, but was not jointed to the sill beam (568) of Mill 2, though it had been levelled with oak wedges and any gaps between the two were packed with moss. The timber (4.34m long, 0.41m wide and 0.37m thick) was of oak, had been box hearted, and squared along its length. It appeared to have been held in position by the ashlar wheel pit walls, but it is unclear why this timber extended so far beyond the limits of the wheel pit (specifically to the south) (Fig 30).

Later, another timber (544) was inserted, although not jointed, lengthways into a slot cut into the top side of timber (543) (Figs 30 and 34–6). This timber (2.24m long, 0.32m wide and 0.25m thick) extended to the external edges of the wheel pit and is again thought to have been secured in place by the wheel pit's ashlar walls, through which a hole had been made to insert the timber through (Fig 35). It was made from box hearted elm, and at its ends on its top side were two mortices, which were located in line with the ashlar walls (453 and 597). These would have originally held posts, however the overhang of the cut, through ashlar wall (453) used to insert this timber, would prevent the insertion of a post in this position. As the northern mortice of this timber had also been partially cut through to reduce the depth of this timber across its top side by 50mm, it also suggests that it may have been recycled. The mortices on the top surface of timber (544) appeared obsolete at this time, and its top inner arris had also become rounded and smooth probably through water action.

To the west, in the wheel pit, sitting on the flagged stone floor (507) and butting up against timber (543) and ashlar wall (453) was a heavily concreted deposit forming a curved breast to the wheel pit (514). The breastwork curve suggests that the wheel pit contained waterwheel around 2.6m in diameter. A 0.91m wide groove through the face of the breast is likely to have been eroded by the wheel, suggesting it was of a similar width, around 0.40m narrower than the wheel pit. Behind the breast a 0.98m wide chamfer in the upper internal arris of timber (543) may have been removed to allow the wheel to turn more freely. Beneath the entrance to the wheel pit, directly below this arris a deep slot (0.70m wide x 0.06m) had been cut into the upper surface of the earlier timbers (525) and (526), but the purpose of this could not be established.

Mill building

To the east of the wheel pit the external ashlar wall (597) of the main mill building ran in a north–south direction for 3.90m. This wall was constructed using the same ashlar blocks as the wheel pit, but was shallower (1.00m deep) and without a foundation bed. The base of this wall sat at the same depth as the breast timber (543). At the northern corner of this building wall (597) formed a T-junction, part of this wall turning west to form the northern wheel pit wall, and the other part turning east, then curving towards the north-east (see leat/mill pond below) (Figs 30 and 37).

To the south-west corner of the excavation area there was another small length of heavily damaged ashlar block wall (619), resting on sill timber (570) of Mill 2 and sealed by brick wall (408) of Mill 5. This is believed to be the western limit of Mill 3 which, therefore, would have closely reflected the footprint of Mill 2. The majority of the southern side of this building is thought to have been truncated by later brick built structures, but it is believed to have been a minimum of 8.00m long (E-W) and 4.10m wide (N-S).

Internal to the main building, to the south of the wheel pit, there was a small area of flagstone floor (529; 1.20m wide and 2.80m long) using the same flagstones as in the wheel pit and so considered contemporary with Mill 3; it represents the earliest internal flooring to survive. These butted up against the southern side of the wheel pit wall (453) and were at the same level as the wheel-pit breast.

Leat/mill pond

Just to the east of Mill 3 there was a single course of four ashlar blocks (618). These were aligned on the north-east corner of this building, towards the wheel pit entrance. It is thought these would have been joined to wall (597) and formed a mill pond wall. A corresponding wall on the southern side of the wheel pit entrance was not identified, but as it was only a single course thick it could easily have been truncated by later activity. Given the shallow depth of this wall it is however possible it served a cosmetic rather than a practical purpose.

Tail pond/leat

To the north-west of the mill was another ashlar wall (437) only briefly seen during the construction of a water storage reservoir for use during the excavation. It appeared to be constructed using the same ashlar blocks as in the main building and was aligned approximately east to west. Although not confirmed, it is thought to belong to this phase due to the similarity of the construction. Its southern end is aligned with the western limits of Mills 2 and 3 and runs for approximately 7.80m to the west. It is possible that ashlar wheel pit wall (607) originally turned north to meet this wall to form a wide tail race or pond below the mill (Fig 30). Based upon the cartographic evidence this wall is thought to have continued in use as the northern tail pond wall until 1853, when the tail race was redesigned and confined in a vaulted brick culvert (see Phase 8).

Design of the mill wheel mechanism

The eastern entrance to the wheel pit and the breast work is complex. The breast sits 0.90m into the wheel pit, and between it and eastern mill wall (597) there is a flagstone floor (620), at the same level as timber (544). However, there is no opening or archway through this building's eastern wall (597) to allow water into the wheel pit. The main building wall (597) rises approximately 0.60m above the level of the breast work, which appears to be an original design as the ashlar wheel pit walls and eastern main building wall are keyed together. As the top of this wall (597) and the top of mill pond wall (618) were of similar heights it also suggests that water entered the wheel pit at least 0.60m above the breast, creating an approximate drop of 1.80m to the base of the wheel pit. Given the dimensions of the wheel and the curving breastwork, the water wheel is thought to have been of low breast shot type at this time.

5.7 Phase 5b; internal modifications (CG8, 9, 10) (late 18th century)

Towards the end of Mill 3 operation there is thought to have been a catastrophic collapse of the northern ashlar wheel pit wall (597/607). It is not thought to have been purposefully dismantled as it was replaced by wall (482) (Figs 38 and 32). The replacement wall (482) was slightly offset to the north of the original wall and was poorly constructed from unworked sandstone blocks, brick and ceramic building material in a sandy lime mortar. This would have supported the water wheel, whose shaft would have rested in a bearing, probably upon a sill beam lying on this wall. The wall measured 0.46m wide and 0.76m high, although it had been reduced in depth for the insertion of later piles from above. This wall is unlikely to have survived long, being so poorly built and is thought to have been a temporary measure to extend the life of the mill.

The earliest brick wall (623) is also of this phase and runs in an approximate east-west direction, through the middle of Mill 3, but does not appear contemporary to any other brick walls (Fig 38). Very little of this wall survived, as it had been heavily damaged by later activity but it had been constructed of hand-made bricks (230 x 115 x 65mm; 9 1/16 x 4 1/2 x 2 9/16 inch) bonded with a cream coloured, coarse sand lime mortar. On the southern side of this wall its face appears to

have been lined with a lime plaster skim (305). To the east this wall appeared to use flagstone floor (529) of Mill 3 (Phase 5a) as a foundation, while to the west a foundation layer of brick, sandstone and concrete up to 0.70m wide had been built butting up against ashlar wheel pit wall (453). Two large wooden blocks (491 and 622) had been built into this wall, both of which had mortices on their top sides to hold vertical posts (Figs 38 and 39–40). It is likely these wooden blocks supported machinery (most likely the hurst structure).

Immediately to the south of this wall, there was a line of stakes running in an east to west alignment consisting of eleven sawn and roundwood pencil-point stakes, a number of which had been reused, as associated peg holes and mortices no longer functioned in their current location (Fig 41). Towards the west of this alignment, it appears as if the concrete foundation (457) for wall (623), had moulded around posts (560, 559, 558 and 557), indicating they were in place prior to the wall insertion. The function of these timbers is not fully understood but given their location it is thought they may have acted as shoring during the construction of wall (457) or as piling to support it across a soft area.

To the north of the excavation area was another brick foundation (439; CG10; not illustrated), which used similar bricks to wall (457) suggesting they were broadly contemporary. This (439) consisted of two rows of unbonded bricks measuring (240 x 124 x 62mm; 9 7/16 x 4 7/8 x 2 7/16 inch) set on edge. These remains suggest an additional building measuring at least 10.0m long (E-W) and 3.90m wide (N-S).

5.8 Phase 6; Mill 4 (CG11, 12 and 13) (late 18th-19th centuries)

From this phase onwards the mill form and its development can also be traced in the cartographic records, as included in the historic building report (Tyler 2012), and the mill range and room names (*italicised*) cited below follow that report.

During this phase the water-related parts of the mill were remodelled and a new wheel pit, cog pit and mill pond wall were built, all constructed of brick. The old (ashlar-built) wheel pit of Mill 3 was abandoned and the western end was closed using ashlar blocks (621) (Figs 33 and 42) and the wheel pit purposefully backfilled with black and reddish brown silty clays containing frequent CBM, sandstone rubble (478, 479 and 480). Pottery and CBM from within these fills (478 and 479) was exclusively dated to the mid to late 18th century. Two pairs of sawn oak piles (435 and 434; Fig 43) were inserted in to the backfill of Mill 3 wheel pit. Their purpose is unclear, but is likely they supported a structure or wall no longer visible. Pottery and CBM from around these piles dates to the late 18th century, and have been placed in this phase due to their similarity with the stakes butting wall (623).

Wheel pit

The new east to west wheel pit subsequently remained in use, in some form, until the abandonment of the mill in 1947 (Figs 21, 42, and 45–6). The wheel pit walls were constructed of brick (210 x 116 x 70mm; 8 1/4 x 4 9/16 x 2 3/4 inch) in English bond with creamy white sandy lime mortar. The size of the bricks suggest that this mill was constructed in the late 18th or early 19th centuries after parliamentary legislation had affected brick sizes. These walls sat on a foundation course of unmortared large angular red sandstone blocks.

The wheel pit was 2.70m wide and 7.20m long (internally) with 0.60m wide walls (409) and (417). These walls were stepped, and in the eastern half of the wheel pit they were 2.0m deep with the internal depth of the wheel pit being 1.60m. In the middle of the wheel pit, approximately 4.10m from the top of the breast, in line with the western edge of the cog pit wall (461), the walls dropped 0.90m creating a 0.70m deep tail race. This ran for another 3.0m, where wall (409) turned to the north and abutted the ashlar block wall (619). The direction of the southern wheel pit wall at this location could not be established as it lay beneath deposits left *in situ*, though cartographic

evidence suggests that on the western side of the mill there was a tail pond, probably still utilising the ashlar wall (437) of Mill 3 (Phase 5).

At the eastern end of the wheel pit the breast work (614) was made from green sandstone ashlar block, possibly reused from the walls of Mill 3. The curvature of the breast suggests the wheel was around 3.7m (12ft) in diameter and up to 2.70m wide. Grooves in the face of the breast show that the wheel at some point had not run true, with the starts carrying the floats having rubbed against the stonework.

Cog pit

A brick-built cog pit (461; 2.5m long, 0.55m wide and 0.93m) was keyed into the northern wheel-pit wall (409) showing they were contemporary. It was constructed using the same bricks as wall (409) and with walls 0.40m thick (Figs 21, 42, 47–8). As with the wheel pit the walls of the cog pit sat upon a foundation course of red sandstone blocks. At the northern end were narrow brick steps that in places had become filled with concrete-like concretions creating a smooth face. These concretions also covered the base of the cog pit and created curved eastern and western ends. In the bottom of the cog pit there was a small drainage hole (0.25m x 0.13m) through wall (409) back into the wheel pit (Figs 22 and 48).

Mill pond

To the east of the mill was a large mill pond, whose walls were keyed into and so contemporary with the wheel-pit walls (409) and (417). The southern wheel pit wall (417) continued straight to the east while the curvilinear northern wall (418) ran to the north-east, presumably to the weir approximately 40.0m away (Figs 42, 44, and 49). These walls were 0.40m wide and a minimum of 2.50m high and were constructed using the same bricks as the wheel pit.

Mill building

As the new cog pit was located to the north of the wheel pit, the mill building must also have been positioned on this side, and several stratigraphical relationships indicate that the ashlar-built mill building (Mill 3) otherwise continued to be used. Firstly, a brick floor (454) abutted the southern side of ashlar wheel pit wall (453) and the cog pit wall (461) (Fig 42 and 51). It is also likely to have abutted the ashlar wall (597) to the east, but the foundation cut for brick wall (415) had truncated it there. To the north of and abutting ashlar wall (453) there was also another heavily damaged brick floor (624; Fig 51), probably contemporary with floor (454). Beneath this floor a large pit (468) had been dug into the clay deposits above the breast of the ashlar wheel pit of Mill 3. This pit had been filled with a broken millstone (469) possibly to stabilise the ground for the brick floor here (Fig 52) so it could support a heavy structure. These French Burrstones are made from Tertiary chert, derived from the Marne Valley in northern France. At least one millstone of around 1.22m (3ft) in diameter, and 110mm thick, was represented and the outer edge had a band of iron concretion, 60mm wide, originating from the iron hoop that had once held the stones together.

The arrangement of floors, butting both the ashlar walls of Mill 3 and the cog pit walls of Mill 4, shows that Mill 3 was modified after its primary wheel pit had been abandoned. The earlier ashlar-built building of Mill 3, therefore, was enhanced with new brick-built features. The step on the northern side of the wheel pit wall may reflect its insertion into the earlier structure with the latte remaining in place above, in which case it may be further (albeit tenuous) evidence for Mill 3 having a timber-framed superstructure.

Timber technology

A full list of the timbers recovered during the excavation, their species identification and conversion methods can be seen in Table 1. The majority of the timbers are of oak although a number are also of elm. The latter appears more common in Mill 2 (Phase 4). Other than the piles (434 and 435) of Mill 4 (Phase 6) which were clearly sawn there was no evidence that any of the main structural timbers had been prepared in that way. Hewing marks were visible on a number of timbers, but were most notably on those which had only been roughly fashioned for example timbers (525 and

526) of Mill 2. The majority of the timber frames were jointed using unpegged mortice and tenon joints and are typical of 14th-15th century construction techniques. Only one timber (569) was marked with carpenter's numbers which may suggest that much of the preparation and jointing occurred on site, rather than the frame being constructed off site, marked, dismantled and then reassembled in position.

Of most interest is timber (569) that illustrated a different construction method using plank walling, which has its origins during the 9th-11th centuries, but in a domestic setting may point to a 14th century date.

Context/Timber	Comments	Phase	Identification	Common name	Conversion
504	wood frags in channel 505	2	<i>Salix</i> spp	willow	Box hearted
510		2	<i>Quercus</i>	oak	Round wood pencil point
519		3	<i>Quercus</i>	oak	Box hearted
520		3	<i>Quercus</i>	oak	Box hearted
521		3	<i>Ulmus</i>	elm	Round wood pencil point
522		3	<i>Quercus</i>	oak	Box hearted
523		3	<i>Quercus</i>	oak	Box hearted
524		3	<i>Quercus</i>	oak	Box hearted
590		3/4	<i>Quercus</i>	oak	Radial split
488		4	<i>Ulmus</i>	elm	Box hearted
488	Slip tenon east	4	<i>Ulmus</i>	elm	
488	Slip tenon west	4	<i>Ulmus</i>	elm	
489	Block to level 488	4	<i>Quercus</i>	oak	
516		4	<i>Quercus</i>	oak	Box hearted
517		4	<i>Ulmus</i>	elm	Box hearted
525		4	<i>Ulmus</i>	elm	Box hearted
526		4	<i>Ulmus</i>	elm	Box hearted
525 and 526 a	slip tenon	4	<i>Quercus</i>	oak	
525 and 526 b	slip tenon	4	<i>Quercus</i>	oak	
525 and 526 c	slip tenon	4	<i>Quercus</i>	oak	
525 and 526 d	peg in tenon a	4	<i>Quercus</i>	oak	
551		4	<i>Quercus</i>	oak	Box hearted
565		4	<i>Quercus</i>	oak	Box hearted
568		4	<i>Quercus</i>	oak	Box hearted
583	Block to level 488	4	<i>Quercus</i>	oak	Half boxed
593	wedge to level 525	4	<i>Quercus</i>	oak	
591	wedge to level 545	5	<i>Quercus</i>	oak	
592	wedge to level 545	5	<i>Quercus</i>	oak	
562		5b	<i>Ulmus</i>	elm	Round wood pencil point
543		5a	<i>Quercus</i>	oak	Box hearted
544		5a	<i>Ulmus</i>	elm	Half boxed
547		5a	<i>Ulmus</i>	elm	Half boxed
434a		5b	<i>Quercus</i>	oak	Radially sawn
434b		5b	<i>Quercus</i>	oak	Radially sawn
435 a		5b	<i>Quercus</i>	oak	Radially sawn
435 b		5b	<i>Quercus</i>	oak	Radially sawn

491		5b	<i>Quercus</i>	oak	Box hearted
540		5b	<i>Ulmus</i>	elm	Halved pencil point
553		5b	<i>Quercus</i>	oak	Quartered
554		5b	<i>Quercus</i>	oak	Quartered pencil point
555		5b	<i>Quercus</i>	oak	Quarter box pencil point
556		5b	<i>Ulmus</i>	elm	Quarter box pencil point
557		5b	<i>Ulmus</i>	elm	Quarter box pencil point
558		5b	<i>Ulmus</i>	elm	Quarter box
560		5b	<i>Ulmus</i>	elm	Round wood pencil point
571		5b	<i>Quercus</i>	oak	Round wood pencil point
572		5b	<i>Quercus</i>	oak	Round wood pencil point
573		5b	<i>Quercus</i>	oak	Radially split
575		5b	<i>Alnus glutinosa</i>	alder	Round wood pencil point
576		5b	<i>Alnus glutinosa</i>	alder	Round wood pencil point
577		5b	<i>Alnus glutinosa</i>	alder	Round wood pencil point
578		5b	<i>Alnus glutinosa</i>	alder	Round wood pencil point
579		5b	<i>Alnus glutinosa</i>	alder	Round wood pencil point
594		5b	<i>Quercus</i>	oak	Round wood pencil point
595		5b	<i>Quercus</i>	oak	Round wood pencil point
596		5b	<i>Ulmus</i>	elm	Tangentially split plank
545		Unknown	<i>Ulmus</i>	elm	Box hearted
546		Unknown	<i>Ulmus</i>	elm	Box hearted
548		4/5	<i>Quercus</i>	oak	Box hearted
548 a-f	wedges in through tenon	4/5	<i>Quercus</i>	oak	-
549		4/5	<i>Quercus</i>	oak	Box hearted
550		4/5	<i>Quercus</i>	oak	Box hearted
569		Unknown	<i>Ulmus</i>	elm	Box hearted
588		Unknown	<i>Ulmus</i>	elm	Box hearted

Table 1: timber species identifications and conversion methods (all phases)

5.9 Phase 7: Mill 5a (CG14) (late 18th-19th century)

Phase 7 marks the first mill building to be entirely constructed of brick (equivalent to Phase 1 in the historic building report; Tyler 2012), and this continued to use the wheel and cog pits of the previous phase. During this phase the south range of the mill was reconstructed in brick and a north-east range was added in brick (Fig 50). The southern part of the east to west wall of this building (408) sat directly upon wheel pit wall (409) and it also infilled the western step of the wheel pit/tail race (409) but was not keyed into it. The wheel pit, cog pit and mild pond remained unchanged from the previous phase. The east (415) and west (408) walls of the building sat directly upon the ashlar stone walls (579) and (619), while the eastern brick wall (415) also created an external eastern face to the ashlar wall (579). As wall (415) only abuts the wheel pit wall (409) it confirms that the main brick building was a later construction than the wheel pit. The construction cut for brick wall (415) also cuts through the brick floor surfaces (451) of Mill 4. The walls used bricks (217 x 103 x 66mm; 8½ x 4 x 2½ inch) in an English bond, with pinkish white sandy lime mortar. Where these walls did not sit upon earlier walls large angular red sandstone blocks had been used as a foundation course. The size of the bricks suggest that this mill was constructed in the late 18th or early 19th centuries after parliament legislation standardised bricks to be of that size (cf Phase 1a in Tyler 2012).

This mill was 8.5m wide, but its north to south dimensions could not be accurately established due to removal during the modern demolition of the mill buildings. However, based upon the cartographic evidence and the building recording (Tyler 2012) it is likely to have been 20m long (N–S). Although not observed during the excavation, another building (a north-east range) extended to the east. No archaeological remains of this north-east range (Phase 1a, Tyler 2012) survived demolition but its western wall lay above the wall foundations (439) of Phase 5b, suggesting it had replaced an earlier building otherwise of unknown form.

On the western side of the southern range, there were the remains of a brick floor (431) butting up to the outside wall (408) (Fig 53). This brick floor was constructed of at least three layers of bricks, laid flat, and there were four small rectangular holes that appeared contemporary with its construction (Fig 50) down to alluvial clay below the floor and, in disuse, filled with brick rubble and ash. The purpose of these holes is unclear but they may have held pads to help locate internal machinery. This floor almost extended the entire length of the mill building, and so wall (465) was a probably a later addition creating rooms G.03 and G.02 (Tyler 2012).

5.10 Phase 8; Mill 5b (CG15) (Mid–late 19th century)

This phase encompasses a large-scale redevelopment around the time the canal and basin were constructed in 1853 (Fig 54; Phase 2 in the historic building report (Tyler 2012)) to the immediate south of the mill (as encountered in evaluation Trenches 1 and 2). The basin, lined with a bluish grey silty clay, was 6.70m wide and 1.60m deep and the walls were constructed of red brick (238 x 116 x 74mm; 9 3/8 x 4 9/16 x 2 15/16 inch) capped with engineering bricks (224 x 106 x 83mm; 8 13/16 x 4 3/16 x 3 1/4 inch) (Fig 55). The walls of the canal were constructed of blue engineering bricks which had been capped with large red sandstone blocks, these remains were only being partially seen during the demolition works.

Based upon the cartographic evidence it is likely the vaulted arched cellars seen in evaluation Trench 1 were constructed around this time (1853–1903) (Fig 56). The vaults (105) were aligned east to west and butted against the canal basin wall (106). They were 3.75m wide and made from orange bricks on edge (230 x 100 x 75mm; 9 1/16 x 3 15/16 x 2 15/16 inch).

At this time the downstream side of Mill 5 was modified from an open tail pond to a covered tail race that ran to the west to re-join the Salwarpe (Fig 54 and 57). The first 6.5m of the vaulted tail race curved to a north-east alignment from where it continued straight for another 55m. The tail race walls (407) were constructed of brick (232 x 110 x 66mm; 9 1/8 x 4 5/16 x 2 5/8 inch), a double course thick (English bond) with a brownish cream sandy lime mortar. The arch was also constructed of two brick courses on edge. It is unclear whether this vaulted tail race covered the western half of the brick-built wheel pit at this time, as later brickwork and vaulting had been inserted there (Phase 9). Above this tail race was an elongated brick building (405), approximately 1.3m to the west of the southern part of the mill. This sat above the tail race (407) and was 11.12m long and 4.60m wide. Although stratigraphically later than the vaulted tail race, cartographic evidence confirms it was constructed between 1853 and 1884, and Jones (2012) has identified this building as a steam engine house constructed in c 1880.

The main mill building was also now altered with the addition of an east to west aligned 'West Range' (rooms G.01/G.02 in Tyler 2012). Little of this building survived after its demolition other than brick walls (438) and (626). As with the previous brick buildings the foundations of these walls (a room 11.80m long and 7.00m wide) were constructed of large red sandstone blocks. It seems probable that at this time an internal wall (465) was also inserted in the main mill building to create room G.03. On the eastern side of room G.03 a new brick floor (625; Figs 59) had been laid across floors (624) and (454) and over ashlar wall (453). Beneath this floor cutting through the earlier brick floor (454) an elongated pit had been dug (456) and filled with white lime mortar and small sandstone rubble fragments. As with pit (468) of Phase 6, which had been filled with a broken millstone fragments it may have been also intentionally created to form a solid sub-base. Floor

(625) butted wall (415) and to the south-east corner of the room butted a large east to west red sandstone block (429) of unknown function. At this time the *South Range* was also extended over the wheel pit with the addition of a southern room (room G.04), which incorporated wall (422 and 423).

The brick floors on the west (431) and the east (625) sides inside the main mill building are thought to be broadly contemporary with this phase, despite a c 0.30cm drop to the west. This height difference is confusing but suggests that, either the room was split on two levels, perhaps with an internal stud partition, or that the floor had sunk into the soft alluvial clay below. As brick floor (431) was slightly undulating with evidence for repeated rebuilds it may indicate some subsidence had occurred. This height difference was also reflected in the latest phase of the mill, as a raised concrete platform was situated on the eastern side of room G.03, interpreted as a machine platform (Tyler 2012).

It is likely that during these modifications a metal cast iron plate (427), an inch thick, was also inserted at the top of the breast work (614) (Fig 60). The north and south ends of the plate had been inserted into walls (409) and (417) to hold the plate in position. This would have helped to keep a smooth flow of water across the top and onto the wheel.

5.11 Phase 9; Mill 5c (20th century)

The final archaeological phase of mill development was associated with the conversion of the wheel pit to hold a turbine (Fig 54). A concrete floor was inserted in to the base of the wheel pit and a 0.50m thick concrete wall (416) built between walls (409) and (417) 4.50m from the top of the breast to shorten the wheel pit. The western end of the wall was clad in corrugated sheet, presumably the shuttering used during the construction of the wall. In the floor there was a 0.80m diameter hole, flanked by bolts that would have held a turbine (627) in position (Fig 61). The turbine casing was 1.20m in diameter and the turbine rotor was 0.80m in diameter with 11 blades (Fig 63). A pipe (not observed) drained into the vaulted tail race. Damage to the eastern end of the vaulted tail race was presumably created during the insertion of that pipe, and this had been repaired with another brick vault (412), using on edge bricks three courses thick, bonded with cement mortar. This had subsequently been covered with a cement slab (410) and a brick floor (411). Parts of these alterations were still visible during the building survey in room G.04 (Tyler 2012) including a stub wall (416) and a brick arch (412) on the west side of the room, repairing the original vault.

During the change from a using a water wheel to a turbine the breast work at the east of the wheel pit was also altered. A square hole (1.30m wide and 0.50m high) was cut through the bottom centre of the breast through to the mill pond behind (Fig 62). On the mill pond side of the breast work two triangular corner pillars had been inserted between the mill pond walls (417 and 418) and the breast (614) to direct water into the turbine chamber. These were capped with bull-nosed blue engineering bricks and between them a sluice gate (removed) was inserted in an iron frame.

5.12 Phase 9b; Industrial units (c mid 20th century)

During the latter half of the 20th century the mill was abandoned and converted to light industrial use. It is probably that at this time the wheel pit was infilled with brick rubble and concrete floors laid throughout the mill, as recorded sealing the wheel pit (Tyler 2012). Cartographic evidence also shows that the mill pond, canal and basin were now all filled at this time (between 1938 and 1964).

6 Scientific dating (by Suzi Richer)

6.1 Dendrochronological dating, by Nigel Nayling and Roderick Bale

6.1.1 Introduction

Tree-ring analysis was undertaken of selected samples from oak timbers excavated at the Town Mill Site, Hanbury Street, Droitwich, where a succession of mill structures including substantial waterlogged timbers was encountered. Sampling of timbers, which had been removed from the excavations and were still located at the development site, was undertaken by one of the authors (NN) using a chainsaw in February 2013. Samples were recovered from 23 substantial timbers, with five of these timbers being sampled twice to maximise their information and dating potential. As part of a post-excavation assessment, a dendrochronological assessment report was produced (Nayling and Bale, 2013) which recommended that samples from twelve of the fifteen sampled oak timbers should be subjected to tree-ring analysis, as they had good dating potential. Three oak timbers had not been recommended for analysis as they had insufficient numbers of annual tree rings to merit such analysis. Eight elm timbers were also not recommended for analysis at this stage, as elm rarely produces absolute dates (analysis of the latter may be undertaken at a future date as a research project). In an updated project design produced following the dendrochronological assessment (Worcestershire Archaeology 2013), excavated timbers were seen as a key resource for dating through dendrochronology and their potential for phasing the site, and for dating particular structures, was highlighted.

6.1.2 Methods

Methods employed at the Lampeter Dendrochronology Laboratory in general follow those described by English Heritage (1998). The selected samples were surfaced by hand using razor blades so that the ring sequence could be clearly discerned and measured. The complete sequence of growth rings in each sample was measured to an accuracy of 0.01mm using a micro-computer based travelling stage (Tyers 2004). Cross-correlation algorithms (Baillie and Pilcher 1973; Munro 1984) are employed to search for positions where the ring sequences are highly correlated against each other. The ring sequences were also tested against a range of reference chronologies from Britain and Ireland (Table 4). The t-values reported are derived from the original CROS algorithm (Baillie and Pilcher 1973). A t-value of 3.5 or over is usually indicative of a good match, although this is with the proviso that high t-values at the same relative or absolute position must be obtained from a range of independent sequences, and that satisfactory visual matching supports these positions. Correlated positions are checked visually using computerised ring-width plots.

Interpretation of any tree-ring date is limited by whether sapwood or bark edge is present in a sample. Sapwood is distinguishable as lighter coloured band around the outer annual rings of a tree and represents the part of the tree that is alive. At a microscopic level, sapwood in *Quercus* spp. is recognisable by the open earlywood vessels used for water and mineral transport. Heartwood earlywood vessels appear filled when viewed microscopically as the cell walls have collapsed (tyloses) and no longer form the living part of the tree. Should a sample contain sapwood and bark edge, the year and even season of felling can be inferred from a dated sample. Should partial sapwood be present an estimate of between ten and forty six rings is used to infer a date range for a British oak sample (Bayliss and Tyers 2004). In samples where there is no sapwood or microscopic sign of the heartwood/sapwood boundary a date will represent a *terminus post quem* (date after which) the parent timber must have been felled. The date in this case will refer to the date of the last complete annual ring, and at least ten years after the date of that final ring, to account for a minimum amount of missing sapwood.

6.1.3 Results

Details of all of the oak timbers sampled from the site, and the results of tree-ring analysis of those selected during assessment, are summarised in Table 2. Absolute dating is presented graphically in a bar diagram (Fig 65).

Sample ref	Timber	Phase	Cross section	Dimensions	Total rings	Sapwood/ bark	ARW	Date range	End date
DTM_491	491	5b	Boxed Whole	450 x 350	110	3	2.48	Undated	-
DTM_519	519	3	Boxed Whole	120x90	37	-	4.05	Unmeasured	-
DTM_520	520	3	Boxed Whole	270 x 260	46	12+?B	3.87	Unmeasured	-
DTM_522	522	3	Boxed Whole	255 x 240	52	+?HS	4.02	Undated	-
DTM_523	523	3	Boxed Whole	210 x 200	54	18++½Bs	2.43	AD1317-AD1370	AD1371 spring
DTM_524	524	3	Boxed Whole	260 x 220	52	7	4.19	Undated	-
DTM_543	543	5a	Boxed Whole	350 x 350	84	12	3.29	Undated	-
DTM_548	548	4/5	Boxed Whole	260 x 180	72	22+Bw	1.91	AD1388-AD1459	AD1459 winter
DTM_549	549	4/5	Radial	110 x 100	82	10	1.21	AD1373-AD1454	AD1454-90
DTM_550	550	4/5	Boxed Whole	210 x 160	97	4	1.85	AD1348-AD1444	AD1450-86
DTM_551	551	4	Boxed Whole	300 x 270	154	28+?B	1.43	AD1400-AD1553	AD1553?
DTM_554	554	5b	Radial	130 x 130	68	4	2.04	Undated	-
DTM_565	565	4	Boxed Whole	180 x 180	31	7+?B	4.44	Unmeasured	-
DTM_568**	568	4	Halved	330 x 250	142	10+?B	3.28	Undated	-
DTM_590	590	3/4	Radial	180 x 15	54	+HS	3.21	AD1406-AD1459	AD1469-1505

*Table 2: Sample details for oak timbers from Droitwich Town Mill site (** for additional chronological modelling of timber 568 see Marshall and Richer in separate section below)*

Total rings = all measured rings. Sapwood: +Bw = winter felled bark edge, ++½Bs = spring felled bark edge, +?B = possible bark edge, +HS = heartwood/sapwood boundary, +?HS = possible heartwood/sapwood boundary. ARW = average ring width of the measured rings. All samples were oak (*Quercus* spp.)

Four of the measured oak samples (by 548, 549, 550 and 590) correlated against each other with significant t-values and good visual matching (Table 3). A 112-year mean was calculated from these synchronised individual ring-width series and named DTM_T4. This mean, and the ring-width series from individual timbers, were compared against a wide range of British oak ring-width means and regional chronologies.

Two individual timbers and the four-timber mean were dated against numerous site means on the basis of replicated high correlations and good visual matches (DTM_523, Table 4; DTM_T4, Table 5; and DTM_551, Table 6).

FileNames	DTM_549	DTM_550	DTM_590
DTM_548	3.53	-	3.18
DTM_549	*	7.9	3.29
DTM_550	*	*	3.66

Table 3: Correlations between samples making up the 112-year four-timber mean DTM_T4

FileNames	-	-	DTM_523
	start	dates	AD1317
	dates	end	AD1370
<i>England Essex</i>			t- value
Fyfield Hall (Bridge 1998)	AD1293	AD1388	5.77
Upminster Tithe Barn (Tyers 1997a)	AD1276	AD1414	5.43
<i>Herefordshire/Worcestershire</i>			
Worcester Commandery (Pilcher 1998)	AD1273	AD1465	8.74
Hightown, Booth Hall (Boswijk, 1997)	AD1302	AD1489	6.76
Droitwich (Upwich2) (Groves 1997)	AD946	AD1415	7.37
St Cuthberts, Wick (Bridge 1981)	AD1257	AD1496	8.23
<i>England South West</i>			
New Inn House Kingswood, Gloucs (Arnold <i>et al</i> 2004)	AD1191	AD1519	5.99
<i>England Yorkshire</i>			
Nostell Priory nr Wakefield (Tyers 1998a)	AD1263	AD1536	5.49

Table 4: Correlations between sample DTM_523 (dated to AD 1317-1370 inclusive) and selected site means

Site Sequence Name	-	-	DTM_T4
	start	dates	AD1388
	dates	end	AD1459
<i>England West Midlands</i>			t-value
Hereford Cathedral Barn (Tyers 1996a)	AD1359	AD1491	8.63
Hightown, Booth Hall (Boswijk and Tyers 1997)	AD1302	AD1489	8.34
St. Cuthberts; Wick (Bridge 1991)	AD1257	AD1496	9.84
<i>England South West</i>			
St Swithun's Church Compton Bassett, Wilts (Miles 2001)	AD1346	AD1454	7.20
Mercer's Hall, Gloucester (Howard 1996)	AD1289	AD1541	7.79
New Inn House Kingswood, Gloucs (Arnold <i>et al</i> 2004)	AD1360	AD1591	7.28
St Mary Magdalene Bellframe, Twynning, Gloucs (Tyers 1996b)	AD1251	AD1452	7.54

Table 5: Correlations between mean sequence DTM_T4 (dated to AD 1388 - AD 1459 inclusive) and selected British site means

Site Sequence Name	-	-	DTM_551
	start	dates	AD1400
	dates	end	AD1553
<i>England East Anglia</i>			<i>t value</i>
Chicksands Priory, Bedfordshire (Howard <i>et al</i> 1998b)	AD1175	AD1541	6.55
Marriot's Warehouse, Kings Lynn, Norfolk (Tyers 1999b)	AD1310	AD1583	5.6
<i>England West Midlands</i>			
St. Mary's Church, Bromfield, Shropshire (Nayling 2000)	AD1389	AD1588	5.87
Ightfield Hall Barn, Shropshire (Groves 1997)	AD1341	AD1566	6.97
Sinai Park, nr Burton, Staffordshire (Tyers 1997b)	AD1227	AD1750	7.45
<i>England Hereford and Worcester</i>			
Farmers Club, Widemarsh St, Hereford (Tyers 1996a)	AD1313	AD1617	5.88
Penrhos Court, near Kington, Herefordshire (Tyers 1998b)	AD1420	AD1571	5.45
White House, Vowchurch, Herefordshire (Nayling 1999)	AD1364	AD1602	6.13
<i>England South East</i>			
Apple Tree Cottage, Elstead, Surrey (Tyers 2000)	AD1396	AD1591	5.39
Longport Farmhouse, Kent (Tyers 1996c)	AD1334	AD1599	5.45
<i>England South West</i>			
The Old Mansion, Clarendon, Wiltshire (Tyers 1999a)	AD1315	AD1625	5.06
26 Westgate Street, Gloucester (Howard <i>et al</i> 1998a)	AD1399	AD1622	6.89
New Inn House Kingswood Gloucs KGWBSQ01 (Arnold <i>et al</i> 2004)	AD1191	AD1519	7.51
Naas House, Lydney (Howard <i>et al</i> 1998c)	AD1360	AD1591	6.63

Table 6: Correlations between sample DTM_551 (dated to AD 1400-1553 inclusive) and selected site means

6.1.4 Interpretation

- Absolute dating of radial oak plank fragment (590), with surviving heartwood /sapwood boundary, provides a felling date range of AD 1469-1505.
- Absolute dating of timber (523), with surviving bark edge allowing precise dating of felling of its parent tree to the spring of AD 1371; this provides a precise date for Mill 1 (Phase 3).
- A single timber (551) associated with Mill 2 (Phase 4) construction has been absolutely dated with a possible felling date of AD 1553?
- Combining the absolute dating results for timbers 549 and 550, indicates a date for the felling of trees used for the production of timbers of CG5 in the range AD 1454-1486. It may be that these timbers came from trees, as in the case of timber 548 (also of CG5), felled in the winter of AD 1459.

A nuanced interpretation of the absolute dating of the six oak timbers reported here, therefore, provides valuable evidence for elucidating the complex mills sequence:

6.2 Radiocarbon dating, by SUERC, Nicholas Daffern, Suzi Richer and Peter Marshall

6.2.1 Methodology

Thirteen samples were submitted for Accelerator Mass Spectrometry (AMS) dating to the Scottish Universities Environmental Research Centre (SUERC) radiocarbon dating laboratory. Eleven samples were submitted from waterlogged seeds/plant macrofossil remains with the aim of providing dates for the top and base of channels (535), (472) and (505), context information can be found in Table 7. Two samples were from the innermost and outermost rings from a piece of oak timber (Timber 568) were also submitted after dendrochronological dating for this major timber was unsuccessful (Table 8). No sources of contamination or non-contemporaneous carbon were evident during the fieldwork or during the sub-sampling. All calibrated dates are identifiable by the prefix 'cal'. Where calibrated date ranges are cited in this report, these are for 95% confidence.

The results are conventional radiocarbon ages (Stuiver and Polach 1997) and are listed in Tables 7-8. The calibrated date ranges for the samples have been calculated using the maximum intercept method (Stuiver and Reimer 1986), and are quoted with end points rounded outwards to ten years. The probability distributions of the calibrated dates, calculated using the probability method (Stuiver and Reimer 1993) are shown in Appendix 1: Radiocarbon date graph have been calculated using OxCal v4.2 (Bronk Ramsey 2009) and the current internationally-agreed atmospheric calibration dataset for the northern hemisphere, IntCal13 (Reimer et al. 2013).

Laboratory code	Context number and depth	Material	$\delta^{13}\text{C}$ (‰)	Conventional Age	OxCal calibrated age (95.4% probability)
Channel [535/539]					
SUERC-50175	534, 1.2–1.25m	Waterlogged seed: <i>Ranunculus</i> sp.	-26.4 ‰	291 +/- 42 BP	cal AD 1470–1800
SUERC-55344	587, 0.92–0.97m	Waterlogged plant: <i>Ranunculus acris/repens/bulbosus</i>	-25.0 ‰	541 +/- 29 BP	cal AD 1310–1440
GU35550	586	Waterlogged seed: mixed	Failed: insufficient carbon		
GU35051	586	Waterlogged plant: various	Failed: insufficient carbon		
GU32335	534	Waterlogged seed: <i>Rumex</i> sp.	Failed: insufficient carbon		
Channel [472]					
SUERC-50174	475, 1.87–1.92m	Waterlogged seed: <i>Ranunculus</i> sp.	-26.8 ‰	470 +/- 42 BP	cal AD 1400–1470
SUERC-55346	473 0.00–0.05m	Waterlogged plant: <i>Ranunculus acris/repens/bulbosus</i>	-25.0 ‰	697 +/- 29 BP	cal AD 1260–1390
GU32334	475	Waterlogged seed: <i>Rumex</i> sp.	Failed: insufficient carbon		
Channel [505]					
SUERC-55345	502, 0.10–0.15m	Waterlogged plant: various	-25.0 ‰	534 +/- 29 BP	cal AD 1320–1440
SUERC-55967	504, 0.91–0.96m	Waterlogged seed: mixed	-25.0 ‰ assumed	1012 +/- 40 BP	cal AD 970–1150
GU35048	504	Waterlogged plant: various	Failed: insufficient carbon		

Table 7: Radiocarbon results

Laboratory Number	Sample	Radiocarbon Age (BP)	$\delta^{13}\text{C}$ (‰)	Calibrated age (95%)	Posterior Density Estimate (95%)
SUERC-59190	Oak heartwood, rings 1–10 from timber 568	430±31	-24.0‰	cal AD 1420–1460	cal AD 1420–1515 (91%) or cal AD 1600–

					1620 (4%)
SUERC-59194	Oak heartwood, rings 121–130 from timber 568	383 \pm 31	–27.6‰	cal AD 1440–1640	cal AD 1440–1525 (63%) or cal AD 1555–1635 (32%)

Table 8: Timber 568 – radiocarbon results

6.2.2 Discussion

Sample failure

Radiocarbon ages were not obtainable from five samples, with all samples failing due to insufficient carbon. It is postulated that a mineralisation process may have begun, which affected the organic content of seemingly waterlogged plant material. This mineralisation is likely to be due to the soil chemistry, in particular the presence of salt, which is well known for this area. This requires further investigation, as there may be implications for future dating submissions.

Channels (472) and (535)

The radiocarbon results from both channels (472) and (535) are inverted, suggesting that the stratigraphic sequence is not intact. There are a number of reasons for the inversion:

- The channels have been deliberately back-filled, rather than the sediment accumulating sequentially over time- this could cause younger material to be included at the base.
- The channels have been disturbed after they have been infilled causing younger material to become incorporated lower down.
- The channels have accumulated naturally, however, the alluvial nature of the sediments does not preclude older/eroded material from having been washed into the site.

6.2.3 Chronological modelling of channel [505], by Suzi Richer

The radiocarbon ages for the channel (505) occur in stratigraphic order and so the sediments in this channel are deemed to be intact. However, given the relatively imprecise individual calibrated radiocarbon dates it is necessary to use the information we have about the deposition process to refine our chronology and also to provide interpolation between dated levels in any sequence.

Simple visual inspection of the calibrated radiocarbon dates does not allow us to assess the date and rate of deposition for channel sediments, since the calibration process does not allow for the fact that this group of radiocarbon dates are related – they all come from the same sequence. Bayesian statistical modelling is required to account for this dependence (Buck *et al* 1992; Bayliss *et al* 2007, Blaauw and Christen 2011), which we have undertaken using OxCal v4.2 (Bronk Ramsey 1995; 1998; 2001; 2009). The U_Sequence (Bronk Ramsey 2008) function in OxCal v4.2 in which deposition is assumed to be uniform giving approximate proportionality to depth, allows us to define the vertical distance between radiocarbon dated samples (i.e. the gap between SUERC-55345 and SUERC-55967 is 81cm) and also to derive an average for the depositional increments (*k* value) over the length of the sequence (Bronk Ramsey and Lee 2013). The date ranges from these models are given *in italics* to distinguish them from simple, calibrated radiocarbon dates.

The model (IntCal 13 (Reimer *et al* 2013); Fig 66) has good overall agreement (Amodel: 99) showing a satisfactory fit between the radiocarbon dates (all from short-lived, single entity plant macrofossils) and the stratigraphy.

The sequence in channel [505] covers an estimated period of 464–549 years (48% probability; distribution not shown), the early–high medieval period.

A second Bayesian age-depth model (Fig 67) was generated using the R software package BACON (Blaauw and Christen 2011). The weighted means generated from this model have been used to construct a Bayesian-based chronology for the time scale of the pollen diagram (Fig 72)

using Tilia v1.7.16. This age-depth model has also been used to provide estimates for local pollen assemblage zones identified.

6.3 Chronological modelling of timber (568), by Peter Marshall and Suzi Richer

Tree-ring dating was undertaken on a series of timbers from the mill structures to aid in understanding the dates of construction for the various mill structures (see above). The results of the tree-ring dating programme of timbers relating to Mill 2 were inconclusive, and so a programme of radiocarbon wiggle-matching was initiated to further attempt determination of the date of timber (568) of Mill 2.

Timber 568 contained 142 rings and the ?bark edge. Samples were provided of two blocks, each containing wood of ten year's growth (inner rings 1–10 and outer rings 121–130) and sent to the Scottish Environmental Research Centre (SUERC). The samples were pre-treated through a three-step Soxhlet extraction process using an organic solvent mixture of ethanol-chloroform (1:2 by volume). Following the Soxhlet extraction the sample is dried, washed with acid/alkali/acid and then bleached until the cellulose is white in colour. The sample is then washed with high purity water to remove all traces of the bleach, before the acid/alkali/acid washes are repeated, leaving alpha cellulose. The sample was then combusted as described in Vandepitte *et al* (1996), graphitized as outlined in Slota *et al* (1987), and dated by Accelerator Mass Spectrometry (Xu *et al* 2004; Freeman *et al* 2010). The laboratory maintains a continual programme of quality assurance procedures, in addition to participation in international inter-comparisons (Scott 2003; Scott *et al* 2010). These tests indicate no laboratory offsets and demonstrate the reproducibility and accuracy of these measurements.

The results are conventional radiocarbon ages (Stuiver and Polach 1997) and are listed in Table 8. The calibrated date ranges for the samples have been calculated using the maximum intercept method (Stuiver and Reimer 1986), and are quoted with end points rounded outwards to ten years. The probability distributions of the calibrated dates, calculated using the probability method (Stuiver and Reimer 1993) are shown in Appendix 1: Radiocarbon dating graphs. They have been calculated using OxCal v4.2 (Bronk Ramsey 2009) and the current internationally-agreed atmospheric calibration dataset for the northern hemisphere, IntCal13 (Reimer *et al* 2013).

Wigglematching uses information derived from tree-ring analysis, in combination with radiocarbon measurements to provide a revised understanding of the age of a timber (Galimberti *et al* 2004). As the exact interval between radiocarbon results can be derived from tree-ring analysis the shapes of multiple radiocarbon distributions can be 'matched' to the shape of the radiocarbon calibration curve.

6.3.1 Results and discussion

Although the technique can be done visually, Bayesian statistical analyses (including functions in the OxCal computer program) are now routinely employed. A general introduction to the Bayesian approach to interpreting archaeological data is provided by Buck *et al* (1996). The approach to wiggle-matching adopted here is described by Christen and Litton (1995).

Details of the algorithms employed in this analysis - a form of numerical integration undertaken using OxCal - are available from the on-line manual or in Bronk Ramsey (1995; 1998; 2001; 2009). Because it is possible to constrain a sequence of radiocarbon dates using this highly informative prior information (Bayliss *et al* 2007), model output will provide more precise posterior density estimates. These *posterior density estimates* are shown in black in the Figures and quoted in italic in the text.

The chronological model shown in Figure 68 includes the radiocarbon dates, the information that SUERC-59190 is 120 years earlier than SUERC-59194. the centre ring of block r121–130 is 120 years earlier or later than r1–10, and that after the centre point of the outermost block (SUERC-

59194) 17.5 rings are present to ?bark edge of the sampled timber. This model has good overall agreement ($A_{\text{comb}} = 62.6\%$ ($A_n = 50.0\%$) $n=2$) indicating that the radiocarbon dates are in accord with the tree-ring sequence of the samples.

The model provides an estimate for the felling of timber 568 of *cal AD 1570–1635* (95.4% probability; Figure 68).

Figure 69 provides an overview of all felling dates obtained from the timbers, both from the dendrochronological dating (exact and ranges) and the modelled date for timber 568.

7 Artefactual evidence (by Laura Griffin)

The artefactual assemblage is summarised in Tables 9-11. The artefact recovery policy conformed to standard Service practice (CAS 1995, appendix 4).

The assemblage from the site amounted to 196 artefacts weighing 32.23kg and is summarised in Table 9. Material could be dated from the Bronze Age period onwards (see Table 9) with the majority dating to the later medieval and early post-medieval periods. Level of preservation was good but with some of the finds affected by waterlogging which had left staining on surfaces. The most abundant material type recovered was pottery.

Material	Count	Weight (g)
Pottery	89	4434
Tile	58	13934
Brick	9	9754
Copper alloy	9	2
Iron	4	853
Tin	11	21
Leather	2	61
Clay pipe	4	16
Mortar	frags	49
Slag	1	186
Glass	9	2925

Table 9: Quantification of the assemblage

7.1 Method of analysis

All hand-retrieved finds were examined and a primary record was made on a Microsoft Access 2000 database. They were identified, quantified and dated to period. A *terminus post quem* was produced for each stratified context. All information was recorded on *pro forma* Microsoft Access 2000 database.

The pottery was examined under x20 magnification and recorded by fabric type and form according to the fabric reference series maintained by the service (Hurst and Rees 1992 and www.worcestershireceramics.org).

Artefacts from environmental samples were examined and are included in the discussion of the finds and the Table 9 quantification.

7.2 Pottery

All sherds have been grouped and quantified according to fabric type (Table 10) and diagnostic form sherds dated accordingly. Remaining sherds were datable by fabric type to their general period or production span.

A total of 89 sherds weighing 4.434kg were analysed. The assemblage was dominated by later medieval and early post-medieval pottery dating between the 15th and early 17th centuries.

Pottery of earlier and later periods was found in smaller quantity, and included sherds of Bronze Age, Roman, post-medieval and modern date.

Period	Fabric code	Fabric common name	Total	Weight (g)
Bronze Age	5.4	Quartzite	1	3
Roman	12	Severn Valley ware	7	105
Roman	12.1	Reduced Severn Valley ware	1	20
Roman	12.2	Oxidised organically tempered Severn Valley ware	2	108
Roman	14	Fine sandy grey ware	2	32
Roman	21.3	Early micaceous ware	2	66
Roman	22	Black-burnished ware, type 1 (BB1)	1	20
Roman	43	Samian ware	2	5
medieval	46.2	Glazed Stamford type ware	1	2
medieval	69	Oxidized glazed Malvernian ware	2	14
medieval	99	Miscellaneous medieval wares	1	1
late medieval/early post-medieval	69	Oxidized glazed Malvernian ware	10	299
post-medieval	75.1	North Devon gravel-free ware	2	31
post-medieval	78	Post-medieval red wares	21	547
post-medieval	81.5	White salt-glazed stoneware	3	12
post-medieval	91	Post-medieval buff wares	1	18
modern	81.4	Miscellaneous late stoneware	20	3093
modern	84	Creamware	1	8
modern	85	Modern china	9	50

Table 10: Quantification of the pottery by fabric type

Bronze Age

A single small fragment of pottery with large, angular quartzite inclusions was identified within alluvial layer (506).

Roman

Roman pottery consisted of 17 sherds weighing 356g. All were of fabric and form types commonly identified from other sites in Droitwich, with Severn Valley wares (fabrics 12, 12.1 and 12.2) dominating. In addition, sherds of sandy grey ware, samian and Black-burnished ware type 1 were also identified (fabrics 14, 43 and 22 respectively). Diagnostic sherds present suggested a late 1st–2nd century date.

Although the proportion of Roman pottery within the assemblage was relatively high, it was all residual, and quite to be expected given the extensive Roman activity in the vicinity. Ground disturbance during construction of the mills and associated watercourses must have dislodged this material from earlier deposits.

Late Saxon/early medieval

There was a single, residual fragment of Stamford ware (fabric 46.2, context 476; P5c) dated to 10th–11th century.

Medieval/early post-medieval

There were a total of 15 medieval/early post-medieval sherds (345g), all identifiable sherds being of Malvernian production (fabric 69), apart from a cooking pot sherd which was too small and abraded to be identified to a specific fabric type. Forms primarily consisted of a narrow range of domestic types typical of the latest period of production, including flared bowl and cistern/jar forms of late 15th–early 17th century date.

Post-medieval

The 25 post-medieval sherds included fragments of black and brown glazed red sandy ware (fabric 78) from flared cup, tyg and jar forms of 17th century date. In addition, there were also sherds from press-moulded, slip-decorated dishes and larger jars in the same fabric, which are more likely to date to the 18th century.

Other sherds of this period included North Devon gravel tempered ware (fabric 75), buff sandy ware (fabric 91) and white salt-glazed stoneware (fabric 81.5). Again, all were from domestic forms.

Modern

Modern pottery amounted to 30 sherds and consisted of modern china tablewares decorated with blue transfer patterns (fabric 85), and large stoneware bottles and/or jars (fabric 81.4).

7.3 Ceramic building material

Roman

Four fragments of Roman tile were retrieved (contexts 474, 497 and 502). All were highly abraded but diagnostic fragments could be identified as coming from box-flue, tegula and imbrex forms.

Medieval and early post-medieval

Roof tile

Roof tile dating to the medieval and early post-medieval periods consisted of 40 fragments, weighing 9.633kg. Three main fabric types were identified, all of which are thought to have been produced locally and have been previously identified on a number of medieval sites in Worcestershire:

- 2a Worcester common sandy type
- 2c Worcester grog/pellet sandy type
- 4 Soft buff type

At present, the manufacturing provenance of the soft, buff fabric type is unknown. However, tiles of this type have been identified within other assemblages from Droitwich and therefore it is assumed that they were produced relatively locally.

Due to the analysis of a number of large tile assemblages, including groups from kiln sites, roofing tile has become increasingly useful for dating, particularly for contexts where pottery is absent. Fragments of both fabrics 2a and 4 were of 13th-15th century date, whilst those of fabric 2c are known to have been produced from the later 15th century onwards. All tile of this date was of flat form, the majority of fragments being undiagnostic. However, four examples were nibbed; two in fabric 2c and two in fabric 4.

Post-medieval and modern

Roof tile

A total of 20 roof tiles could be dated to the later post-medieval and modern periods. The majority had mortar adhering to the surface. The earliest examples from the group were thought to be 17th century in date and included one fragment with a round, pierced peg hole.

Other tile

In addition to the roof tile, there were also two fragments of ceramic paving slabs (context 440, P6).

Brick

Brick was found throughout the later phases of the mill from Phase 5b onwards, and details of brick sizes are provided in the Structural Evidence section above.

7.4 Other finds (by Derek Hurst)

All other finds are quantified in Table 11, and those of particular note are discussed further below.

Copper Alloy

Five small copper alloy pins were recovered from the stave groove and the top of timber (569, Phase 3/4; Fig 70). These had wound-wire spherical heads in a range of lengths (17, 23, 24, 26, 27, 33mm with head sizes varying proportionately from 1 to 2mm, and based on round-sectioned parallel-sided wire sharpened at the other end. These are of later medieval date (c mid 15th–mid 16th century; cf Margeson 1993, Type 1 pin) and in that period were in widespread use, for instance for fastening in place female head-dresses (A Bolton, pers comm).

An accompanying small D-shaped buckle loop (flattened oval section and 16mm wide) with the ends flattened and perforated to take a hinge pin (2mm dia; now missing); this could not be readily paralleled (Fig 71).

These finds had an unusual location in that they were found inside the muddy fill of an empty stave groove. Though it was tempting to suggest a special deposit this was resisted as the finds were not obviously pressed into the base of the slot. These objects also exhibited distinctly yellow shiny surfaces which has been noted elsewhere for copper alloy objects found in a waterlogged saline environment.

Leather

A well-preserved, near complete sole from a shoe was retrieved from one of the earliest channel fills associated with the mill (context 475; P3). A small amount of medieval footwear has been recovered from Upwich previously (Mould in Hurst (ed) 1997, 129) and this sole is comparable with one belonging to a near complete shoe likely to date to the later 14th century (*ibid*, 130 fig 118 no 2). The sole is from a medieval turnshoe sole for the left foot (Q Mould, pers comm.). It measures 240mm in length and 80mm across at the widest part, making it roughly equivalent to an adult size 4 in modern sizing.

The good level of preservation means that stitching holes are clearly defined around the outside edge of the sole. There were made at 5-6mm intervals and indicate use of an edge/flesh stitch. The sole is noticeably thinner on the left side of the heel, indicating that it had seen a good amount of wear. A small amount of medieval footwear has been recovered from Upwich previously (Mould in Hurst 1997, 129) and this sole is comparable with one belonging to a near complete shoe likely to date to the later 14th century (*ibid*, 130 fig 118 no 2).

A perforated circular disc of leather was also retrieved (unstratified). The piece was roughly cut and is most likely an offcut.

7.5 Artefactual dating

Context	Phase	Cut	Material class	Object specific type	Total	Weight (g)	Start date	End date	Finds TPQ
0	-	-		mortar		49			
0	-	-	ceramic	pot	1	44	L17C	18C	

Excavation at Town Mill, Hanbury Road, Droitwich, Worcestershire

0	-	-	ceramic	roof tile(flat)	1	273	13C	15C+	
0	-	-	iron	?nail	1	43			
0	-	-	organic	leather	1	10			
106	-	-	ceramic	brick	2	3600			20C
206	9	-	ceramic	pot	20	3093	19C	20C	20C
206	9	-	glass	vessel	6	2604			
206	9	-	metal	can	11	21			
305	5	-	ceramic	brick	1	3100		18C	18C
325	3	326	ceramic	pot	2	25	15C	16C	15-16C
328	2	327	ceramic	pot	1	33	M1C	4C	4C
331	5	-	ceramic	brick	2	1234			20C
331	5	-	ceramic	roof tile(flat)	4	994			
331	5	-	ceramic	roof tile(flat)	4	957	13C	15C	
340	6	-	ceramic	roof tile(flat)	2	736		18C	18C
414	9	409	glass	vessel	1	216	19C	20C	20C
440	6	450	ceramic	brick	2	52		18C	18C
440	6	450	ceramic	roof tile(flat)	2	270	L15C+		
440	6	450	ceramic	tile(floor)	2	688			
474	3	472	ceramic	box-flue tile	1	8	M1C	4C	4C
474	3	472	ceramic	pot	1	14	M1C	4C	
474	3	472	ceramic	tile	1	68	M1C	4C	
475	3	472	ceramic	pot	1	1			15-16C
475	3	472	ceramic	pot	1	11	13C	16C	
475	3	472	ceramic	pot	1	4	M1C	4C	
475	3	472	ceramic	roof tile(flat)	1	51	13C	15C	
475	3	472	organic	leather	1	51			
475	3	472	ceramic	pot	1	51			
476	5c	477	ceramic	clay pipe	3	14			M17-18C
476	5c	477	ceramic	pot	1	1			
476	5c	477	ceramic	pot	3	113	M17C	E18C	
476	5c	477	ceramic	pot	1	2	10C	11C	
476	5c	477	ceramic	pot	1	53	15C	16C	
476	5c	477	ceramic	pot	1	8	1760	1780	
476	5c	477	ceramic	pot	1	25	2C	3C	
476	5c	477	ceramic	pot	3	28	L17C	18C	
476	5c	477	ceramic	pot	3	54	M17C	18C	
476	5c	477	ceramic	pot	1	5	M18C		
476	5c	477	ceramic	roof tile(flat)	1	295			
476	5c	477	ceramic	roof tile(flat)	2	774	13C	15C	
476	5c	477	ceramic	roof tile(flat)	2	677	15C+		

476	5c	477	ceramic	roof tile(flat)	3	574	L15C+		
476	5c	477	ceramic	tile	1	110	18C	19C	
476	5c	477	glass	vessel	1	101	18C		
478	5c	483	ceramic	brick	2	1768			L17-18C
478	5c	483	ceramic	clay pipe	1	2			
478	5c	483	ceramic	pot	8	49	18C	20C	
478	5c	483	ceramic	pot	2	80	L17C	18C	
478	5c	483	ceramic	pot	4	119	M17C	L17C	
478	5c	483	ceramic	pot	1	3	M18C		
478	5c	483	ceramic	roof tile(flat)	1	33	L15C+		
478	5c	483	glass	window	1	4			
479	5c	483	ceramic	pot	1	1	18C	20C	
479	5c	483	ceramic	pot	1	29	L17C	18C	
479	5c	483	ceramic	pot	1	4	M18C		18C
479	5c	483	ceramic	roof tile(flat)	1	47			
479	5c	483	iron	object	1	202			
484	4	489	ceramic	pot	1	5	17C		17C
484	4	489	ceramic	roof tile(flat)	1	723	L15C+		
485	4	489	ceramic	roof tile(flat)	1	298			L15C+
485	4	489	ceramic	roof tile(flat)	2	309	L15C+		
486	4	489	ceramic	pot	1	20	E2C	M2C	L15C+
486	4	489	ceramic	pot	1	34	M1C	E2C	
486	4	489	ceramic	roof tile(flat)	4	1082	L15C+		
487	4	489	ceramic	pot	1	12	L15C	16C	16C
487	4	489	ceramic	roof tile(flat)	1	376	13C	15C	
487	4	489	ceramic	roof tile(flat)	2	1308	L15C+		
496	6	-	ceramic	roof tile(flat)	1	95	13C	15C	L15C+
496	6	-	ceramic	roof tile(flat)	5	820	L15C+		
496	6	-	ceramic	tile	1	62			
497	3	535	ceramic	roof tile(flat)	3	747	L15C+		L15C+
497	3	535	ceramic	tegula	1	42			
497	3	535	iron	objects	2	608			
502	2	505	ceramic	imbrex	1	323			4C
503	2	505	ceramic	pot	1	2	M1C	4C	4C
504	2	505	ceramic	pot	1	1	M1C	4C	4C
506	1	505	ceramic	pot	1	3			Bronze Age
534	3	535	ceramic	pot	1	12	15C	E17C	17C
534	3	535	ceramic	pot	2	31	16C	17C	
534	3	535	ceramic	pot	1	4	2C		

534	3	535	ceramic	pot	1	30	E2C	M2C	
534	3	535	ceramic	pot	6	209	L15C	E17C	
534	3	535	ceramic	pot	2	73	L1C	E2C	
534	3	535	ceramic	pot	1	26	M1C	4C	
534	3	535	ceramic	pot	1	74	M1C	E2C	
534	3	535	ceramic	roof tile(flat)	5	1155	13C	15C	
534	3	535	ceramic	roof tile(flat)	1	39	L15C+		
534	3	535	slag	smithing slag	1	186			
536	3	535	ceramic	pot	1	3	13C	16C	16C
537	3	535	ceramic	pot	1	13	M1C	2C	2C
551	3	-	ceramic	pot	2	20	M17C	18C	M17-18C
569 (487)	3	-	copper alloy	pin	8	1	15C	16C	15-16C
569 (487)	3	-	copper alloy	?earring/buckle	1	1	15C	16C	
585	6	-	ceramic	pot	1	2	M1C	2C	2C
599	6	-	ceramic	pot	1	61	M17C	E18C	L17C

Table 11: Summary of context dating based on artefacts

7.6 Synthesis of the artefactual evidence

Although not directly linked to the function of the mill, the finds and in particular, the ceramic finds, have helped to inform the site dating and phasing. The ceramic roofing tile is likely to have originated from the mill buildings themselves, whilst the medieval and post-medieval pottery assemblages are domestic in nature, and may either represent the vessels used by the mill workers or simply be rubbish from elsewhere in the town.

8 Environmental evidence (by Elizabeth Pearson)

8.1.1 Project parameters

The environmental project conforms to relevant sections of the *Standard and guidance for archaeological excavation* (IfA 2012) and *Environmental Archaeology: a guide to the theory and practice of methods, from sampling and recovery to post-excavation* (English Heritage 2010).

8.1.2 Aims

The aims of the analysis were as follows:

To interpret the fluvial and depositional environment of the channels

To determine the nature of the local environment of the site

To provide information on activities carried out on the site and in the immediate vicinity, particularly those which may relate to the use of the mill.

8.1.3 Sampling policy

Samples were taken according to standard Worcestershire Archaeology practice (2012). A total of four sequences of deposits from palaeochannel or alluvial fills were sampled by monoliths for retrieval of pollen and micromorphological remains and bulk samples. Samples of 10 litres were taken in spits every 0.05m with the exception of the base of the main channel where samples of only approximately 2 litre size could be taken because of concerns over the safety of the section.

The following sequences were sampled were as follows (Figs 11 and 21):

Phase 1, prehistoric alluvial deposits (506) <5> and <6>;

Phase 2, Late Saxon/early medieval water management feature (502, 503 and 504), samples <3> and <4>;

Phase 3, medieval channel associated with Mill 1 (CG1) (473, 474 and 475), samples <1> and <2>;

Phase 4, medieval palaeochannel associated with Mill 2 (CG3) into which the mill structure was cut (585, 586, 587, 600), samples <7> and <8>.

8.2 Plant macrofossil remains (by Elizabeth Pearson)

As a result of assessment (Worcestershire Archaeology 2014) full analysis was proposed for fills of the main channel (535) and channel (472) (Table 12). Further scanning and limited full sorting of material from channel [535] was undertaken, but subsequent radiocarbon dating results indicated that there was an inversion of the deposits in this feature (ie the upper deposits dating earlier than the basal deposits). A date at the top of (587) showed this to be the case at least from the base of the main channel (535) up to c 1m below top surface of its fills shown on Figure 11, which was also in addition c 1.5m below modern mill floor surface. See above for an explanation of how this pattern of deposition is likely to have occurred (Section 5.4). The results from this sequence are, therefore, presented as being representative of a broad period of time from the 14th to 16th centuries. An inversion of deposits could also not be disproven for channel [472], and so further work here was similarly adjusted.

Spit samples and samples from monoliths from the main channel [535] were processed by wash-over as follows. Sub-samples of 0.5 to 2 litres size were broken up in a bowl of water to separate the light organic remains from the mineral fraction and heavier residue. The water, with the light organic fraction was decanted onto a 300mm sieve and the residue washed through a 1mm sieve. The remainder of the bulk sample was retained for further analysis.

Since radiocarbon dating of the Phase 2 channel [505] indicated progressive deposition of material from cal AD 970-1150 to cal AD 1320-1440 further work was just carried out on the base of this feature, where organic survival was suitable for analysis. Analysis was carried out by scanning of wet flots from the entire sample available (generated from paraffin flotation for insect analysis) to estimate abundance of plant remains (see below). Results from the quantification of a small sub-sample of the lowest spit, processed by the wash-over method, is also included.

Flots from samples of 8 to 10 litre size from channel [505], the water management feature, which had been generated by paraffin flotation to recover insect remains, were used to produce estimates of abundance of plant remains by scanning.

The wet flots from all samples were scanned or fully sorted using a low power MEIJI stereo light microscope. Plant remains were identified using modern reference collections maintained by Worcestershire Archaeology, and a seed identification manual (Cappers *et al* 2012). Nomenclature for the plant remains follows the *New Flora of the British Isles*, 3rd edition (Stace 2010). Residues were either scanned or fully sorted for significant organic material not extracted in the flots.

Context	Sample	Spit/Sub-sample	Feature type	Fill of	Phase	Sample volume (L)	Volume processed (L)
473	2	0.00 - 0.05m	Palaeochannel	472	3	10	1
475	2	1.20 - 1.25m	Palaeochannel	472	3	10	1
475	2	1.05 - 1.10m	Palaeochannel	472	3	10	1
504	4	0.75 - 0.80m	Palaeochannel	505	2	10	9
504	4	0.80 - 0.85m	Palaeochannel	505	2	10	10

504	4	0.85 – 0.90m	Palaeochannel	505	2	10	10
504	3	0.91 - 0.96m	Palaeochannel	505	2	10	0.5
585	8	0.05 - 0.10m	Palaeochannel	535	4	2	1
585	8	0.30 - 0.35m	Palaeochannel	535	4	0.6	0.6
585	8	0.50 - 0.55m	Palaeochannel	535	4	2	2
586	7	0.87 - 0.92m	Palaeochannel	535	4	0.6	0.6
587	7	0.92 - 0.97m	Palaeochannel	535	4	0.5	0.5
587	8	1.00 - 1.05m	Palaeochannel	535	4	2	2
587	7b	1.06 - 1.14m	Palaeochannel	535	4	0.6	0.6
600	7b	1.23 - 1.30m	Palaeochannel	535	4	0.6	0.6
600	7b	1.30 - 1.38m	Palaeochannel	535	4	0.6	0.6
600	8	1.52 - 1.57m	Palaeochannel	535	4	2	2
600	8	1.57 - 1.62m	Palaeochannel	535	4	2	2
600	8	1.67 - 1.72m	Palaeochannel	535	4	2	2
600	8	1.72 - 1.77m	Palaeochannel	535	4	2	2
600	8	1.77 - 1.82m	Palaeochannel	535	4	2	2
600	8	1.87 - 1.92m	Palaeochannel	535	4	2	0.5

Table 12: List of environmental samples

8.2.1 Discard policy

Samples will be discarded after a period of 6 months following submission of this report unless there is a specific request to retain them.

8.2.2 Results

The results for macrofossil remains are summarised in Tables 13-15.

Context	Sample	Spit/Sub-sample	insect	charcoal	charred plant	waterlogged plant
473	2	0.00 - 0.05m	occ	occ		abt
474	2	1.05 - 1.10m	occ	mod	occ	abt
475	2	1.20 - 1.25m	occ - mod			abt
502	4	0.05 - 0.10m		abt		
502	4	0.50 - 0.55m		abt		occ
503	4	0.75 - 0.80m	occ		occ	abt
506	6	0.00 - 0.05m				abt
506	6	0.15 - 0.20m			occ	abt
506	6	0.25 - 0.27m		occ		occ-mod
585	8	0.05 - 0.10m	occ	abt		abt
587	8	1.00 - 1.05m	occ	occ		abt
600	8	1.87 - 1.92m	occ-mod			abt

Table 13: Summary of environmental remains (occ = occasional, mod = moderate, abt = abundant)

Phase 1 Prehistoric alluvium/?Bronze Age (context 506)

The environmental remains were poorly preserved, consisting of only unidentified waterlogged wood fragments at the base and fragmented herbaceous material in samples from the middle and top of the sequence (Worcestershire Archaeology 2014). It is likely that this reflects a change from a woodland carr environment to a more open environment with mixed herbaceous vegetation. A single unidentified charred cereal grain was noted in the middle of the sequence, at 0.15 to 0.20m.

Phase 2 base of Late Saxon (late Saxon/Saxo-Norman) water management channel (505) (context 504) (Table 14)

Plant macrofossil remains were diverse, largely reflecting mosaic channel margin vegetation but with some evidence for agricultural and/or craft or industrial activity in the vicinity. Channel margin vegetation included various plants which would have been growing at the wet margins of the channel (Table 14), low levels of alder (*Alnus glutinosa*), bramble (*Rubus* sect *Glandulosa*) and elderberry growing on overgrown, neglected ground close to or lining the channel, and, in

particular, weeds of arable and waste ground. The latter included abundant stinking mayweed (*Anthemis cotula*), with lower levels of corn marigold (*Glebionis segetum*), corn cockle (*Agrostemma githago*), cornflower (*Centaurea cyanus*), field penny-cress (*Thlaspi arvense*) and prickly poppy (*Papaver argemone*). Abundant common nettle (*Urtica dioica*) suggests nitrogen-rich ground in the vicinity, potentially resulting from animal dung on pastureland or from manuring and middens. This might have resulted from the frequent presence of horses carting in grain and taking away flour.

Of interest was the presence of flax (*Linum usitatissimum*) and dyers rock (*Reseda luteola*) which are likely to relate to textile industrial activity in the vicinity or cultivation of crops relating to textile industry in the catchment area. Fennel (*Foeniculum vulgare*), a culinary herb, found towards the base of the channel may derive from disposal of kitchen waste or kitchen gardens in the vicinity. However, fennel can also grow as an escape from cultivation.

Context				504	504	504	504
Spit depth				0.75–0.80m	0.80 – 0.85m	0.85 – 0.90m	0.91 – 0.96m
Volume (L)				10	10	10	0.5
Latin name	Family	Common name	Habitat				
Charred plant remains							
<i>Triticum</i> sp glume base	Poaceae	wheat		+			
<i>Triticum</i> sp free-threshing grain	Poaceae	wheat		+			
Cereal sp indet grain	Poaceae	cereal	F		+		
Waterlogged plant remains							
<i>Papaver argemone</i>	Papaveraceae	prickly poppy	AB		+		
<i>Fumaria</i> sp	Papaveraceae	fumitory	ABC		+		
<i>Ranunculus acris/repens/bulbosus</i>	Ranunculaceae	buttercup	CD	++	+		
<i>Ranunculus sceleratus</i>	Ranunculaceae	celery-leaved buttercup	E	+	+	+	1
<i>Ranunculus</i> sbgen	Ranunculaceae	crowfoot	E		+		
<i>Prunus spinosa</i>	Rosaceae	sloe	C		+		
<i>Rubus</i> sect <i>Glandulosus</i>	Rosaceae	bramble	CD	++/+++	+	+	
<i>Urtica dioica</i>	Urticaceae	common nettle	ABCD	+++	+++	++	1
<i>Alnus glutinosa</i> (fruits)	Betulaceae	alder	CE		+	+	
<i>Viola</i> sp	Violaceae	violet	DF			+	1
<i>Linum usitatissimum</i> seed	Linaceae	flax	AF	+			1
<i>Linum usitatissimum</i> capsule segment	Linaceae	flax	AF	+			
<i>Epilobium</i> sp	Onagraceae	willowherbs	ABCDE				2
<i>Reseda luteola</i>	Resedaceae	dyer's rocket, weld	ABDF		+		
<i>Capsella bursa-pastoris</i>	Brassicaceae	shepherd's-purse	AB				1
<i>Lepidium coronopus</i>	Brassicaceae	swine-cress	B				1
<i>Brassica nigra</i>	Brassicaceae	black mustard	ABF		+		
<i>Thlaspi arvense</i>	Brassicaceae	field penny-cress	AB	+			
<i>Persicaria maculosa</i>	Polygonaceae	redshank	AB	+++	+++	++	
<i>Persicaria lapathifolia</i>	Polygonaceae	pale persicaria	AB				1
<i>Polygonum aviculare</i>	Polygonaceae	knotgrass	AB		+	+	
<i>Polygonum</i> sp	Polygonaceae	knotgrass	AB				1
<i>Rumex acetosella</i>	Polygonaceae	sheep's sorrel	ABD			+	1
<i>Rumex</i> cf <i>obtusifolius</i>	Polygonaceae	broad-leaved dock	AC				2
<i>Rumex</i> sp	Polygonaceae	dock	ABCD		++		2
<i>Stellaria media</i>	Caryophyllaceae	common chickweed	AB		+		1
<i>Cerastium</i> sp	Caryophyllaceae	mouse ear	DE			+	
<i>Agrostemma githago</i>	Caryophyllaceae	corn cockle	AB	++	+	+	
<i>Agrostemma githago</i> fragments	Caryophyllaceae	corn cockle	AB				+
<i>Silene flos-cuculi</i>	Caryophyllaceae	ragged-robin	ABE	+			4
<i>Chenopodium album</i>	Amaranthaceae	fat hen	AB	+	++		1
<i>Atriplex</i> sp	Amaranthaceae	orache	AB	++	++	+	
<i>Lysimachia</i> sp	Primulaceae	loosestrife	CDE	+			
<i>Hyoscyamus niger</i>	Solanaceae	henbane	AB		+		1
<i>Plantago major</i>	Plantaginaceae	greater plantain	ABD	++			2

<i>Scrophularia</i> sp	Scrophulariaceae	figwort	ABC				1
<i>Galeopsis tetrahit</i>	Lamiaceae	common hemp-nettle	AB		+		
<i>Marrubium vulgare</i>	Lamiaceae	white horehound	ABD	++			1
<i>Lycopus europaeus</i>	Lamiaceae	gypsywort	E	+	+	+	
<i>Cirsium arvense</i>	Asteraceae	creeping thistle	ABDE				1
<i>Cirsium</i> sp	Asteraceae	thistle	ABDE	++	+	+	1
<i>Centaurea cyanus</i>	Asteraceae	cornflower	D		+		
<i>Centaurea</i> sp	Asteraceae	knapweed/cornflower	ABD	+			
<i>Lapsana communis</i>	Asteraceae	nipplewort	BCD	++	+		
<i>cf Inula</i> sp	Asteraceae	fleabanes	ABCD		+		
<i>Anthemis cotula</i>	Asteraceae	stinking chamomile	AB	+++	+++	++	4
<i>Glebionis segetum</i>	Asteraceae	corn marigold	AB		++	+	1
<i>Bidens tripartita</i>	Asteraceae	trifid bur-marigold	E			+	
<i>Bidens</i> sp	Asteraceae	bur-marigold	ABE		+		
<i>Sambucus nigra</i>	Caprifoliaceae	elderberry	BC	+	+		
<i>Foeniculum vulgare</i>	Apiaceae	fennel	ABF			+	
<i>Conium maculatum</i>	Apiaceae	hemlock	AB		+		
<i>Bupleurum rotundifolium</i>	Apiaceae	thorow-wax	AB		+		1
<i>Apium nodiflorum</i>	Apiaceae	fool's watercress	E	+			
<i>Alisma plantago-aquatica</i>	Alismataceae	water-plantain	E	+			
<i>Eleocharis</i> sp	Cyperaceae	spike-rush	E	+	+	+	2
<i>Carex</i> sp (2-sided) nutlets	Cyperaceae	sedge	CDE		+		
<i>Carex</i> sp (3-sided) nutlets	Cyperaceae	sedge	CDE	+	+	+	1
<i>Poaceae</i> sp indet grain	Poaceae	grass	AF	+	+		
unidentified moss fragments	unidentified						+

Table 14: Plant remains from Phase 2 water management feature

Phase 3 medieval channel associated with Mill 1 (CG1) (contexts 473, 474 and 475) (Table 14)

The results of the analysis from channel (472) are shown in Table 15. Assessment had shown that plant macrofossil remains were also diverse in these samples, with a similar composition to the Phase 2 channel (above). Weeds of arable cultivation (segetals) were particularly prevalent in the base of channel (472). Also significant were the finds of fig (*Ficus carica*) at the base of channel (472), dyers rocket (*Reseda luteola*), a plant used traditionally to produce a yellow dye, at the top of channel (472), and at the same level, a fragment of teasel which could be wild teasel (*Dipsacus fullonium*) or the cultivated fullers teasel (*Dipsacus sativus*). Although the presence of teasel does not necessarily imply that teasels were used to raise the nap on cloth after fulling, the presence of teasel (wild or cultivated) is of note as it rarely occurs in waterlogged assemblages, and when it does occur it is most often associated with other remains indicative of textile industry. The base of channel (472) was dated to cal AD 1400-1470 (95.4% probability). Since Mill 1 was located on the eastern edge of the town it is a likely area for the tentering of cloth which had been washed in the river in preparation for this stage.

Context				473	475	475
Spit depth				0.00 – 0.05m	1.05– 1.1m	1.20 – 1.25m
Volume (L)				1	1	1
Latin name	Family	Common name	Habitat			
Charred plant remains						
<i>Triticum</i> sp (free-threshing) grain	Poaceae	free-threshing wheat	F		+	
Waterlogged plant remains						
<i>Ranunculus acris/repens/bulbosus</i>	Ranunculaceae	buttercup	CD	++	++	+
<i>Ranunculus</i> sp	Ranunculaceae	buttercup	ABCDE			+
<i>Ranunculus</i> s/bgen <i>Batrachium</i>	Ranunculaceae	crowfoot	E		+	+
<i>Rubus</i> sect <i>Glandulosus</i>	Rosaceae	bramble	CD	+	+	+
<i>Ficus carica</i>	Moraceae	fig	F			+
<i>Urtica dioica</i>	Urticaeae	common nettle	ABCD	++		
<i>Urtica urens</i>	Urticaeae	small nettle	AB			+
<i>Alnus glutinosa</i> (fruits)	Betulaceae	alder	CE		++	+
<i>Hypericum</i> sp	Hypericaceae	St johns's wort	CD	+		
<i>Reseda luteola</i>	Resedaceae	dyer's rocket, weld	ABDF	+		
<i>Rorippa islandica</i>	Brassicaceae	northern yellow-cress	E	+		+

<i>Brassica</i> sp	Brassicaceae	cabbages	ABDF			+
<i>Persicaria maculosa</i>	Polygonaceae	redshank	AB		+	+
<i>Polygonum aviculare</i>	Polygonaceae	knotgrass	AB		+	+
<i>Rumex acetosella</i>	Polygonaceae	sheep's sorrel	ABD		+	
<i>Rumex</i> sp	Polygonaceae	dock	ABCD	+	+	++
<i>Stellaria media</i>	Caryophyllaceae	common chickweed	AB		+	+
<i>Stellaria graminea</i>	Caryophyllaceae	lesser stitchwort	D	+		+
<i>Agrostemma githago</i>	Caryophyllaceae	corn cockle	AB			+
<i>Chenopodium album</i>	Amaranthaceae	fat hen	AB		++	
<i>Atriplex</i> sp	Amaranthaceae	orache	AB	+		+++
<i>Primula/Lysimachia</i> sp	Primulaceae	primrose/loosestrife	CDEF			+
<i>Hyoscyamus niger</i>	Solanaceae	henbane	AB		+	+
<i>Plantago major</i>	Plantaginaceae	greater plantain	ABD			+
<i>Prunella vulgaris</i>	Lamiaceae	selfheal	D	+		
<i>Cirsium</i> sp	Asteraceae	thistle	ABDE		+	+
<i>Lapsana communis</i>	Asteraceae	nippewort	BCD			+
<i>Sonchus asper</i>	Asteraceae	prickly sow-thistle	ABD			+
<i>Anthemis cotula</i>	Asteraceae	stinking chamomile	AB			++
<i>Glebionis segetum</i>	Asteraceae	corn marigold	AB			++
<i>Sambucus nigra</i>	Caprifoliaceae	elderberry	BC	+		+
<i>Sambucus ebulus</i>	Caprifoliaceae	dwarf elder	BD			+
<i>Dipsacus</i> sp	Dipsacaceae	teasel	BDF	+		
<i>Apium graveolens</i>	Apiaceae	wild celery	E	++	+	+
<i>Apium nodiflorum</i>	Apiaceae	fool's watercress	E			++
cf <i>Apium inundatum</i>	Apiaceae	lesser marshwort	E			+
<i>Zannichellia palustris</i>	Potamogetonaceae	horned pondweed	E	+		
<i>Eleocharis</i> sp	Cyperaceae	spike-rush	E		+	+
<i>Carex</i> sp (2-sided) nutlets	Cyperaceae	sedge	CDE	+		+
<i>Carex</i> sp (3-sided) nutlets	Cyperaceae	sedge	CDE	+	+	+
Poaceae sp indet grain (small)	Poaceae	grass	AF			+
unidentified twig/bud fragments	unidentified				+	
unidentified moss fragments	unidentified				+	
unidentified wood fragments	unidentified			+++	+++	
unidentified herbaceous fragments	unidentified			+++	+++	+++

Table 15: Plant remains from Phase 3 channel associated with Mill 1 (CG1) – assessment results

Phase 4 medieval mill channel [535] (contexts 585, 586, 586 and 600)

Radiocarbon dating of deposits in this channel showed an inversion (Fig 21) and are thought to have been affected by dumping and backfilling during the construction of mill CG2/3. The lower layer (600) may be relatively undisturbed and have built up sequentially, but this is uncertain. It must, therefore, be borne in mind that the results from this sequence represent a broad date range (14th to 15th century).

Plant macrofossil composition is similar to the above channels, largely reflecting mosaic bankside vegetation, including some alder (*Alnus glutinosa*) and bramble (*Rubus* sect *Glandulosa*), plants which would have been growing at the wet margins of the channel, with the exception that weeds of arable and waste ground are poorly represented. The composition was relatively consistent through the sequence, although preservation was poorer in deposits above 0.70m (bgs) which are assumed to be dumped and are, therefore, inverted.

However, of note, in several contexts, was the moderate quantity of wild celery (*Apium graveolens*) which may either have been an escape from cultivation as it is a known culinary herb, or may be present because it is tolerant of brackish (briny) conditions. It has been recorded at other sites in and around Droitwich, for example at occasional finds at Old Bowling Green (Colledge and Greig 1992) and Upwich (Greig 1997, 139). Also, cultivated flax (*Linum usitatissimum*) and dyers rocket (*Reseda luteola*) in the middle to base of the sequence (0.90 to 1.60m) again suggesting textile processing or cultivation either on the site or in the catchment.

Context				585	585	585	586	587	587	587	600	600	600	600	600	600	600	
Spit depth				0.05 – 0.10m	0.30 – 0.35m	0.50 – 0.55m	0.87 – 0.92m	0.92 – 0.97m	1.00 – 1.05m	1.06 – 1.14m	1.23 – 1.30m	1.30 – 1.38m	1.52 – 1.57m	1.57 – 1.62m	1.67 – 1.72m	1.72 – 1.77m	1.77 – 1.82m	1.87 – 1.92m
Volume (L)				1	0.6	2	0.6	0.5	2	0.6	0.6	0.6	2	2	2	2	2	2
Latin name	Family	Common name	Habitat															
Charred plant remains																		
Cereal sp indet culm node	Poaceae	cereal	F														+	
<i>Corylus avellana</i> shell fragment	Betulaceae	hazelnut	C														+	
Waterlogged plant remains																		
<i>Polygonum lapathifolium</i>													+					
Cereal sp indet culm node	Poaceae	cereal	F														+	
<i>Ranunculus acris/repens/ bulbosus</i>	Ranunculaceae	buttercup	CD	+	+	++			++	++	+	+	+	+	++	++	++/+	+
<i>Ranunculus sardous</i>	Ranunculaceae	hairy buttercup	ABD			+											+	
<i>Ranunculus arvensis</i>	Ranunculaceae	corn buttercup	A														+	
<i>Ranunculus sceleratus</i>	Ranunculaceae	celery-leaved buttercup	E		+	+				+		+	++				+	
<i>Ranunculus</i> sbgen <i>Batrachium</i>	Ranunculaceae	crowfoot	E								+		+					
<i>Rubus</i> sect <i>Glandulosus</i>	Rosaceae	bramble	CD		+	+			+	+	+		+	+	+		+	
<i>Rubus</i> sp	Rosaceae	raspberry/bramble/dewberry	BC					1						+				
<i>Urtica dioica</i>	Urticaeae	common nettle	ABCD	+	+	+	3	1	+	+	+		++	+				+
<i>Alnus glutinosa</i> (fruits)	Betulaceae	alder	CE			+			+	+		+	+		+	+	++	
<i>Alnus qlutinosa</i> fruit	Betulaceae	alder	CE											+				

Context				585	585	585	586	587	587	587	600	600	600	600	600	600	600	
Spit depth				0.05 – 0.10m	0.30 – 0.35m	0.50 – 0.55m	0.87 – 0.92m	0.92 – 0.97m	1.00 – 1.05m	1.06 – 1.14m	1.23 – 1.30m	1.30 – 1.38m	1.52 – 1.57m	1.57 – 1.62m	1.67 – 1.72m	1.72 – 1.77m	1.77 – 1.82m	1.87 – 1.92m
Volume (L)				1	0.6	2	0.6	0.5	2	0.6	0.6	0.6	2	2	2	2	2	2
Latin name	Family	Common name	Habitat															
(fragment)																		
<i>Corylus avellana</i> shell fragment	Betulaceae	hazelnut	C										+					
<i>Viola</i> sp	Violaceae	violet	DF									+						
<i>Linum usitatissimum</i> seed	Linaceae	flax	AF					1					+					
<i>Linum catharticum</i>	Linaceae	fairy flax	D					1					+					
<i>Geranium dissectum</i>	Geranaceae	cut-leaved crane's-bill	ABD						+									
<i>Reseda luteola</i>	Resedaceae	dyer's rocket, weld	ABDF					1		+								
<i>Brassica nigra</i>	Brassicaceae	black mustard	ABF	+														
<i>Persicaria maculosa</i>	Polygonaceae	redshank	AB			+							+	+	+	+	+	
<i>Persicaria lapathifolia</i>	Polygonaceae	pale persicaria	AB											+				
<i>Persicaria hydropiper</i>	Polygonaceae	water-pepper	E										+					
<i>Persicaria</i> sp indet (fragment)	Polygonaceae	water-pepper	E				1											
<i>Polygonum aviculare</i>	Polygonaceae	knotgrass	AB			+	3	1				+	+		+	+	+	
<i>Polygonum</i> sp	Polygonaceae	knotgrass	AB					2										
<i>Persicaria</i> / <i>Polygonum</i> sp	Polygonaceae	knotgrass	AB								+		+					
<i>Rumex acetosella</i>	Polygonaceae	sheep's sorrel	ABD								+				+	+		
cf <i>Rumex acetosella</i>	Polygonaceae	sheep's sorrel	ABD		+													
<i>Rumex</i> cf <i>obtusifolius</i>	Polygonaceae	broad-leaved dock	AC								+							
<i>Rumex</i> sp	Polygonaceae	dock	ABCD			+	5	7	++		+	+	+	+	+	+	++	++
<i>Stellaria media</i>	Caryophyllaceae	common chickweed	AB	+		+	2		+		+	+	+	+			+	+
<i>Stellaria graminea</i>	Caryophyllaceae	lesser	D							+								

Context				585	585	585	586	587	587	587	600	600	600	600	600	600	600	
Spit depth				0.05 – 0.10m	0.30 – 0.35m	0.50 – 0.55m	0.87 – 0.92m	0.92 – 0.97m	1.00 – 1.05m	1.06 – 1.14m	1.23 – 1.30m	1.30 – 1.38m	1.52 – 1.57m	1.57 – 1.62m	1.67 – 1.72m	1.72 – 1.77m	1.77 – 1.82m	1.87 – 1.92m
Volume (L)				1	0.6	2	0.6	0.5	2	0.6	0.6	0.6	2	2	2	2	2	2
Latin name	Family	Common name	Habitat															
		stitchwort																
cf <i>Cerastium</i> sp	Caryophyllaceae	mouse ear	DE															+
<i>Agrostemma githago</i>	Caryophyllaceae	corn cockle	AB				3											
<i>Agrostemma githago</i> fragments	Caryophyllaceae	corn cockle	AB				1											
<i>Silene flos-cuculi</i>	Caryophyllaceae	ragged-robin	ABE													+		
<i>Chenopodium glaucum/rubrum</i>	Amaranthaceae	oak-leaved/red goosefoot	AB															
<i>Chenopodium album</i>	Amaranthaceae	fat hen	AB								+		+	+		+		+
<i>Atriplex</i> sp	Amaranthaceae	orache	AB		+	+			+				+	+	+	+	+	
<i>Chenopodium/Atriplex</i> x sp	Amaranthaceae	goosefoot/orache	AB					1										
<i>Lysimachia</i> sp	Primulaceae	loosestrife	CDE															+
cf <i>Glaux maritima</i>	Primulaceae	sea-milkwort	B			+												
<i>Hyoscyamus niger</i>	Solanaceae	henbane	AB						+				+	+		+		
<i>Plantago major</i>	Plantaginaceae	greater plantain	ABD				1			+		+						
<i>Scrophularia</i> sp	Scrophulariaceae	figwort	ABC					2										
<i>Prunella vulgaris</i>	Lamiaceae	selfheal	D											+				+
<i>Lycopus europaeus</i>	Lamiaceae	gypsywort	E				1											
<i>Arctium</i> sp	Asteraceae	burdock	ABC								+							
<i>Cirsium</i> sp	Asteraceae	thistle	ABDE			+			+		+	+			+			
<i>Centaurea</i> sp (pappas)	Asteraceae	knapweed/c ornflower	ABD								+							
<i>Picris</i> cf <i>hieracioides</i>	Asteraceae	hawkweed oxtongue	D										+					
<i>Sonchus oleraceus</i>	Asteraceae	smooth sow-thistle	ABD								+							
<i>Sonchus asper</i>	Asteraceae	prickly sow-thistle	ABD												+	+	+	
cf <i>Inula</i> sp	Asteraceae	fleabanes	ABC											+				

Context				585	585	585	586	587	587	587	600	600	600	600	600	600	600
Spit depth				0.05 – 0.10m	0.30 – 0.35m	0.50 – 0.55m	0.87 – 0.92m	0.92 – 0.97m	1.00 – 1.05m	1.06 – 1.14m	1.23 – 1.30m	1.30 – 1.38m	1.52 – 1.57m	1.57 – 1.62m	1.67 – 1.72m	1.72 – 1.77m	1.77 – 1.82m
Volume (L)				1	0.6	2	0.6	0.5	2	0.6	0.6	0.6	2	2	2	2	2
Latin name	Family	Common name	Habitat														
<i>Solidago/Aster</i> sp	Asteraceae	goldenrod/ Michaelmas -daisies	BCD											+			
<i>Artemisia</i> sp	Asteraceae	mugwort	BC										+				
<i>Anthemis cotula</i>	Asteraceae	stinking chamomile	AB		+	+	1	1					+	+		+	
<i>Glebionis segetum</i>	Asteraceae	corn marigold	AB	+		+					+		+	+	+		
<i>Bidens</i> sp	Asteraceae	bur- marigold	ABE								+						
Asteraceae sp indet	Asteraceae		ABCDEF										+				
<i>Sambucus nigra</i>	Caprifoliaceae	elderberry	BC			+	1						+	+		+	
<i>Anthriscus caucalis</i>	Apiaceae	bur chervil	ABC								+						
<i>Aethusa cynapium</i>	Apiaceae	fool's parsley	AB		+												
<i>Conium maculatum</i>	Apiaceae	hemlock	AB			+										+	
<i>Apium graveolens</i>	Apiaceae	wild celery	E			+	5	4	++	+	+						+
<i>Apium nodiflorum</i>	Apiaceae	fool's watercress	E			++	18	20	+++	++	+	+	++	+	++	++	+++
<i>Alisma plantago- aquatica</i>	Alismataceae	water- plantain	E								+						
<i>Zannichellia palustris</i>	Potamogetonaceae	horned pondweed	E									+			+		
<i>Juncus</i> sp	Juncaceae	rush	DE										+				++
<i>Schoenoplectus lacustris</i>	Cyperaceae	common club-rush	E			+						+				+	
<i>Eleocharis</i> sp	Cyperaceae	spike-rush	E		+	+			+			+	+			+	
<i>Carex</i> sp	Cyperaceae	sedge	CDE											+		+	
<i>Carex</i> sp (2-sided) nutlets	Cyperaceae	sedge	CDE	+	+	+		1	+						+	+	
<i>Carex</i> sp (3-sided) nutlets	Cyperaceae	sedge	CDE		+	+		1	+	+	+		+			++	+
<i>Glyceria/Melica</i> sp	Poaceae	sweet grass/melic	CDE			+										+	

Context				585	585	585	586	587	587	587	600	600	600	600	600	600	600	
Spit depth				0.05 – 0.10m	0.30 – 0.35m	0.50 – 0.55m	0.87 – 0.92m	0.92 – 0.97m	1.00 – 1.05m	1.06 – 1.14m	1.23 – 1.30m	1.30 – 1.38m	1.52 – 1.57m	1.57 – 1.62m	1.67 – 1.72m	1.72 – 1.77m	1.77 – 1.82m	1.87 – 1.92m
Volume (L)				1	0.6	2	0.6	0.5	2	0.6	0.6	0.6	2	2	2	2	2	2
Latin name	Family	Common name	Habitat															
		k																
Poaceae sp indet grain	Poaceae	grass	AF		+													
unidentified twig/bud fragments	unidentified					++												
unidentified moss fragments	unidentified			+	+	+	+					+	+	+		+++	+	
unidentified thorn	unidentified										+							
unidentified seed	unidentified													+			+	
unidentified leaf fragments	unidentified													+				
unidentified wood fragments	unidentified				++		++							+		+++	+	
unidentified bud	unidentified				bud													
unidentified herbaceous fragments	unidentified			+++	+++	+++	+++		+++	++++	++++	++++		+++ +	+++ +	+++ +	+++ +	

Table 16: Plant remains from Phase 4 medieval palaeochannel 535

Key for Env Tables 14-16	
Habitat	Quantity
A= cultivated ground	+ = 1 - 10
B= disturbed ground	++ = 11- 50
C= woodlands, hedgerows, scrub etc	+++ = 51 -100
D = grasslands, meadows and heathland	++++ = 101+
E = aquatic/wet habitats	
F = cultivar	

8.3 Pollen analysis (Suzi Richer and Nick Daffern)

8.3.1 Methodology

Following assessment of 15 sub-samples from monoliths <1>, <3>, <5>, <7>, and <8> (by N Daffern) and the initial results of the radiocarbon dating programme, full analysis was only continued on monolith <3> as this was deemed to be stratigraphically intact. The radiocarbon dates from monoliths <1> and <7/8> were reversed, causing the integrity of the stratigraphy to be called into question and therefore the validity of any further pollen work on these sequences. Monolith <5> exhibited poor pollen preservation.

Samples were submitted to the laboratories of the Department of Geography & Environment at the University of Aberdeen for chemical preparation following standard procedures as described by Barber (1976) and Moore et al (1991). The full methodology is described in Appendix 2.

Where preservation allowed, pollen grains were counted to a total of 150 land pollen grains (TLP) for assessment purposes and 300 TLP for full analysis using a GS binocular polarising microscope at x400 magnification. Identification was aided by using the pollen reference slide collection maintained at the Worcestershire Archaeology office, and the pollen reference manual by Moore et al (1991) and Beug (2004). Nomenclature for pollen follows Stace (2010) and Bennett (1994).

The pollen diagrams have been drawn using Tilia 1.7.16 software (Grimm 2011) with taxa plotted against both depth and time scales. A dendrogram was created using CONISS (software within TILIA) to identify three local pollen assemblage zones (LPAZs). The age-depth model used to produce the chronology in the diagram can be found in the Radiocarbon dating Section (Fig 67). The maximum and minimum of the 95% probability range for the posterior density estimates have been used to construct two age-depth models (Fig 72; Y axis), enabling the full 95% probability range for depths of interest to be estimated.

Fungal spores and parasite ova were noted with rapid identification being undertaken to genus level. Identifications were aided through reference material maintained at the Worcestershire Archaeology office and reference manuals, Kirk et al (2008) and Grant-Smith (2000).

8.3.2 Pollen Results

The assessment and full analysis results are summarised in Appendix 3 and a summary pollen diagram for monolith <3> can be found in Figure 72.

8.3.3 Assessment Results

Monolith <1>

Channel (472) (1.32m, context 475; 0.92m; context 474; 0.60m, context 474; 0.12m, context 473)

This sequence typically contained pollen in low to moderate concentrations whilst preservation was often good to moderate although the basal sample, 1.32m, did exhibit poor preservation.

Herbaceous species contributed between 64% and 59% TLP of the pollen sum in all four samples with Poaceae (grasses) being the dominant component of this figure contributing between 25% and 21% TLP. *Cichorium intybus*-type (chicory/dandelions), *Urtica dioica* (stinging nettle), *Solidago virgaurea*-type (daisies/goldenrods) and Cyperaceae undiff (sedges) were the only additional herbaceous species to make significant contributions (>5% TLP) but none exceeded 10% TLP.

Lesser contributions (<5% TLP) were made by a range of herbaceous species including Apiaceae (carrot family), Rosaceae (rose family), Amaranthaceae (goosefoots), *Achillea*-type (yarrows/chamomiles), *Trifolium*-type (clovers) *Centaurea cyanus* (cornflower) and *Vicia sylvatica*-type (vetches/vetchlings/peas).

Cereal cultivars or species utilised in textile production, such as *Cannabis*-type, *Linum bienne*-type (flax) *Reseda* (weld/mignonette) and *Cerealia* indet were also present in lower quantities.

Tree and shrub species contributed between 40% and 35% TLP with *Alnus glutinosa* (alder) consistently representing between 29% and 20% of this figure. *Corylus avellana* –type (hazel) was the sole additional species to exceed 5% TLP, although grains of *Pinus sylvestris* (Scot's pine), *Ulmus* (elm), *Quercus* (oak), *Betula* (birch), *Salix* (willow), *Tilia cordata* (small-leaved lime), *Fraxinus excelsior* (ash) and *Ilex aquifolium* (holly) were sporadically identified in limited quantities.

Heaths were solely represented by *Calluna vulgaris* (heather), although their contribution was limited.

Spores identified were *Pteridium aquilinum* (bracken), *Polypodium* (polypody), *Pteropsida* (mono) indet (ferns) and *Sphagnum* (Sphagnum) whilst aquatics included *Myriophyllum spicatum* (spiked water milfoil), *Butomus umbellatus* (flowering rush), *Sparganium emersum*-type (unbranched bur-reed/lesser bulrush), and *Typha latifolia* (bulrush).

Monolith <5>

These samples were characterised by very low concentrations of material in poorly preserved condition with none of the three samples containing enough material to achieve a complete assessment count. No further consideration will be given to these samples.

Monolith <7>

Channel [535] (1.87m–1.92m, context 534/600; 1.47m, context 497/587; 0.96m, context 497/587; 0.50m, context 585d; 0.02m, context 585a)

Herbaceous species again dominate, increasing from 60% TLP in the basal sample increasing to 69% TLP by the top of the sequence, and this expansion is also witnessed in Poaceae undiff, the main herbaceous contributor, increasing from 14% TLP at the base to 32% and 25% TLP in the upper two samples. Significant contributions (>5% TLP) were made by *Urtica dioica*, *Cichorium intybus*-type, *Solidago virgaurea*-type, Apiaceae and Cyperaceae undiff.

A wide variety of species made lesser contributions including *Ranunculus acris*-type (buttercups), Rosaceae, *Filipendula* (meadowsweet), Brassicaceae, *Fallopia* (black bindweed), *Rumex acetosella* (sheep's sorrel), *Rumex obtusifolius*-type (broad-leaved dock), Amaranthaceae, *Cuscuta* (dodders), *Plantago lanceolata*, *Centaurea scabiosa*, *Centaurea nigra* (common knapweed), *Centaurea cyanus*, *Cirsium*-type, *Achillea*-type and *Valeriana dioica* (marsh valerian).

Cultivars were represented by the presence of *Cannabis*-type, *Cerealia*-type, *Avena/ Triticum*-type, *Hordeum*-type (barley) and *Secale cereale*.

Heaths were more abundant in this sequence than those previously investigated peaking at 8% TLP in the middle sample, 0.96m. *Calluna vulgaris* and *Vaccinium*-type (bilberry/heath/bog-rosemary) were the two identified species with the latter being the most abundant (5%TLP) in the middle sample.

Tree and shrub species reduces upwards through the sequence from 37% and 40% TLP in the two basal samples down to 30% TLP in the uppermost sample (0.02m). *Alnus glutinosa* was the most abundant arboreal species throughout contributing between 23% and 19% TLP whilst *Betula* and *Corylus avellana*-type also made contributions over 5% TLP. Grains of *Pinus sylvestris*, *Ulmus*, *Quercus*, *Salix*, *Tilia cordata*, *Ligustrum vulgare* (wild privet) and *Ilex aquifolium* were also identified in low frequencies.

Spores identified were *Pteridium aquilinum*, *Polypodium*, *Pteropsida* (mono) indet and *Sphagnum*.

8.3.4 Full analysis results

Monolith <3>

Channel [505] (0.94m, context 504; 0.90m context 503, 0.86m, context 503, 0.78m context 503, 0.68m, context 503, 0.58m, context 503; 0.50m, context 503; 0.10m, context 502; all P2)

A summary diagram is presented in Figure 72. The profile is dominated by herbaceous taxa. Using the dendrogram produced by CONISS, three local pollen assemblage zones have been defined and the modelled estimates for their boundaries can be found in Table 17.

Posterior	Posterior Density Estimate (95% probability)
HR1_2	<i>cal AD 955–1180</i>
HR2_3	<i>cal AD 1085–1295</i>

Table 17: Posterior density estimates for the boundaries between the local pollen assemblage zones in Monolith <3>.

Preservation

Pollen preservation and concentration in the basal samples was good–excellent, but declined towards the upper samples with a full count being unachievable on the uppermost sample (0.1m). In the samples where preservation was poor, this was exhibited by degradation to the exine and mechanical damage, in this instance grains being folded or broken. Degradation is indicative of oxidation and mechanical damage is often caused by the transportation of pollen grains, for instance by water (Delcourt and Delcourt 1980).

HR1 (94–82cm)

Based on the age-depth model (Fig 67) this pollen zone is estimated to have started in *cal AD 900–1130* (95% probability; distribution not shown) and ended in *cal AD 955–1180* (95% probability; distribution not shown).

Herbaceous taxa dominate this zone (75–77%), being composed principally of Poaceae (17–24%), Cyperaceae (21–22%), *Cichorium intubus*-type (7–9%) and *Achillea*-type (0–4%). In terms of anthropogenic indicator species, a peak in Cerealia-type (7%) was noted in this zone, along with grains identifiable as *Secale cereale* (rye) and *Avena/Triticum*-type (oat/wheat). Chenopodiaceae, *Plantago lanceolata* and *Urtica dioica* were also present, indicating disturbed ground. Other herbaceous taxa present above 1% were: Apiaceae, Cannabaceae, Brassicaceae, *Centaurea Cyanus*, *Cirsium*-type, *Filipendula*, *Ranunculus acris*-type, *Saxifraga granulata*-type and *Solidago vigaurea*-type.

Arboreal pollen was dominated by *Alnus glutinosa* (9–13%), with *Betula* contributing a small percentage (1–2%). Occasional grains of *Quercus*, *Tilia cordata* and *Ulmus* were noted. *Corylus* and *Salix* represent the shrubby taxa (6–8 and 1–3%, respectively).

Spores from *Polypodium*, *Pteridium*, *Diphasiastrum* and *Pteropsida* (mono) indet. were present in HR1. The sole aquatic species identified was *Sparganium erectum*. Although present in low numbers, the spores are indicative of damp, shady conditions and *S. erectum* is suggestive of still, open water.

Of particular note in HR1 is the presence of fungal ascospores. *Sporormiella*-type dominated the zone. Other types present included *Cercophora*-type, *Chaetomium*-type, *Podospora*-type and *Sordaria*-type. All of the species present are affiliated with dung, with *Sporormiella*-type, *Podospora*-type and *Sordaria*-type having a preference for herbivore dung; *Cercophora* can also be indicative of more general degraded organic matter (van Geel *et al* 2003; Davis and Shafer

2006; Aproot and van Geel 2006). Parasite ova from *Trichuris trichiura/suis* also peaked in this zone, although they were not present in sufficient quantity to suggest whether they were from a species that affects people or animals. Their presence, in combination with the dung fungal spores, indicates the presence of grazing animals close to the site.

HR2 (82–55 cm)

Based on the age-depth model (Fig 67) this pollen zone is estimated to have started in *cal AD* 955–1180 (95% probability; distribution not shown) and ended in *cal AD* 1085–1295 (95% probability; distribution not shown).

Herbaceous taxa continue to dominate this zone (62–77%). A slight dip in the percentage of herbaceous taxa occurs in the middle of the zone; this is likely to be a statistical effect of an increase in alder pollen at this point, rather than a change in the environment. However, this is also the boundary between context 504 and 503. The main species present are Poaceae (9–18%), Cyperaceae (16–23%), *Cichorium intubus*-type (6–12%) and *Achillea*-type (3–5%).

In terms of anthropogenic indicator species Cerealia-type are steadily present throughout the zone (4–5%) and *Avena/Triticum*-type (oat/wheat) forms a continuous curve (1–2%). Levels of Chenopodiaceae, *Plantago lanceolata* and *Urtica dioica* fall compared to HR1. Taxa that could be indicative of textile processing occur in very low numbers in this zone: *Linum bienne*-type (1%), *Cuscuta* (1–3%) and Cannabaceae (1%). Other herbaceous taxa present above 1% were: Apiaceae, Brassicaceae, *Centaurea Cyanus*, *Cirsium*-type, *Filipendula*, *Ranunculus acris*-type, *Saxifraga granulata*-type and *Solidago vigaurea*-type.

Arboreal pollen remains dominated by *Alnus glutinosa* (10–20%), with *Betula* contributing a small percentage (1–2%). Occasional grains of *Fraxinus excelsior*, *Quercus*, *Tilia cordata* and *Ulmus* were noted. *Corylus* and *Salix* represent the shrubby taxa (5–8 and 2–7%, respectively).

Spores from *Polypodium*, *Pteridium* and *Diphasiastrum* were present. The only aquatic species identified was *Sparganium erectum*.

Fungal spores and parasite ova are still present in this zone, but their numbers have declined compared to HR1.

HR3 (55–10 cm)

Based on the age-depth model (Fig 67) this pollen zone is estimated to have started in *cal AD* 1085–1295 (95% probability; distribution not shown) and ended in *cal AD* 1324–1463 (95% probability; distribution not shown).

Herbaceous taxa continue to dominate this zone (64–73%), being composed principally of Poaceae (17–21%), Cyperaceae (20–21%), *Cichorium intubus*-type (6–7%) and *Achillea*-type (0–5%). In terms of anthropogenic indicator species, Cerealia-type (5%) continues to be present. The highest levels of Chenopodiaceae are recorded in this zone (5–6%); *Plantago lanceolata* and *Urtica dioica* were also present in low numbers, all indicative of disturbed ground. Other herbaceous taxa present above 1% were: Apiaceae, Cannabaceae, Brassicaceae, *Centaurea Cyanus*, *Cirsium*-type, *Filipendula*, *Ranunculus acris*-type, *Saxifraga granulata*-type and *Solidago vigaurea*-type.

Arboreal pollen was dominated by *Alnus glutinosa* (11–24%), with *Betula* contributing a small percentage (1–5%). Occasional grains of *Fraxinus excelsior*, *Pinus sylvestris*, *Quercus* and *Tilia cordata* were noted. *Corylus* and *Salix* represent the shrubby taxa (2–7%).

The only spores identified from HR1 were *Pteridium*. The sole aquatic identified was *Typha latifolia*, suggestive of still, open water.

The only fungal spore present in this zone is *Sordaria*-type, however HR3 sees a large increase in microcharcoal particles, suggesting that burning was occurring close to the site.

Pollen discussion

Overall, the pollen from Hanbury Road reveals an open, meadow-type landscape, close to water that was being used for a range of activities including crop cultivation, animal grazing and possibly the growing/processing of textiles such as flax and hemp.

Environment

The pollen evidence from all sequences indicates that a relatively open landscape prevailed throughout the life of the site, with no significant change occurring. The presence of grasses alongside common and greater knapweed, broad-leaved dock, clovers/trefoils, daisies/goldenrods, chicory/dandelions and stinging nettles, indicates meadow grassland with some disturbance.

Vegetation from the banks of a watercourse, or from a permanently waterlogged area, is indicated by the high levels of alder and willow, both species having a preference for 'keeping their feet wet'. The presence of meadowsweet is also indicative of wet, marshy or boggy conditions. Prior to *cal AD 1100–1300* (95% probability; distribution not shown) the presence of ferns indicates that damp shady places existed close to the site.

Tree pollen is relatively scarce across all profiles, however occasional grains of oak, lime, pine, ash, elm were recorded. While the area directly around the site is likely to have been open, the broad-leaved trees would have been growing on drier/higher ground, slightly further away from the site. This pattern of vegetation is similar to other sites around Droitwich (e.g. Head 2005; 2007) and within the wider Severn and Avon valleys within post-Roman Worcestershire. Work to the north of Droitwich at Impney Farm (Greig 1999), recorded values for tree higher tree pollen, in particular hazel and pine from AD 1200 onwards - coppiced hazel may have been particularly important for fuelling the salt industry (D Hurst, pers comm).

Looking more broadly, dodder may have an etymological link with the local parish name Dodderhill (Hurst *et al* 2011), suggesting that it may once have been common in the vicinity. Its presence in the pollen spectra is unsurprising given its parasitic relationship with species including stinging nettle, hop/hemp, cereals, clover vetches and heather, all of which have been identified.

Arable activity

Cereal pollen, in particular that of oat/wheat and rye, was recorded in contexts 503 and 504. In addition, the arable weed, cornflower, is also present in context 503 from *cal AD 935–1165* (95% probability; distribution not shown). This is broadly contemporary with Greig's (1982) suggestion that it first appears in British vegetational records from the 12th century onwards. Other arable weeds are also present at the site including bindweed, common poppy and chamomile. Similar pollen evidence of arable agriculture was seen at Impney Farm near Droitwich (Greig 1999) and from another Roman–post-Medieval site off Hanbury Road in Droitwich (Head 2007), suggesting that parts of the local landscape were being cultivated.

It should be noted that in all of the sub-samples in which *Cereal*-type (indeterminable cereal/large Poaceae) occurs, the grain may not necessarily be that of a cultivated grass/cereal species. There are numerous overlaps as regards the morphology of Poaceae family grains which could mean that the pollen may in fact derive from uncultivated species such as *Glyceria* (sweet-grass) (Anderson 1979; Moore *et al* 1991, 100). However, its combination with arable weeds and oat/wheat and rye pollen grains indicates that the grains identified are very likely to be cereal pollen grains.

Animals

Whipworm (a parasite of the large intestine) ova, were identified in monoliths <7> and <3>. This genus is present within the intestinal tract and faecal material of many mammals including humans, livestock and domestic pets, and therefore identifying the source is extremely difficult. Based upon size and morphology, the ova identified in all samples are likely to be *T. suis* or *T. trichiura*. The former is a whipworm whose natural host are pigs, whilst the latter infects humans and is the cause

of *Trichuriasis*, although it should be noted that Beer (1976) has shown that humans can be infected with *T. suis*.

The presence of dung fungal spores and indicators of disturbed ground such as nettle, dock and fat-hen goosefoot family, in conjunction with the parasite ova, suggest that animals were present prior to *cal AD 1085–1300* (95% probability; distribution not shown), likely in a grazing capacity. The presence of sheep's sorrel can indicate shorter, grazed grassland, so these floodplain pastures in the vicinity of the town were probably utilised for grazing due to the richness of the grassland. The pollen evidence for cereal cultivation also raises the possibility that animal bedding is being represented, rather than crop growing *per se*. The discarded bedding could potentially lead to a similar pollen assemblage. On balance, this last interpretation is not flavoured given the alluvial nature of channel 505, and that pollen is less likely to be included within a straw layer because i) straw is unlikely to include the flower head of the cereal, and therefore not the pollen ii) pollen will be less likely to survive/would show increased signs of damage if they had exposed to oxygen and friction associated with animal movement.

Textile processing

The *Cannabis*-type (hop/hemp) grains identified throughout the sequences are of interest as both species were widely cultivated in the past. Hop (*Humulus lupulus*) is a native species growing in hedgerows and damp scrub woodland, although it became more widely cultivated as flavouring for beer in the 15th–16th centuries. Hemp (*Cannabis sativa*) is an introduced species and thought to have arrived with the Anglo-Saxons, being grown for the production of textiles and oil. Attempts have been made to separate the grains of the two species but this is often difficult due to size/morphological overlaps (Moore et al 1991, 103) although in the present example, a tentative identification of hemp is proposed due to the greater pore protrusion and grain size. The tentative identification of the grains as hemp would support, in association with grains of flax (source of linen) and weld/mignonette (source of natural dye) in monolith sequence <1> and <3>, and the complementary plant macrofossil evidence, the notion of textile manufacture occurring in close proximity, and possibly directly relating to the mills themselves.

This pollen assemblage has, therefore, offered us an unusual opportunity to assess the potential of pollen evidence for revealing information about medieval textile production from an on-site context, especially when viewed in conjunction with the plant macro-remains.

Evidence of textile processing is more often recorded purely through plant macro remains, for example in 16-22 Coppergate, York (Kenward and Hall 1995) and Dundas Wharf, Bristol (Jones and Watson 1987). Where pollen and plant macro remains have been examined together a fuller picture of site activity can be gained as can be seen through the work of Geary *et al* (2005) on flax retting in eastern England. Thus far, pollen analysis has primarily contributed to the identification of flax and hemp retting. Other areas of textile production, such as dyeing, are often not detected palynologically because on-site waterlogged material is rare and/or pollen samples are not taken and also because the pollen is likely to have been removed by the time other processes occur. However, if the preparation of dyes was occurring on site, or if the plants were growing close by, this could account for the presence of pollen here in the archaeological record.

Pollen and plant macro evidence for flax and dye-plants at Staunch Meadow, Brandon, Suffolk (Wiltshire forthcoming; with similar pollen and plant macro-deposits to Hanbury Road) have been used to aid the interpretation of Anglo-Saxon textile processing. Staunch Meadow is one of the few sites where pollen has been used to help identify textile processing in the UK. The Droitwich Town Mill site is potentially an indicator of what can be gained through the application of pollen analysis in a mill context in terms of detecting other activities conducted with a focus on the river, and in this case, textile production, which could have been attracted here by a clean water supply on the upstream side of the town.

8.4 Insect remains (Geoffrey Hill)

8.4.1 Introduction

Three samples were submitted for insect analysis from a sequence of waterlogged material in channel [505] which pre-dated the earliest surviving mill structure, with a view to providing evidence for its purpose and use. An initial assessment of insect remains water channels and leat features at this site had revealed faunas in keeping with both the proximity of fast, running waters and settlement activity, including grain storage pests (Smith 2014).

8.4.2 Methods

To concentrate the sub-fossil sclerite fraction, the three bulk samples were processed following the standard paraffin flotation methods outlined in Kenward *et al* (1980). Insect remains were sorted and identified under a low-power binocular microscope at magnifications between x15–x45. Where achievable the insect remains were identified to species level by direct comparison to specimens in the Gorham and Girling insect collections, housed in the Department of Classics, Ancient History and Archaeology, University of Birmingham. The nomenclature and taxonomic order presented follows the BugsCEP database (Buckland, 2006) which uses Lucht (1987), revised Böhme (2005), and Gustafsson (2005).

8.4.3 Results

Details of analysed samples and associated features and dates are presented in Insect Table 18.

The majority of the insect remains present are beetles (Coleoptera), alongside a few fly puparia in the sample from 0.75–0.8m. A list of Coleoptera recovered is presented in Table 19. The nomenclature for Coleoptera (beetles) follows that of Lucht (1987). The list of host and associated plants (Table 19) for the phytophagous species of beetle that were recovered are predominantly derived from Koch (1989; 1992), but include other sources found in BugsCEP database (Buckland, 2006) where referenced. The plant taxonomy follows that of Stace (2010).

In order to aid interpretation, where possible, taxa have been assigned to ecological groupings via the ecological data available in BugsCEP (Buckland 2006). This grouping of Coleoptera follows a simplified version of the scheme suggested by Robinson (1981; 1983) with the addition of Kenward's (Hall and Kenward 1990) 'house fauna'. This 'house fauna' comprises of a suite of beetles with a particular affinity to human habitation and settlement, making home in the dry timbers or roofing and bedding materials of buildings. The affiliation of each beetle species to a particular ecological grouping is indicated in the second column of Table 19. The meaning of each ecological code is explained in the key at the base of this table. The occurrence of each of the ecological grouping is expressed as a percentage in Table 20 and in Figures 73–4 for the samples. The pasture/grassland, dung, tree and 'house fauna' taxa are calculated as percentages of the number of terrestrial species, as opposed to the whole fauna, where uncoded, true aquatic and waterside taxa are included.

A total of 340 individuals were recovered from 98 taxa, with a good recovery and preservation across all samples, although the sample from 0.8–0.85m had a notably reduced fauna. There are differences in some of the functional group proportions from sample to sample, suggesting activity around the channel may have changed through time. Since a channel was suspected the aquatic fauna across all samples is considered first below, followed by discussion of the terrestrial functional groups.

Sample	Context	Weight (Kg)	Volume (L)	Associated Feature	Period
0.75–0.8	504	7.5	3.5	Palaeochannel, water management feature (505)	Phase 2 901–1155 cal AD to 1319 – 1439 cal. AD.

0.8-0.85		5.7	2.5		
0.85-0.9		6.4	3		

Table 18: Details of samples for archaeoentomological analysis

Context		503	504	504	Associated plants / pests
Depth		0.75-0.8	0.8-0.85	0.85-0.9	
COLEOPTERA	Ecological Code				
CARABIDAE					
Carabidae indet.	u		4	1	
<i>Elaphrus cupreus</i> (Duft.)	ws	1			
<i>Clivina fossor</i> (L.)	p	2		1	
<i>Trechus quadristriatus</i> (Schrank)	u	4	4	2	
<i>Trechoblemus micros</i> (Hbst.)	ws	1			
<i>Bembidion tetracolum</i> (Say)	u	1			
<i>Bembidion illigeri</i> (Net.)	ws	1		1	
<i>Bembidion</i> sp.	u	1			
<i>Harpalus affinis</i> (Schrank)	p	1			
DYSTICIDAE					
<i>Nebrioporus depressus</i> (F.)	a			1	
<i>Rhantus</i> sp.	a			1	
GYRINIDAE					
<i>Gyrinus</i> sp.	a		1	1	
HYDRAENIDAE					
<i>Hydraena</i> spp.	a	1	2	1	
<i>Ochthebius</i> spp.	a	2		3	
<i>Limnebius</i> spp.	a			1	
<i>Helophorus aquaticus</i> (L.)	a	2			
<i>Helophorus</i> spp.	a	7	5	6	
HYDROPHILIDAE					
<i>Cercyon unipunctatus</i> (L.)	rt	1			
<i>Cercyon quisquilius</i> (L.)	df			1	
<i>Cercyon atricapillus</i> (Marsham)	rt	1			
<i>Cercyon convexiusculus</i> (Steph.)	ws		3		
<i>Cercyon analis</i> (Payk.)	rt	1		1	
<i>Megasternum obscurum</i> (Marsham)	rt			1	
<i>Laccobius</i> spp.	a	1	1	1	
HISTERIDAE					
<i>Gnathoncus rotundatus</i> (Kug.)	rt		1		
ORTHOPERIDAE					
<i>Corylophus crassidoides</i> (Marsham)	rt	1			
<i>Orthoperus</i> sp.	l	1			
STAPHYLINIDAE					
<i>Omalium caesum</i> (Grav.)	rt			2	
<i>Lesteva</i> spp.	u	3	3	3	
<i>Carpelimus</i> spp.	u			1	
<i>Anotylus rugosus</i> (F.)	rt		1	2	
<i>Anotylus sculpturatus</i> (Grav.)	rt	3		3	

<i>Anotylus nitidulus</i> (Grav.)	ws	3		2	
<i>Platystethus arenarius</i> (Geoff.)	df	2	3		
<i>Platystethus nitens</i> (Sahl.)	ws	2			
<i>Platystethus</i> spp.	u			3	
<i>Stenus</i> spp.	u	4	1	3	
<i>Lathrobium</i> sp.	u			1	
<i>Xantholinus linearis</i> (Ol.)	rt	1		4	
<i>Xantholinus</i> spp.	u	4	1		
<i>Philonthus</i> spp.	u	2	3	2	
<i>Tachinus</i> spp.	u	2		1	
Aleocharinidae indet.	u	10	4	8	
PSELAPHIDAE					
Pselaphidae indet.	u	1			
<i>Euplectus decipiens</i> (Raff.)	l			1	
<i>Rybaxis longicornis</i> (Leach)	ws		1	1	
ELATERIDAE					
Elateridae indet.	u		1		
<i>Agriotes sputator</i> (L.)	p			2	
<i>Athous</i> sp.	p			1	
SCIRTIDAE					
Scirtidae indet.	u	1		1	
DRYOPIDAE					
<i>Dryops auriculatus</i> (Fourc.)	a (running)			1	
<i>Elmis aenea</i> (P. Müller)	a (running)	1		4	
<i>Esolus parallelepipedus</i> (P. Müller)	a (running)			1	
<i>Oulimnius tuberculatus</i> (P. Müller)	a (running)	13	6	13	
<i>Limnius volckmari</i> (Panz.)	a (running)	1	1	1	
CUCUJIDAE					
<i>Monotoma quadrifoveolata</i> (Aubé)	h			1	
CRYPTOPHAGIDAE					
<i>Cryptophagus</i> spp.	h	3	2	5	
<i>Atomaria</i> spp.	h	2		3	
LATRIDIIDAE					
<i>Lathridius</i> spp.	h	4	2	7	
<i>Corticaria</i> spp.	rt	6	4	10	
<i>Melanophthalma</i> spp.	u			6	
CISIDAE					
<i>Cis</i> spp.	l	2	1		
LYCTIDAE					
<i>Lyctus linearis</i> (Goeze)	l	1			
ANOBIIDAE					
<i>Grynobius planus</i> (F.)	l			1	
<i>Anobium punctatum</i> (Deg.)	h	1			
<i>Anobium</i> spp.	l			1	
PTINIDAE					
<i>Ptinus fur</i> (L.)	h	1	2	2	
TENEBRIONIDAE					
<i>Corticeus linearis</i> (F.)	l	1			
SCARABAEIDAE					
<i>Aphodius paykulli</i> Bedel	df		1		
<i>Aphodius prodromus</i> (Brahm)	df	3	2		
<i>Aphodius lapponum</i> Gyll.	df	1	1		

<i>Aphodius sordidus</i> (F.)	df			2	
<i>Aphodius</i> spp.	df	2	1		
CHRYSOMELIDAE					
<i>Donacia aquatica</i> (L.)	ws	1			<i>Sparganium</i> & <i>Carex</i> spp.
<i>Plateumaris sericea</i> (L.)	ws	1			<i>Carex</i> spp.
Donaciinae indet.	ws			1	
<i>Gastrophysa</i> sp.	u	1			<i>Polygonum</i> & <i>Rumex</i> spp.
<i>Prasocuris junci</i> (Brahm)	ws		1		<i>Veronica</i> <i>beccabungae</i> (L.) - Brooklime
<i>Phyllotreta vittula</i> (Redt.)	u	1			Brassicaceae
<i>Phyllotreta</i> spp.	u	2	1	1	Brassicaceae
<i>Aphthona</i> sp.	u			1	
<i>Longitarsus suturellus</i> (Duft.)	u		3		<i>Senecio</i> spp.
<i>Longitarsus</i> spp.	u		2	4	
<i>Altica</i> sp.	u	1			
<i>Chaetocnema concinna</i> (Marshall)	u			1	Polygonaceae
<i>Chaetocnema arida</i> (Foud.)	u	1			<i>Juncus</i> & <i>Carex</i> spp.
<i>Chaetocnema</i> sp.	u		1		
SCOLYTIDAE					
<i>Xyleborus</i> sp.	dw		1		
CURCULIONIDAE					
<i>Apion</i> sp.	p	1		3	
<i>Otiorhynchus</i> sp.	u	1		2	
<i>Sitona</i> sp.	u	1		1	
<i>Ceutorhynchus erysimi</i> (F.)	p			2	<i>Capsella bursa-</i> <i>pastoris</i> (L.) – Shepards Purse
<i>Ceutorhynchus rapae</i> (Gyll.)	p	2			Cultivated and wild Brassicas
<i>Mogulones asperifoliarum</i> (Gyll.)	u		2		Boraginaceae
<i>Ceutorhynchus</i> sp.	p			1	
<i>Neosirocalus viduatus</i> (Gyll.)	u	2			<i>Stachys palustris</i> (L.) – Marsh Woundwort
<i>Gymnetron pascuorum</i> (Gyll.)	p			1	<i>Plantago lanceolata</i> (L.) – Ribwort Plantain
<i>Isochnus foliorum</i> (Müll.)	l			2	<i>Salix</i> spp.
MNI		125	73	142	340

Table 19: Beetles (Coleoptera) recovered (a = aquatic water beetles (running = rivers/streams) ws = waterside taxa often associated with emergent vegetation, df = taxa often associated with dung, p = taxa associated with grassland and open areas, l = taxa associated with trees / woodland, dw = taxa associated with deadwood, h = 'house fauna' synanthropic beetles, sensu Hall and Kenward (1990), rt = decomposer beetles)

8.4.4 Discussion

Aquatic and waterside fauna

The samples contain consistent proportions of aquatic fauna (22-25% Table 20, Fig 73), and large numbers of these are individuals from a range of species specifically associated with fast running waters, usually running over gravelly/stony beds in clear water. Particularly indicative of these conditions are the Elmid 'Riffle Beetles', *Elmis aenea*, *Esolus parallelepipedus*, *Oulimnius tuberculatus*, and *Limnius volckmari*. This suggests that the water running through the feature was fast, and clearly scoured the channel clear of silt and mud. There are also taxa associated with still

or slow flowing waters, which largely include the Hydraenids; *Hydraena* spp, *Ochthebius* spp, *Limnebius* and *Helophorus* spp, suggesting perhaps that the channel was not in always in motion. A further species identification, *Helophorus aquaticus*, suggests the surrounds were richly vegetated (Koch 1989).

There are also numerous inclusions of waterside fauna and species associated with aquatic and semi-aquatic plants. While this fauna is varied and diverse across the samples, they are fairly eurytopic in their habitat preference, being found in and on the damp ground besides waters of varying habitats. Of these, the Chrysomelids, *Donacia aquatica*, *Plateumaris sericea*, *Chaetocnema arida* together indicate the proximity of *Carex* spp (sedges); with *Prasocuris junci* suggesting the local presence of *Veronica beccabunga* (brooklime) and; *Neosirocalus viduatus* indicating *Stachys palustris* (marsh woundwort). *Isochnus ?foliorum* further suggests that *Salix* (willow) was a possible a feature of this waterside environment.

Sample	0.75-0.8M	0.8-0.85M	0.85-0.9M
Total number of individuals	125	73	142
Total number of species	58	35	60
% aquatic	23.1	22.2	24.6
% waterside	10.7	11.1	5.6
% dung foul / terrestrial	18.2	36.4	5
% tree / terrestrial	13.6	4.5	8.3
% grassland and pasture / terrestrial	13.6	0	18.3
% 'house fauna' / terrestrial	22.7	27.3	30
% decomposer / terrestrial	31.8	27.3	38.3

Table 19: The proportions of the ecological grouping of Coleoptera

Terrestrial fauna

The major terrestrial groups from these deposits are the 'dung', 'house' and 'decomposer' assemblages (Table 20, Fig 74). Together they present a very strong synanthropic package, suggesting that the site was being heavily used.

The proportions of the 'dung' fauna are the only of these three to vary significantly across the three samples. The earliest sample (0.85-0.9m) contains very few dung fauna (5%), as well as the only inclusions of *Aphodius sordidus*, which is, however, eurytopic (tolerant of a wide range of environments) in its choice of herbivorous dung (cattle, sheep and horse). Dung proportions increase significantly into the later sample (0.8-0.85m) reaching 36% of the terrestrial assemblage. This sample includes the greatest diversity of the dung fauna (largely members of the *Aphodius* genus), although these are all generalists, with no particular herbivore on this basis, indicated. The proportions drop off again into the latest sample (0.75-0.8m) down to 18% (Table 20, Fig 74).

The house fauna assemblage, comprise a classic suite of species that have adapted to settlement and these include *Monotoma quadrifoveolata*, *Cryptophagus* spp, *Atomaria* spp, *Lathridius* spp, *Anobium punctatum* and *Ptinus fur*. These are present in consistently high proportions (22-30%, Table 20, Fig 74), although their numbers do drop steadily from the earliest to the latest sample. The Anobid 'woodworm', *Grynobius planus* and the 'powder post beetle' *Lyctus linearis*, are also known as a pest of structural timbers (Palm 1959), and are, therefore, more than likely part of this synanthropic suite as well - especially as the landscape would appear to be largely cleared of trees based on the functional group proportions.

The largest terrestrial group overall is the decomposers (27-38%, Table 20, Fig 74), indicating the build-up of organic waste both as a by-product of human settlement and animal husbandry. These largely comprise of a suite of hydrophilids, the *Cercyon* spp and *Megasternum obscurum* which are typically synanthropic, as well as the staphylinids *Omalium caesum*, *Anotylus rugosus*, *A sculpturatus* and *Xantholinus linearis*, all of which are common amongst vegetative heaps, manure and hay bales.

There are a number of species present which indicate the proximity of open land, possibly agricultural. These include *Clivina fossor*, *Harpalus affinis*, *Agriotes sputator*, *Ceutorhynchus ?erysimi*, *Ceutorhynchus rapae* and *Gymnetron pascuorum*. While a number of species discussed above are probably linked to timbers used in settlement construction, some, such as *Euplectus ?decipiens*, *Cis* spp, *Corticeus linearis* (F) and *Isochnus ?foliorum*, are unlikely to be related to settlement activity. However, as all these tree/wood species, amount to less than 15% of the terrestrial assemblage in all samples, this suggests that there was little woodland in the vicinity.

8.4.5 Conclusion

It is uncommon to identify a diverse and abundant running-water fauna from those waterlogged features typically analysed at settlement sites, such as wells or ditches. On this basis it can be said with certainty that this channel was periodically being scoured and contained fast-flowing water, presumably associated with the use of the adjacent mill. Given the aquatic nature of the cut channel, and owing to the large numbers of 'house' fauna across the samples, it is also certain that the channel was located near to settlement.

Given the large numbers of synanthropic fauna recovered, it is possible that this channel was a race, leading water towards or away from a mill, and carrying with it a range of the 'tell-tale' beetles associated with both fast waters and settlement activity. Notable by their absence, however, are any grain or granary beetles which would confirm this material was directly associated with a corn mill. These results can be compared with archaeoentomological records from excavated Saxon mill channels in Northfleet, Kent (Smith 2011). While the numbers of 'riffle-beetles' are far higher than any of these analysed samples, there is a similar spread of house, dung and decomposing faunas, within an open landscape. At this site, however, the mill race samples contained significant numbers of beetle pests of stored grain/granaries (Smith, unpublished). While there was no indication as to whether these were head or tail races, it is perhaps suggestive that recoveries of at least some grain pests should be indicative of a race channel sample, the tail channel perhaps being most likely to contain grain pests, as it is fed by water having passed the mill.

It is also clear that animals were present on site in the later periods/samples, the great numbers of dung fauna within the middle sample, 0.8-0.85m, especially, suggesting a period of intensive use, with working animals potentially being present (cf Kenward and Carrott 2001) or stock being housed on the site. There was no contemporary insect data from other sites in Droitwich for comparison, and so this assemblage represents a useful addition for future reference.

9 Environmental synthesis

The pollen, plant macrofossil and insect assemblages complement each other well. Insect evidence from the late Saxon/Saxo-Norman (Phase 2) channel [505] indicates that this alternatively was scoured and contained fast flowing water, which would be consistent with use of the channel. The lack of grain storage pests implies that it was not located below a mill and this is in keeping with the mill locations that came to light during excavation. Cereals or arable weeds were, however, a significant component of assemblages from base of this channel and of the medieval channel associated with Mill 1 (Phases 2 and 3 respectively) implying cereal cultivation in the vicinity. Peaks in cereal type pollen and oat/wheat pollen were noticeable in the lower part of [505].

Both pollen and plant macrofossil remains also indicated either cultivation of crops used in the textile industry (flax, hemp, dyers rocket or weld and possibly fuller's teasel) or the processing of these crops in the vicinity. This activity is recorded following the decline in cereal cultivation (or use) in the context of the early phase of Mill 1. This evidence may give rise to some speculation about the function of the mill, with at least the gravitation of some textile activities (eg dyeing or fulling) in its direction, if not direct involvement. This textile theme is continued with the later phase of Mill 2 when hemp-type pollen is present. There was, therefore, a higher than usual concentration of evidence relating to the textile industry (dye plants, flax and hemp crops) on this site. Given that textile production was a very great later medieval industry following on from the export trade in wool (Hurst 2005), then these results would not be out of character for the site and period as representing activities that have not previously been detected in the Droitwich archaeological record.

Other evidence is in keeping with the site being on the edge of the urban settlement: fennel seeds in Phase 2 channel [505], and fig seeds in the Phase 3 channel [472] associated with Mill 1, indicating either gardens and orchards, or disposal of food waste in the river catchment, and the Phase 2 'house fauna' insect remains.

10 Overview and discussion (by Martin Watts)

10.1 Introduction

In England over sixty watermill sites dating from Roman times to the early modern period have been investigated by archaeological excavation. Of the thirty or so post-Conquest medieval and post-medieval watermills which have been reported, about two-thirds were corn mills and of these just under one third were urban sites. Some four or five fulling mill sites have also been identified, the remainder being industrial mills, including a number of forges and furnaces which were excavated in Yorkshire and the Weald, mostly from the 1960s to the 1980s. The iron-working sites in particular have provided valuable information about late medieval and post-medieval timber structures which housed water wheels, as well as some remains of the water wheels themselves. The cycle of regular maintenance, repair and renewal of both the structure and machinery results in many mill sites being multi-period, with phases dating from the medieval period to the 19th century.

Watermill sites were deliberately selected to take account of both physical features, such as a bend or fall in a natural watercourse which could be used to advantage, and social constraints, such as land tenure and rights of way. Access by paths or tracks to and from a mill site was vital for customers and the location of a watermill sometimes provided a convenient crossing point over a watercourse. Because the construction and maintenance of hydraulic structures such as dams, millponds and leats required considerable resources, they tended to continue in use once established. However, the evidence from some mill excavations shows that localised changes caused by erosion and deposition and technical improvements, such as raising the water level upstream in order to provide a greater head and thus more power, need also to be taken into account.

The construction of watermills in locations which are vulnerable to regular water penetration and periodic flood damage, as well as changes in technology, often combine to make mill sites difficult to interpret. A lack of small finds is sometimes associated with the lower levels of mill structures, due to the abrasive action of water and silt. Pottery may sometimes be found in silt deposits, although as it could have been washed in, it cannot be relied upon for dating evidence (Keith and Wrathmell 2006, 13). Successive structures were often built on top of each other, sometimes reusing timbers, and the difficulty of dating mill timbers (whether primary or reused) by dendrochronological analysis, which may further complicate phasing and interpretation, has been commented on elsewhere (for example Ford *et al* 2013, 138). From the evidence of excavations where timber structures have been dated, however, significantly early mill remains, from the late Anglo-Saxon period for example, do not appear to survive beneath later medieval and post-

medieval mills. Generally, the footprint of a watermill building is seen to increase in area over time and later mill complexes, in particular those developed during the post-medieval and industrial periods, appear to have largely obliterated earlier structures (see for example Goodchild and Wrathmell 2002). Documentary evidence from the late medieval period onwards indicates that mills were frequently repaired and John Langdon has calculated that on average a mill renewed its original construction cost about every ten years (Langdon 2004, 180). Mills were also sometimes completely demolished and the building site or platform cleared for the construction of a new mill (see for example Salzman 1952, 536-7; Cole 1958, 172). In some cases stable parts of earlier structures, such as ground beams, were left *in situ* and reused as part of the new mill building, as found at Droitwich.

Mills built of stone were uncommon in the medieval period, primarily due to cost and also to the dominance of carpentry (see Langdon 2007). Stone-built mills are therefore seen as symbols of prestige, usually associated with monastic or other high status sites such as at Fountains Abbey in Yorkshire (Coppack 1993, 90-5).

10.2 Town Mill

The location of the Town Mill within a small detached part of Dodderhill parish is of considerable historical interest. The parish boundary follows the north bank of the river Salwarpe which curves around the north of the site, and the centreline of the headrace and tailrace of the final phase of mill on the south side. The Ordnance Survey maps show that at least latterly the mill was fed from the east by a long narrow mill pond which had an overflow or spill weir on the north side towards its west end. The height of the cill of this weir would have controlled the level of the water in the pond and allowed excess water to spill over into the channel around the north of the site. The Droitwich Junction Canal, which was constructed in 1852-3, ran close to south end of the mill building and its construction undoubtedly had some effect on the hydrology of the site.

The head or fall of water at the Town Mill site was relatively low and the archaeological evidence indicates that the water wheels that worked a succession of mills there, at least in the medieval and post-medieval periods, would have been undershot. The later water wheels were breast-shot, taking advantage of the fall as well as the impulse of the water. The height from the base of the final phase wheelpit to the sill on which the penstock closed was 1.6m, which represents the minimum usable fall; the overall head of water that could be maintained in the millpond is not known. A cross-section (north-south) through the site shows that the lowest levels of three identified phases of wheel emplacement were similar (see below). The earliest mill appears to have been set slightly higher than the phase 2 structure, but the base of the final phase wheelpit is virtually the same as that of phase 2.

The earliest evidence for water control found on the site was the southern edge of an almost vertically-sided flat-bottomed channel (505). Dating evidence obtained from silts deposited in this channel suggests that some form of water management was taking place by the late 10th century. If the Town Mill site was occupied by one of the five mills recorded under the manor of Dodderhill/Wychbold in Domesday Book, then a late Anglo-Saxon origin for a mill in this location is feasible (see Thorn and Thorn 1982; Hurst *et al* 2011, 58). The excavations also revealed some alteration of the watercourses through natural action, de-silting and re-cutting, and also repositioning of the water wheel emplacement, which appears to have migrated southwards in successive phases.

10.3 Interpretation of the mill structures

At the Town Mill site five main mill construction phases (Fig 64) have been identified, together with some sub-phases which are likely to represent intermediate repairs and alterations. For detailed accounts of the timbers mentioned below reference should be made to the structural report above.

The earliest mill phase (CG1) is part of a ground-frame comprising an east-west timber (523) aligned in the direction of water flow, with a shorter timber (520) returning southwards from its downstream end. Timber (523), which has been dated to 1371 (Nayling and Bale 2015), was slightly inclined from east to west and there were the bottom sections of two vertical timbers, one at the downstream corner, the other about 2.15m upstream, tenoned into it. This is considered to represent the north side of a mill structure which has been truncated at its upstream (east) end. The layout of an inclined sill timber with upright posts is reflected on a larger scale by the later phase mill to the south (CG3) (see below), which appears to have truncated this earlier structure. The fragmentary nature of this structure does not allow any meaningful reconstruction of its layout to be made.

The remains of the second phase mill (CG3; Fig 75) are more substantial. Although precise dating of the timber structure by dendrochronology was not possible, a felling date estimate of *cal AD 1570-1635* has been proposed by using a combination of dating methods for timber (568), one of two sill beams (568 and 570) which are aligned north-south across the direction of water flow. These timbers are set about 4.9m apart, with an east-west timber (488) which is jointed to both of these sill beams at their north ends. At the upstream end, beneath the longitudinal timber, are two further timbers (525 and 526), which are jointed to each other and set against the downstream face of (568). Three vertical posts (516, 517 and 566) were tenoned into (488), fairly equally spaced from downstream to upstream, with an empty mortise at the north end of (568) for a fourth upright. This appears to define the upstream corner of the structure. An interesting feature of this phase is a wall of coursed sandstone blocks built off the top of the sill timber (488) and around the vertical posts. The back of this wall was built into the fill of the former channel to the north, with its face to the south and it appears to define the northern extent of the mill building, at least at the lower level. The mortises in the top of the outer sill beam (568) and those which indicate that the area between the upstream and downstream sills (568, 570) was floored, suggest that the water wheel emplacement was on the north side, the area for the wheel emplacement being about 1.2m wide. As with the first phase mill, there is a fall of about 1:18 between the upstream and downstream sills. It is considered that this incline may reflect that of a timber trough in which an undershot wheel was located. The south side of the possible wheel emplacement is not clearly defined, however, and the southern part of the building, which appears to have been about 7.30m east-west (upstream-downstream) by 4.43m wide, has been lost due to subsequent building in that area. If the wheel emplacement was on the north side, as is implied, then the hurst (the timber structure that enclosed the driving gears and supported the millstones) and machinery would appear to have been positioned within the structure on the south side. No structural evidence for the layout of the working parts was apparent, however.

The presence of the paired beams (525 and 526), which must have been positioned before or during the construction of the frame, may be interpreted as either a precaution against erosion or an identified need to stabilise this area during reconstruction. These timbers were of elm and have not been dated. Timber (551), which is trenched to support the longitudinal floor beams spanning between the head and tail sill timbers, is a reused timber which has been dated to c.1553. No other timbers from the phase 2 mill ground-frame were able to be dated by dendrochronology, although a small group of reused and one displaced timber (548, 549, 550 and 590) were found to date from the second half of the 15th century (Nayling & Bale 2015). (550) is a reused timber with a long mortise in its upper face; it overlays the south end of (525), which is from a later phase of mill construction (see below). Towards its east end it is underpinned by a worked timber with a long through mortise (548). This timber, which is dated to 1459, has the appearance and dimensions of a bridge post, although no tenons survived on either end. If this identification is correct, this was a vertical timber that formed part of the hurst. The long mortise would have supported one end of an adjustable horizontal bridge tree and the survival of some timber blocks and wedges in the mortise supports this interpretation (see diagram/illustration).

In 1608 a 'Mill called ffrog Mill in Wyche', valued at £2 10s per annum, appeared in a list of mills belonging to king James I, drawn up at a time when the Crown was selling off mills in order to raise money (Bennett & Elton 1900, 37). That this was the Town Mill is confirmed by the will of Isabella

Anderson dated 1694, which refers to 'Town Mill in Dodderhill In Liberties, alias Fogge Mill' (Jones 2012). The earliest known depiction of the mill occurs on the right-hand edge of a 17th century map of Droitwich, which is thought to date from c.1685 (Tyler 2012, Fig.3a). This map (original manuscript map now at WRO (BA8060, s497.33) possibly dating to c 1590–c 1620; Bassett 2010) shows a building on the present site, stylistically drawn with an external water wheel on its south side or possibly on its south gable. Whether this is a representation of the mill at that time or simply cartographic convention to show it was a watermill is not known.

The third phase mill (CG7), which was of similar plan dimensions to its predecessor, is represented by ashlar stone walls, at least at the lower levels, and a new stone-built wheelpit, which was the best preserved feature of this phase. There was evidence of breastwork at its upstream end and a timber head sill (543) had been inserted on top of that from the earlier phase (568). The new sill timber was levelled with wedges and the gap between in and the earlier timber caulked with moss. This phase of mill is tentatively dated 17th to 18th century. The north wall of the wheelpit appears to have suffered major collapse, being replaced with a rubble stone wall of inferior quality which is set back from the original wall face. The poor construction of this wall might suggest that the pit was rebuilt as a water channel or spillway through the mill building rather than to house a water wheel, the latter being further to the south and lost during subsequent rebuilding. This is a possibility if any value can be placed on the drawing of the mill on the 17th century map.

The plan of the mill building drawn on the 1786 map of Droitwich (Tyler 2012, Fig. 3b) shows the south end of the mill against a watercourse, with a bridge on the upstream side and the southern boundary of the detached part of Dodderhill parish running through the centre of the watercourse. This appears to confirm that by this time the mill building was in its final position, with the wheelpit at its south end. The wheelpit was 2.70m wide and 7.20m long internally and constructed in brick with curved breastwork of ashlar sandstone blocks at its upstream end. The curve of the breastwork indicates that it would have housed a water wheel of about 3.7m in diameter and up to 2.7m wide.¹ The water wheel appears to have had two rings with projecting radial starts which carried the floats or paddles, for at some time during its working life some of the starts appear to have worked loose and scored the close-fitting stone breastwork behind the wheel.² There was a curved cast-iron plate built in across the top of the masonry sill, over which water ran onto the breast of the wheel, and inclined cast-iron guides built into the walls on each side of the headrace opening which indicated the position of the sluice or penstock that would have been raised to let water onto the wheel (illustrated in Tyler 2012). The construction of this wheelpit clearly illustrates some of the design principles that were developed during the later part of the 18th and early 19th centuries, to improve the performance and thus the power of breast-shot water wheels.

In this phase the mill machinery was located to the north of the water wheel, there being a brick-built cog pit inside the wall that ran along the north side of the wheelpit. The cog pit was 2.5m long by 0.55m wide, with a drainage hole through the wall into the wheelpit at its downstream end. This was a common feature, to allow ground water and flood water to drain away. Two timber blocks set in the floor some 1.9m north of the pit wall, both downstream of the wheelshaft centreline, may define the position of the front of the hurst, although this might be expected to span the whole width of the building from east to west. With no detailed description or recorded evidence of the layout of the machinery and millstones, however, other than there being three pairs of millstones in the final working phase, this can only be conjecture.

A significant rebuilding phase is considered to date from the construction of the canal and basin in 1852-3. The tailrace was culverted within a brick arched structure between this date and c.1884 and the wheelhouse was extended to the south. The later phases are discussed in the Historic

¹ The dimensions of the waterwheel quoted by Tucker (1982, 11) are 12ft [3.66m] diameter by 7ft [2.13m] wide, which would fit the pit comfortably. The source of this information may be from notes made by H.E.S. Simmons, whose mill records were deposited in the Science Museum Library, London.

² Similar scoring was noted on the breastwork of the later (18th century) phase wheelpit at King's Mill, Leeds (Goodchild and Wrathmell 2002, 32)

Building Recording report (Tyler 2012, fig14). The west range, a two-storey rectangular brick building with its first floor supported on cast-iron columns (G.01/F.03, 04) which extended westwards from the northern end of the earlier watermill, appears to have been purpose-built in or by the early 1880s to house roller milling plant. This was driven by a steam engine which, with its boiler house and chimney, was located to the south of this range (G.06). The engine, boiler house and chimney were demolished shortly after the 1909 fire (Jones 2012).

The final phase of water-power use at the Town Mill site is represented by the installation of a water turbine. This work included alteration of the water intake structure at the upstream end of the wheelpit and building a wall across the lower end of the pit to form a tank in which the turbine was situated. The water turbine, which was removed during excavation and clearance of the site, appears to have been a vertical-shaft reaction (Francis) type, with a draught tube that went down through the floor of the wheelpit.

The installation of the water turbine appears to coincide with the significant change from millstones to roller mills for the production of flour in the late 19th century. In 1901 the roller milling equipment was described as 'A three-sack Turner roller plant,³ and grain cleaning machinery of modern type, driven by compound condensing engine and double flued, Galloway tubes, Lancashire steel boiler.' Although there is no direct reference to the turbine, the same sale notice refers to 'provender plant, comprising three pairs of French burr millstones, crushing and splitting rolls, &c., driven by water power...' (*The Miller*, 7 January 1901). Pieces of French burr millstone were found pit [468], part of Mill 4 (Phase 6). It is possible that the millstones driven by the turbine were still in their earlier water wheel-driven configuration, French stones being used generally for milling wheat for flour, and they were turned over to grinding animal feed when the roller plant was installed. The water turbine appears to have continued in use after the 1909 fire, the power source for the mill being listed as water in subsequent trade directories. A new, smaller lean-to engine room was also constructed to the south of the west wing before c.1927 (Jones 2012).

The mill was still in use, apparently for animal feed (provender) production in 1938, being marked as 'Town Mill (Corn)' on the Ordnance Survey map. In 1944, after the death of Charles Everton who had acquired the mill shortly after the 1909 fire, the property was sold by auction. The sales particulars referred to a ground floor Filling Store 'containing water wheels, shafting and hoist, with steel supports and pillars.' The reference to 'water wheels' appears inaccurate, as the evidence suggests there was only a water turbine *in situ* at that time. There were also a hoist, hoppers and garners on the third floor (Jones 2012, citing Worcester Record Office 705: 1010/9306/178/vii/2). A serious fire gutted the mill and the surviving machinery was apparently destroyed in August 1947. The buildings on the site were subsequently converted for light industrial use (Jones 2012; Tyler 2012).

10.4 Conclusions

Some of the issues surrounding the excavation and interpretation of watermill sites have already been outlined above, in particular the need to record and interpret the watercourses and hydraulic systems that were constructed or adapted to provide a usable water supply. Such watercourses tend to have slightly sloping or nearly vertical sides, which are sometimes revetted to prevent erosion and under-cutting, and flat bottoms. The earliest such features at the Town Mill site indicate that some form of water management for power supply was in existence by the late 10th century. The fragmentary remains of the first mill found by excavation, however, dated from the late 14th century, suggesting that any earlier structures had been removed completely before that phase of construction. The more substantial ground frame of the second mill, which has been dated to the late 16th or early 17th century, incorporated some older, re-used timbers, suggesting that the medieval timber-built mill had been largely demolished, or perhaps destroyed by flood, before a more substantial timber and stone structure was built. This transition from timber

³ The roller milling equipment was therefore supplied (and possibly installed) by E.R. & F. Turner of Ipswich, Suffolk (G. Jones 2001, 100-5). The output quoted is equivalent to about 380kg of finished flour per hour.

structures in the later medieval phases to masonry structures in the post-medieval period, as clearly illustrated at Droitwich, has been seen elsewhere, for example the wheelpit excavated at the Priory Mill, Coventry, which was rebuilt in 1688 with sandstone ashlar walls on top of base timbers (Rylatt and Mason 2003, 55-6).

With undershot and breast-shot wheel installations, as at Droitwich, the headrace channel was usually funnelled in towards the penstock (the sluice gate that lets water onto a waterwheel) in order to concentrate the flow and thus the power available from the water. Again a transition from timber structures in the medieval period to stone and, later, brick intake structures is apparent from other sites, for example at the Town Mill, Stafford, where a ramped structure of timber beams with horizontal planking was modified in the later 17th or early 18th century by the addition of stone rubble walls and in the final 19th century phase by a V-shaped headrace intake structure of dressed sandstone blocks (see Hislop, Ramsey and Watts 2006). A similar planked timber headrace structure dated to the 1590s, which was superseded by a V-shaped stone-built intake structure probably in the mid to late 18th century, was found at Low Mill, Dewsbury (Keith and Wrathmell 2006, 13-17; 30). At Droitwich there is also evidence from the phase 3 mill (late 17th-early 18th century) for raising the head sill, in order to increase the power available by providing and increased head or fall of water. This would have had an effect on the water level in the mill pond by increasing its depth, which may in turn have affected the stability of the mill building, there being evidence of structural collapse of the north wall of the wheel chamber. The final wheelpit was built of brick with stone breastwork, its construction reflecting the improved design principles which were established by millwrights and engineers to maximise the performance of low breast waterwheels. The final adaptation of the wheelpit to house a water turbine resulted in alterations to the headrace intake, although the pond and other water supply and control structures, established and locally modified over a period of several hundred years, continued in use.

The layout of working parts of the mill, including the position of the hurst and millstones, is difficult to reconstruct for most of the phases from the excavated evidence (Fig 64). The Phase 3 mill (17th-18th century) provided the best evidence in the form of a cog pit, in which the pitwheel, the primary driven gear on the inner end of the waterwheel shaft, turned. There was also some indication of where the hurst may have been positioned, from timber blocks set in the floor.

In general the development of Town Mill, as illustrated by the results of the excavations and the interpretations given here, reinforces the model of watermill structures being built mostly of timber up to the end of the medieval period, with a waterwheel driving a single pair of millstones through a pair of gears. The demand for greater output, and thus more power, in the post-medieval period, saw the introduction of larger waterwheels and, where feasible, raising the head of water available. More powerful waterwheels and improvements in gearing technology allowed more than one pair of millstones to be driven from a single waterwheel and mill buildings were also more substantially built, or rebuilt, with masonry used for wheelpits and foundations. From the late 18th century further technical improvements resulted in a better use of water resources, particularly with waterwheels working on relatively low heads. The excavation of the Town Mill in Droitwich has provided an unusual opportunity to record the development of water-power technology on a specific site over a period of several centuries. In addition the final phase of building and water power use, with the introduction of a water turbine in the late 19th century, illustrates the important transition from the use of millstones to roller mills for the production of flour.

11 Publication summary

Worcestershire Archaeology has a professional obligation to publish the results of archaeological projects within a reasonable period of time. To this end, Worcestershire Archaeology intends to use this summary as the basis for publication through local or regional journals. The client is requested to consider the content of this section as being acceptable for such publication.

An archaeological project (desk-based assessment, evaluation, excavation and watching brief) was undertaken at the site of Town Mill, Hanbury Road, Droitwich, Worcestershire (NGR 39050 26335). It was undertaken on behalf of CgMs Consulting working for McCarthy and Stone Retirement Lifestyles Ltd, who were developing the site (planning reference W/11/02666/PN) for housing.

Excavation was restricted to the footprint of the new build. Features relating to the mill and the canal (vaulted cellars, wharf side buildings and basin backfilled with early 20th century) were most in evidence. Five major medieval to later phases of mill construction were recorded, dating from the later 14th–20th century onwards, and could be correlated with the historical evidence for a mill at this location since at least the 17th century, being variously known as King's Mill (ie owned by the Crown), Frog Mill, and lastly Town Mill; historic building recording was also undertaken as part of this development on the surviving above ground remains. The lower levels of the site were waterlogged and this meant that the timber structures of the earlier mill buildings were well preserved. Though the floor levels of the earlier mills had been truncated by more modern mill phases, some of the principal components, especially the wheel/cog pits, and the mill pond, were much in evidence. Extensive sampling was undertaken for dendrochronology and radiocarbon dating, especially given the relative dearth of associated artefacts.

In addition, waterlogging ensured that there was a high potential for environmental investigation and so plant macrofossil and pollen analysis formed an integral part of the project, resulting in an unsuspected incidence of material indicating activities relating to textile working in this part of the medieval town. There was also a strong dung signature that might be best explained as arising from the mill being the focus for goods (ie grain/flour) being transported using horse haulage.

Mills are rarely tackled archaeologically as they are inherently difficult and also are usually protected from development by being on the flood plain and in the immediate path of the river. Such structures are also best regarded as machines rather than simply buildings and Droitwich Town Mill has, therefore, offered a relatively unusual opportunity to investigate mill workings evolving over time. The degree of preservation has enabled a picture to be reconstructed of a major structure in a constant state of repair and redesign, and, therefore, with investment to allow its valuable location on the edge of the town to be fully exploited as efficiently as possible.

Results will also be published in the Transactions of the Worcestershire Archaeological Society.

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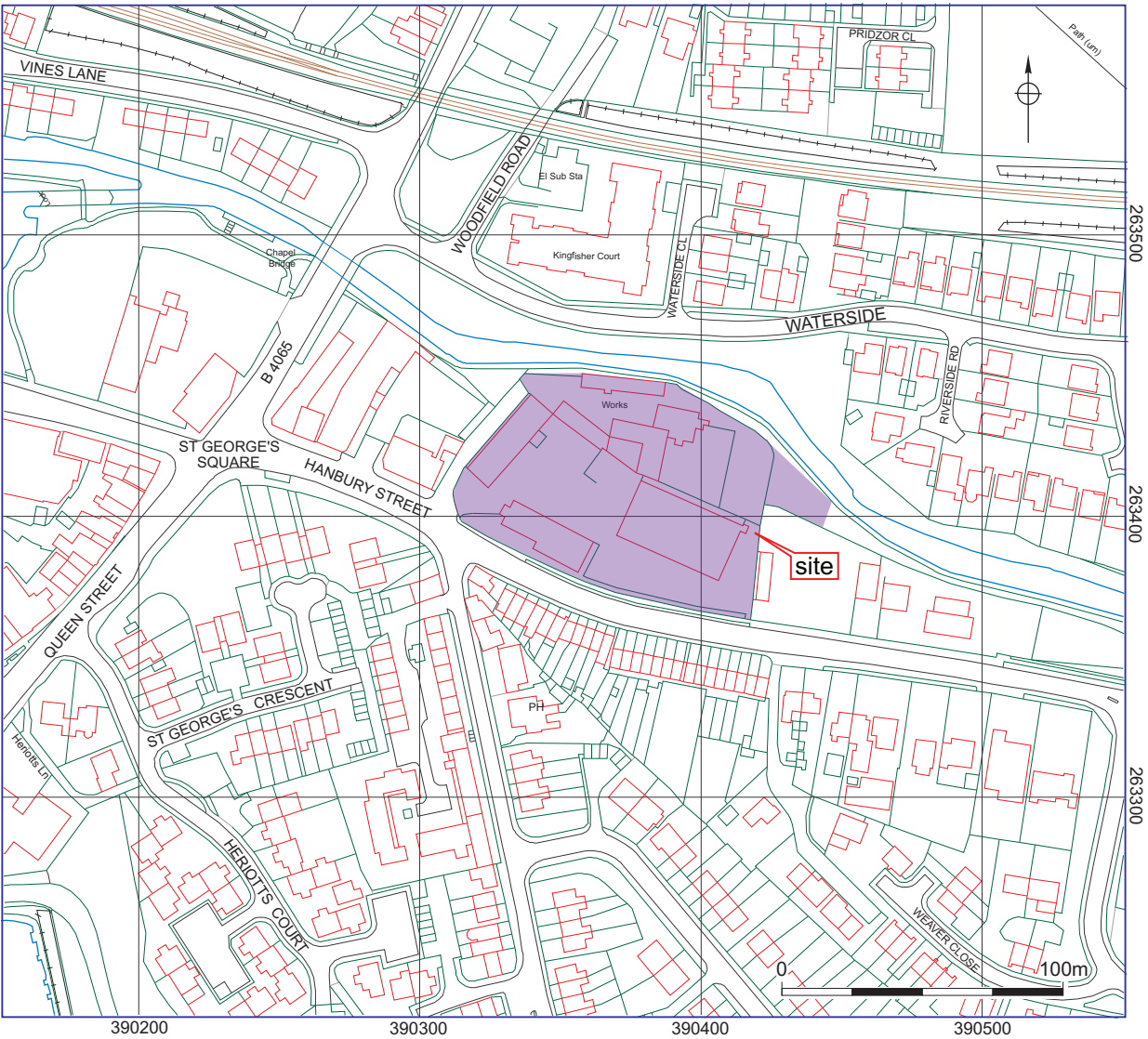
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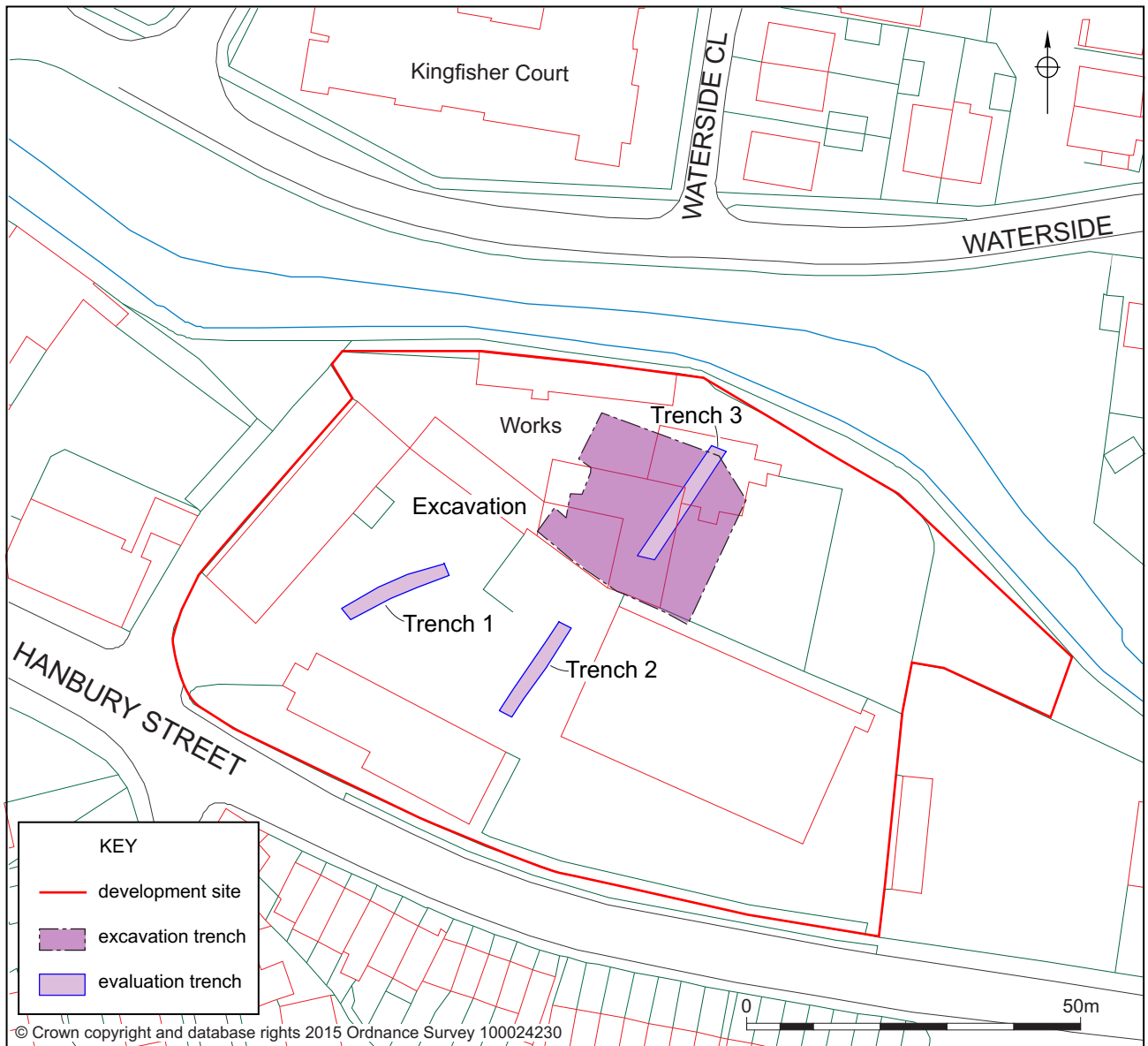
Figures



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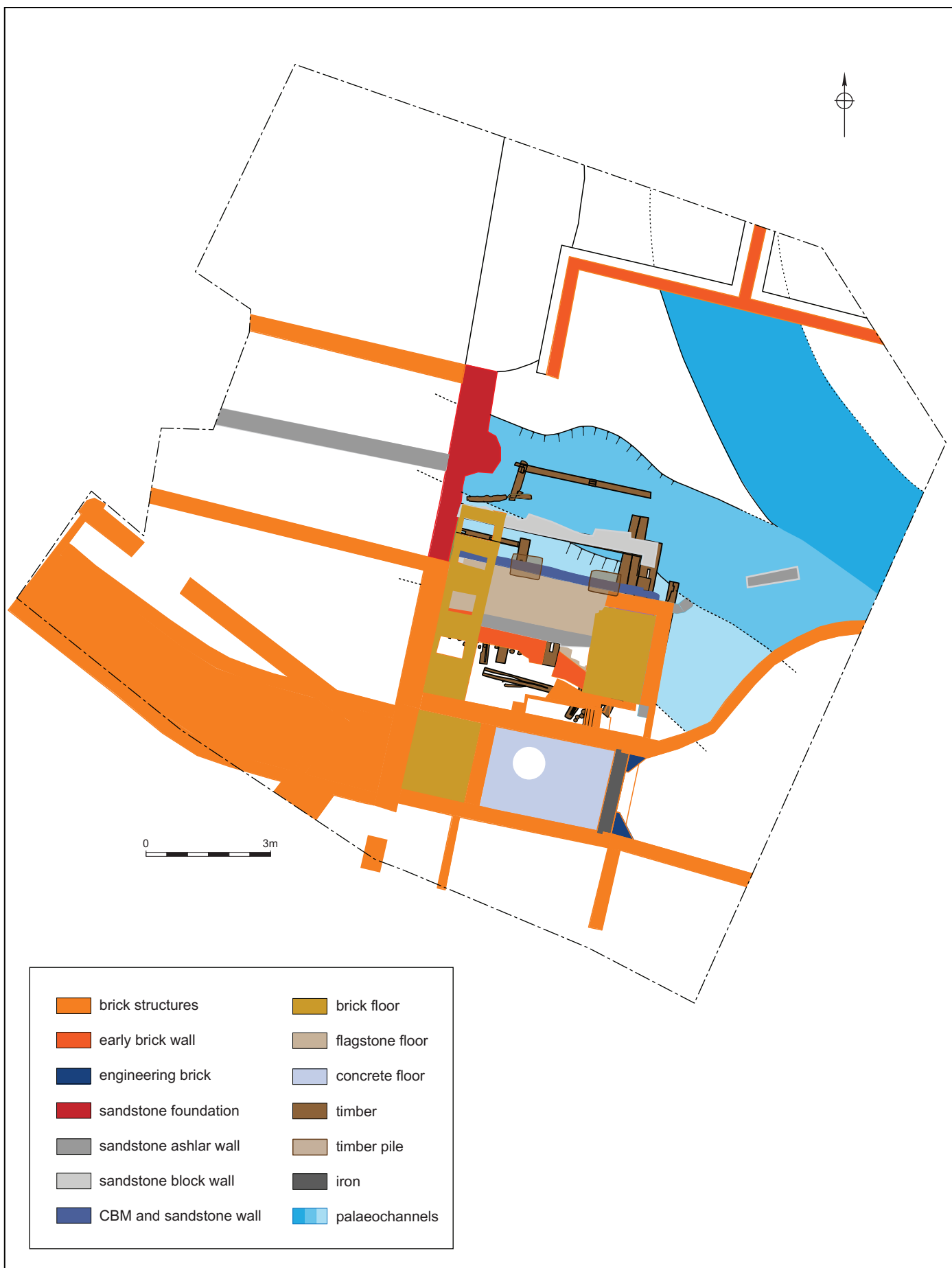
Location of the site

Figure 1



Location of the evaluation trenches and excavation area

Figure 2

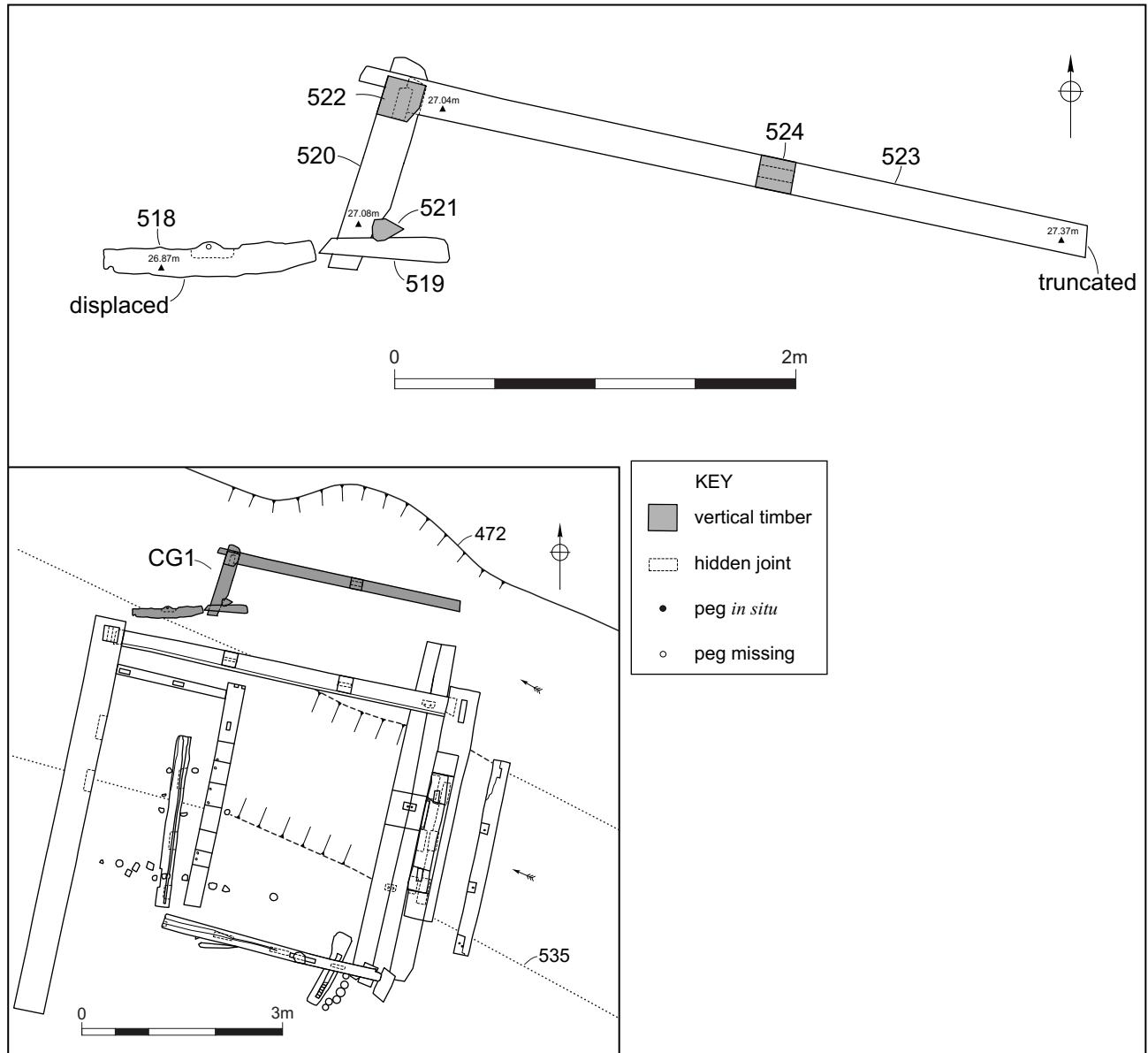


Plan of all features in excavation area

Figure 3



Figure 4: Diversion channel (505) (left) and channel extension (472) (right) in section facing west, 1m scales.



Plan of surviving remains of Mill 1 (CG1) truncated on south and east sides
(inset shows its location in relation to channels 472, 535 and other timber structures)

Figure 5



Figure 6: Mill 1 ground frame (CG1; foreground), facing south east, 1m scales



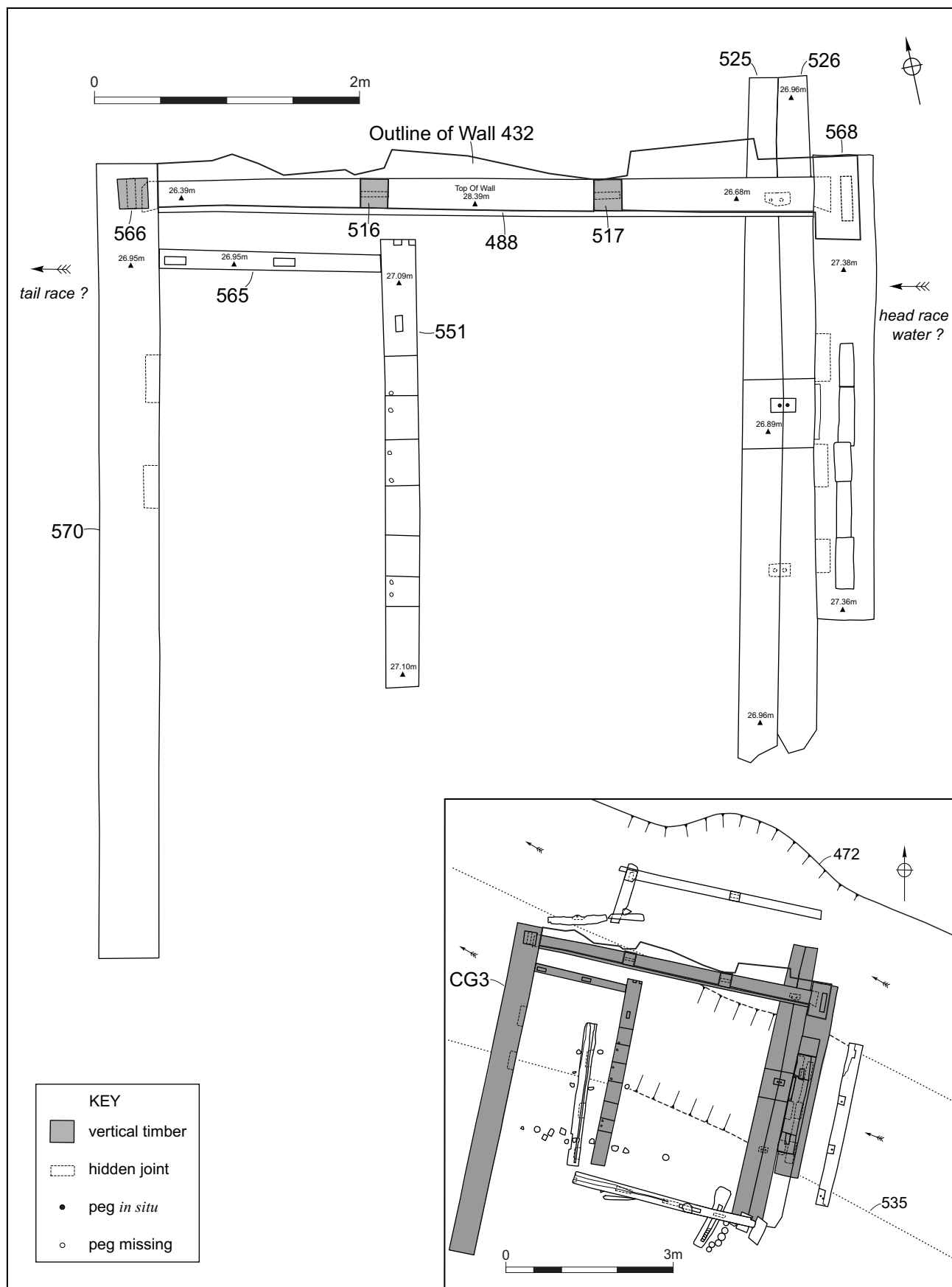
Figure 7: Mill 1 ground frame CG 1, looking east, 0.30m scale



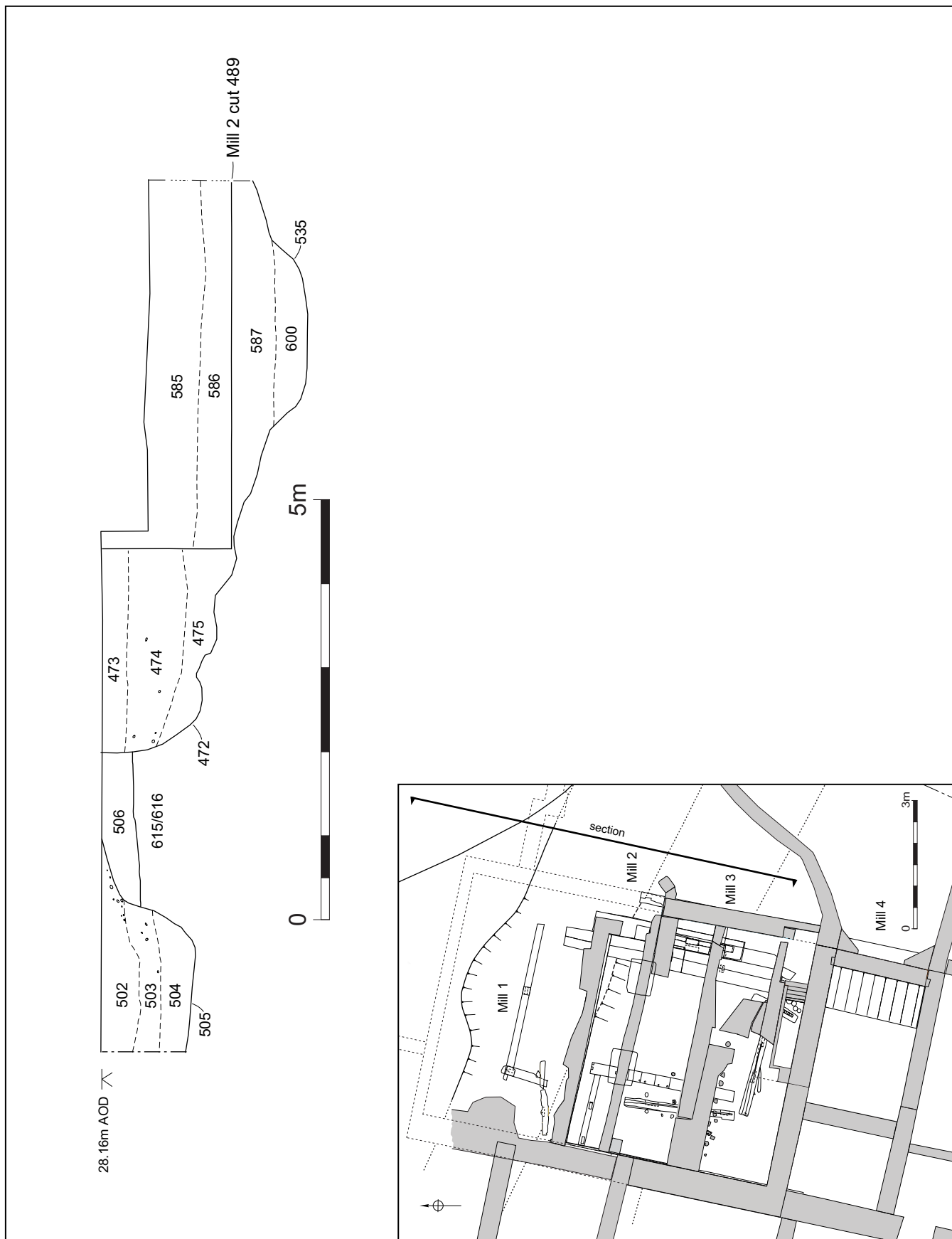
Figure 8: Mill 1 ground frame (CG1), looking west, 1m scale



Figure 9: Main (?river bed) channel (535) beneath later mill structures, facing east, 1m scales.



Surviving remains of Mill 2 (CG3) truncated to south (inset shows its location in relation to channels 472, 535 and other timber structures)



N-S section across east side of site 2.0m upstream of Mill 2

Figure 11



Figure 12: Aerial photo of Mill 2 timber structure, CG1 in foreground, view looking south.



Figure 13: Mill 2 under excavation viewed looking north-east, showing sill beam (488), timber posts (516 and 517) and wall (432) to the left, timber (551) left of centre and support timbers (525 and 526 (top) 551 (lower) with 569 to its left, all sitting over channel (535), the latter excavated where water accumulated in centre.



Figure 14: Aerial view of Mill 2 under excavation, showing timbers (525) and (526) (right scale), Timber 551 (left scale) and Mill 1 (CG 1) (top scale)



Figure 15: Mill 2 wall (432) over sill beam (488) between posts (536) left and (517) right, viewed looking north, 1m scale.



Generated by Aerial-Cam for WHEAS 2013

Figure 16: Mill 2. Extract of a 3 dimensional photograph showing wall (432) over sill beam (488) between posts (536) left and (517) right, facing north. Note the slope of timber sill beam (488) and repair (628) at east side of wall.



Figure 17: External face of wall (432) of Mill 2, viewed looking south, 1m scale.



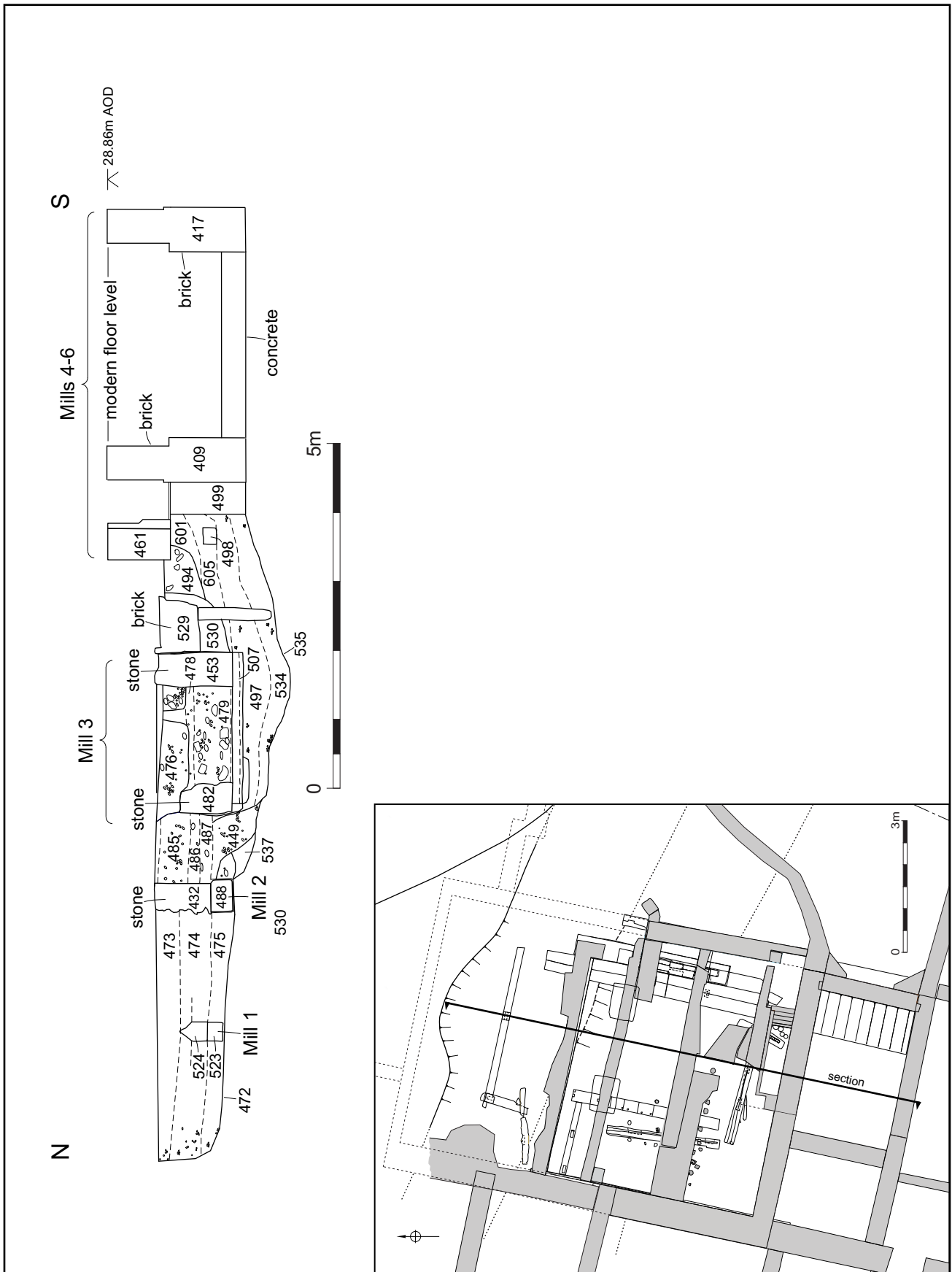
Figure 18: Detail of internal face of wall (432) of Mill 2, viewed looking north, 1m scales.



Figure 19: Mill 2 floor joist support timber (551) in foreground, with sill beam (488) left after removal of wall (432), support timbers (525 and (526) below 1m scale and eastern sill beam (568) above/behind 1m scale. Note three mortices in the western side of sill beam (568) aligned with cuts in the top side of timber (551): view looking east, 1m scale.

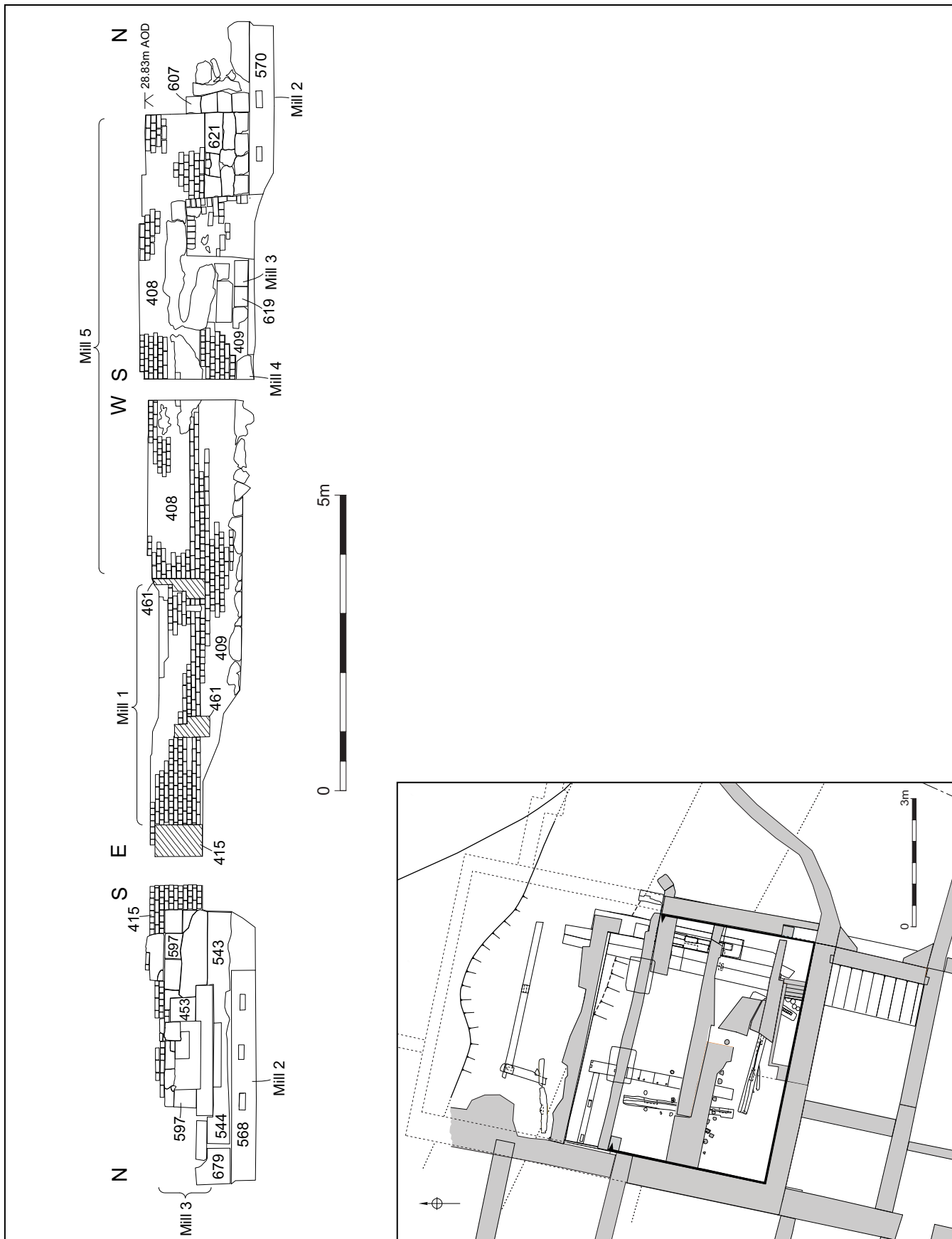


Figure 20: Western side of Mill 2 (wiggle-dated) sill beam (568) after lifting, 0.50m scale.



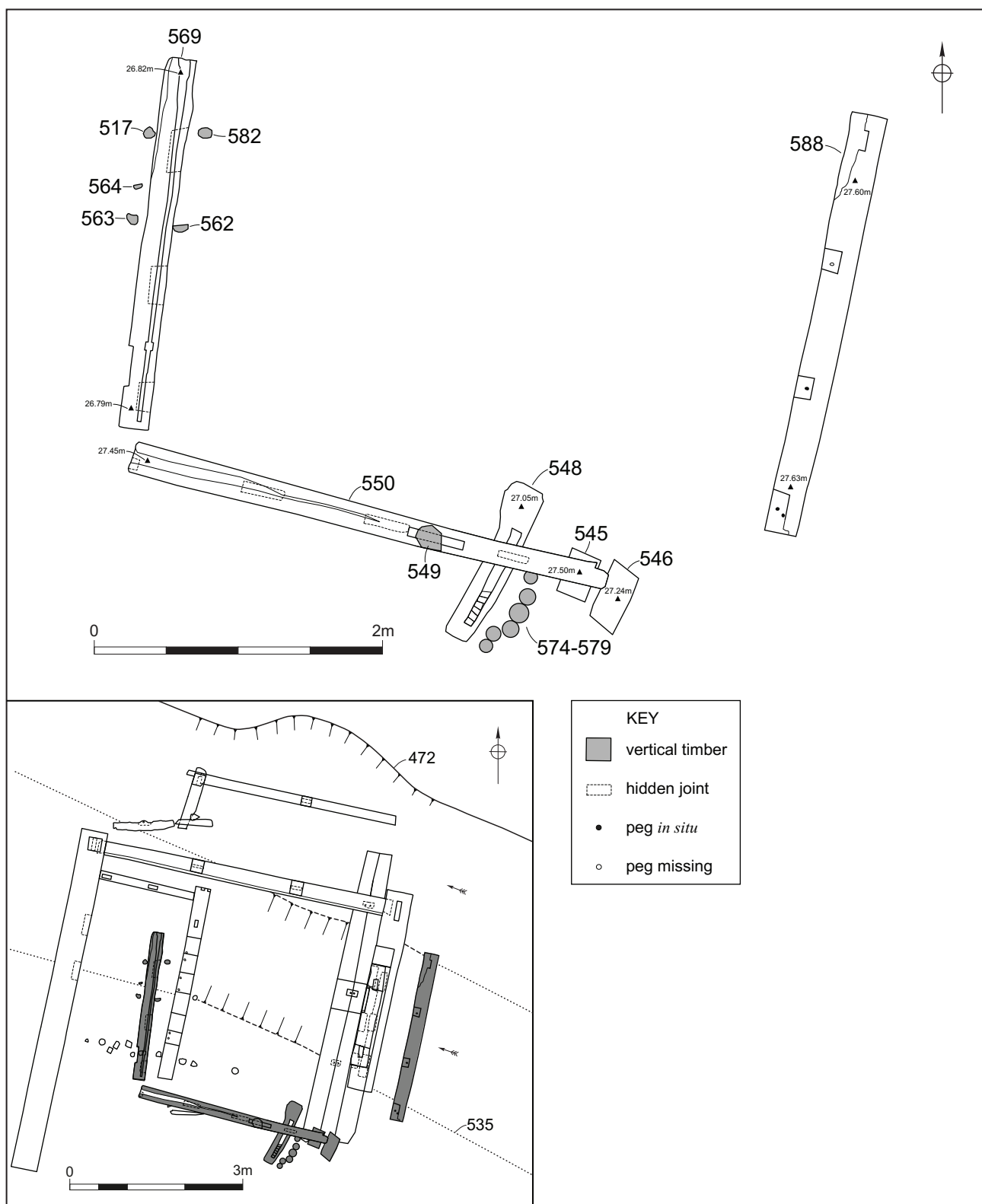
N-S section across middle of site through all mills

Figure 21



Internal elevations of Mills 2-5

Figure 22



Timbers associated with Mill 2/3

Figure 23



Figure 24: Red snap line across face of timber (588; uncertainly phased)



Figure 25: Timber (569 in centre; uncertainly phased) viewed looking south, 0.20m scale. Copper alloy pins were found in long slot



Figure 26: Timber (550; uncertainly phased) viewed looking west, 1m scale.



Figure 27: timber blocks (545) left and (546) right supporting timber (550), viewed looking south, 0.20m scale



Figure 28: Timber (548) representing possible hurst component with wedges still in place on right side of slot, viewed looking east, 1m scale. Part of Mill 2 ground frame visible to rear

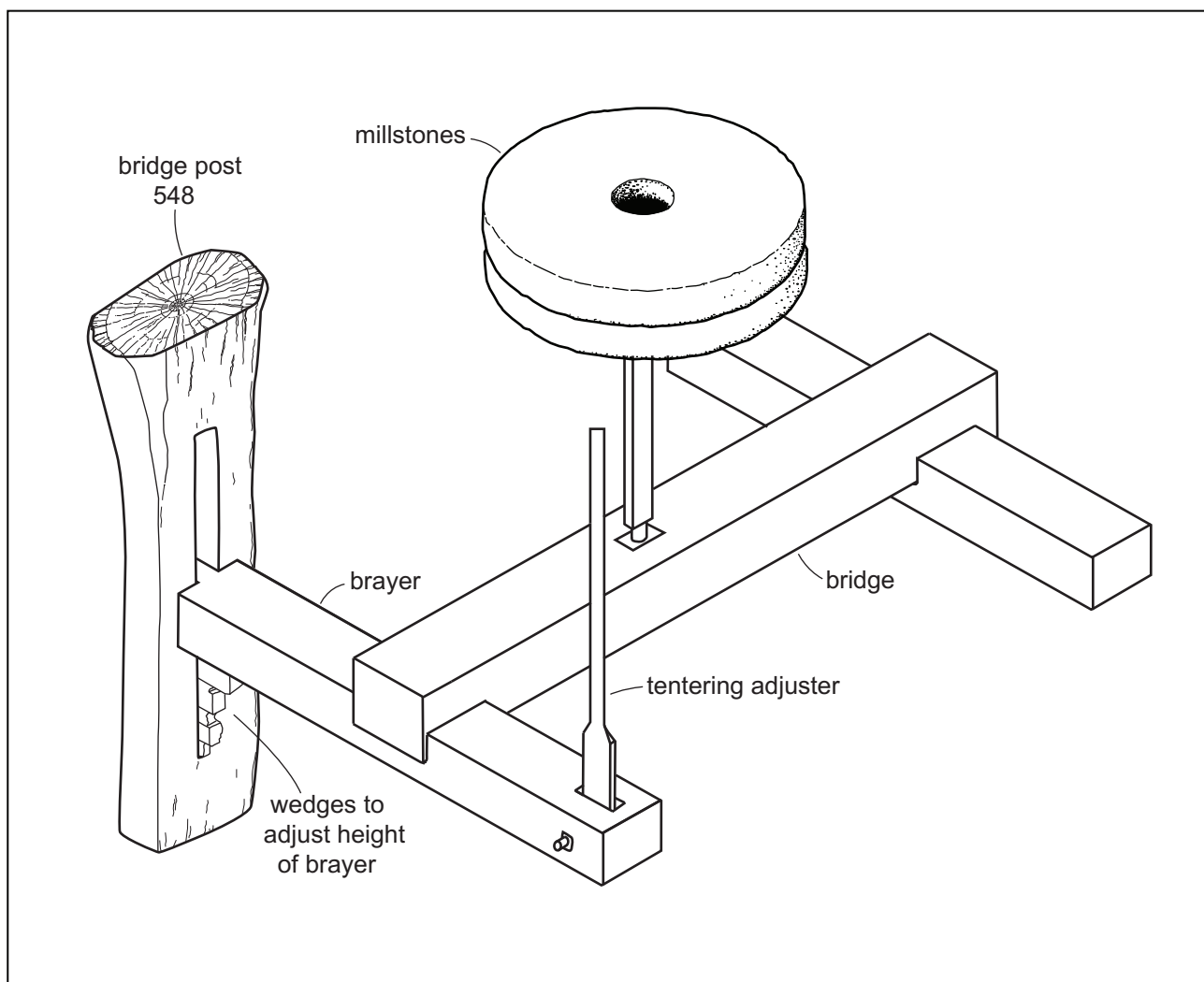
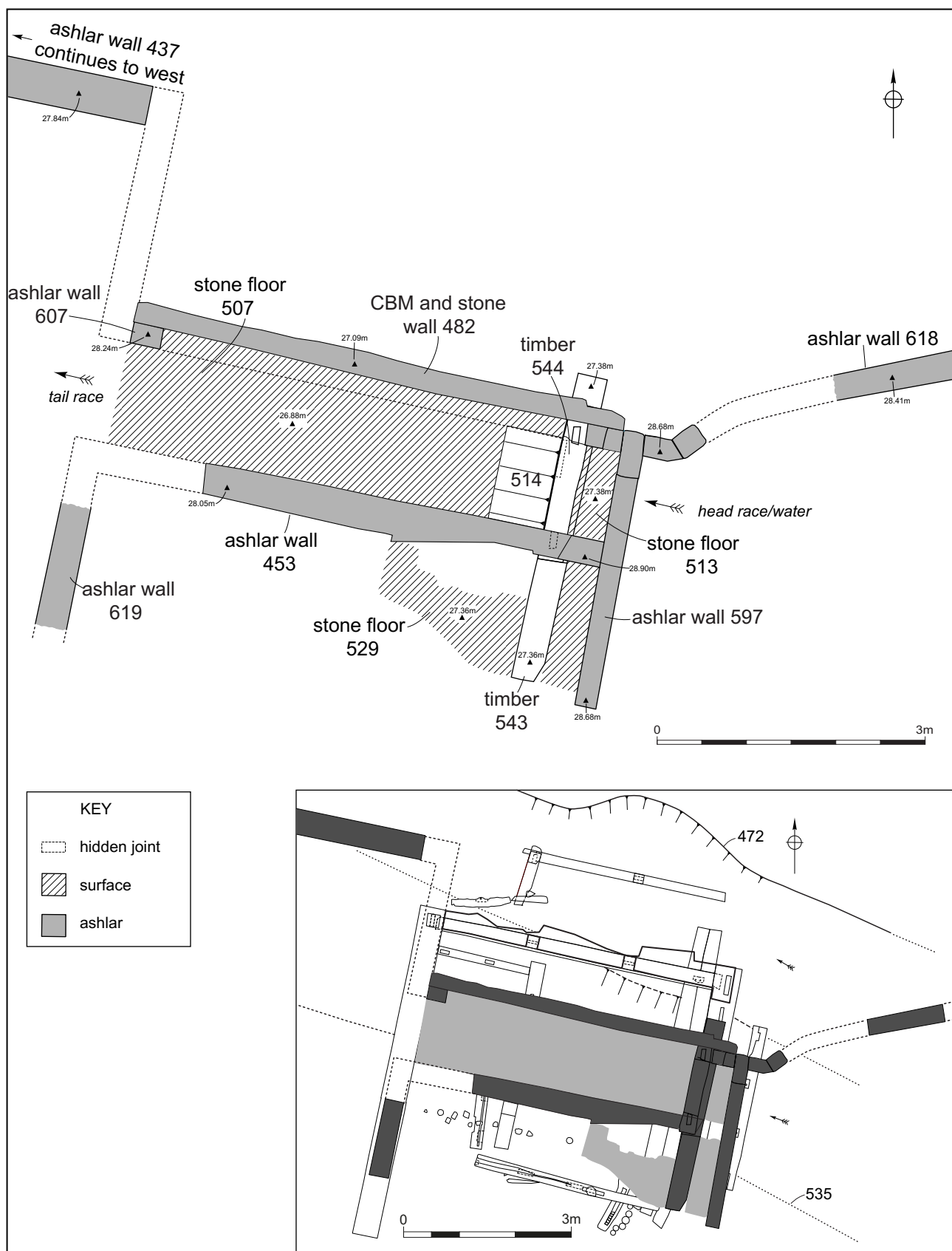


Diagram to show working position of bridge post 548

Figure 29



Plan of Mill 3 (inset showing its location in relation to earlier timber structures including Mills 1 and 2) Figure 30



Figure 31: Mill 3 (CG7) wheel pit, showing its sandstone ashlar wall (453, view looking south-east, 1m scales.



Figure 32: Mill 3 (CG7) wheel pit: walls 453 and 482 (replacement wall) (right and centre respectively) with wheel-pit entrance in background; stone wall 432 of Mill 2 showing to left with Mill 1 beyond. View looking north-east, 1m scales.



Figure 33: View of Mill 3 wheel pit (453 left, 607 right with its replacement wall (482) to side by side to right) looking downstream with flagstone floor (507) in its base and showing later blocking to wheel-pit exit. View looking west, 1m scale.



Figure 34: Entrance to Mill 3 (CG7) wheel pit, showing ashlar wall (453) right, remains of ashlar wall (597) top left, and timber (544) in centre. View looking east, 1m scale.



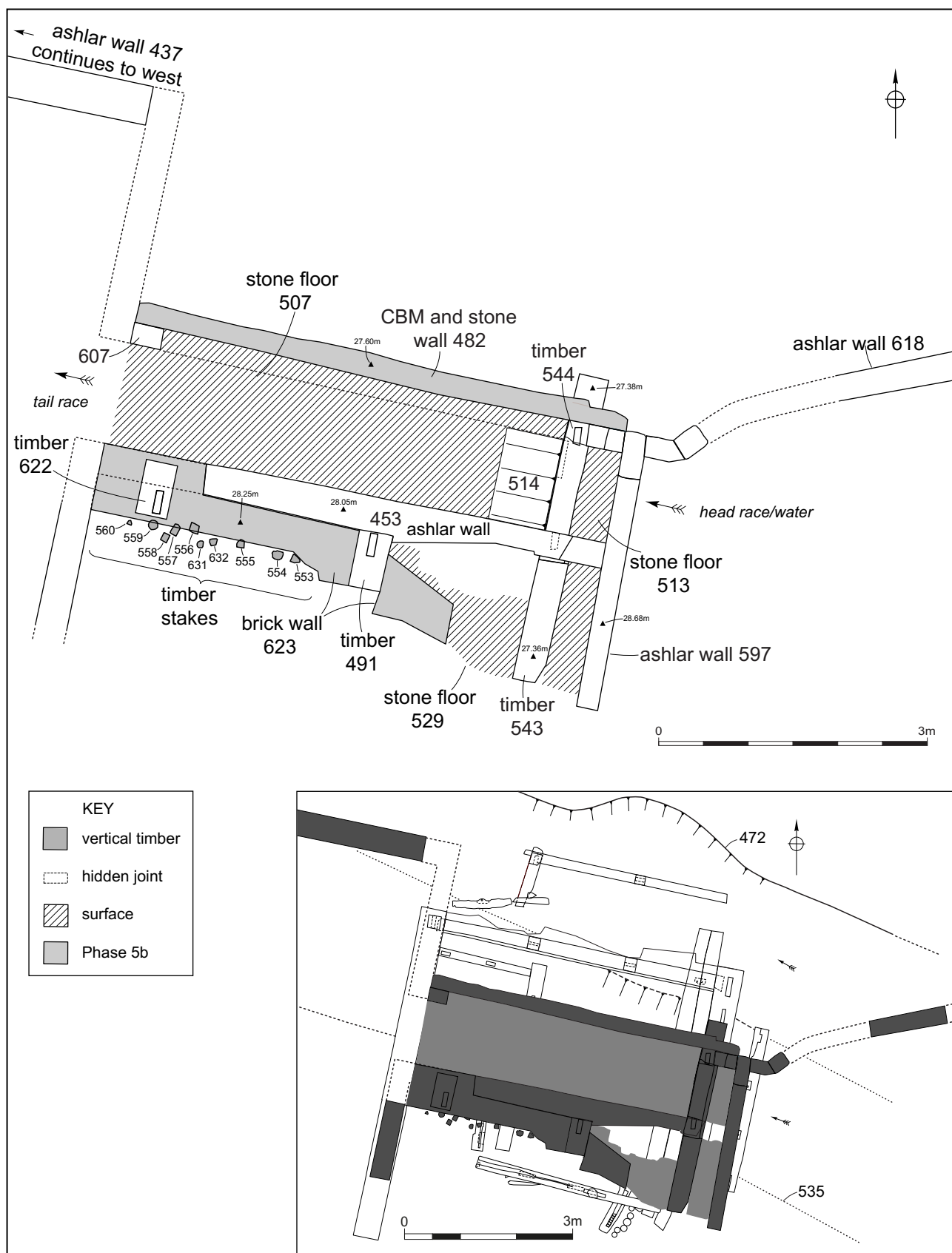
Figure 35: Entrance to Mill 3 (CG7) wheel pit, showing ashlar wall (453) distance and timber (544). Note cut through wall (453).



Figure 36: Entrance to wheel pit of CG7 showing timber (544) at top of breast work. Note wide grooves in breast work (514 below timber). View looking east, 1m scale.



Figure 37: Mill 3. Looking down on mill pond wall (597 in centre - truncated length) with pond to right and wheel pit to left. View looking north, 1m scale.



Plan of Mill 3 Phase 5b (inset showing other elements of the mill in use at this time and their location in relation to earlier timber structures including Mills 1 and 2)

Figure 38



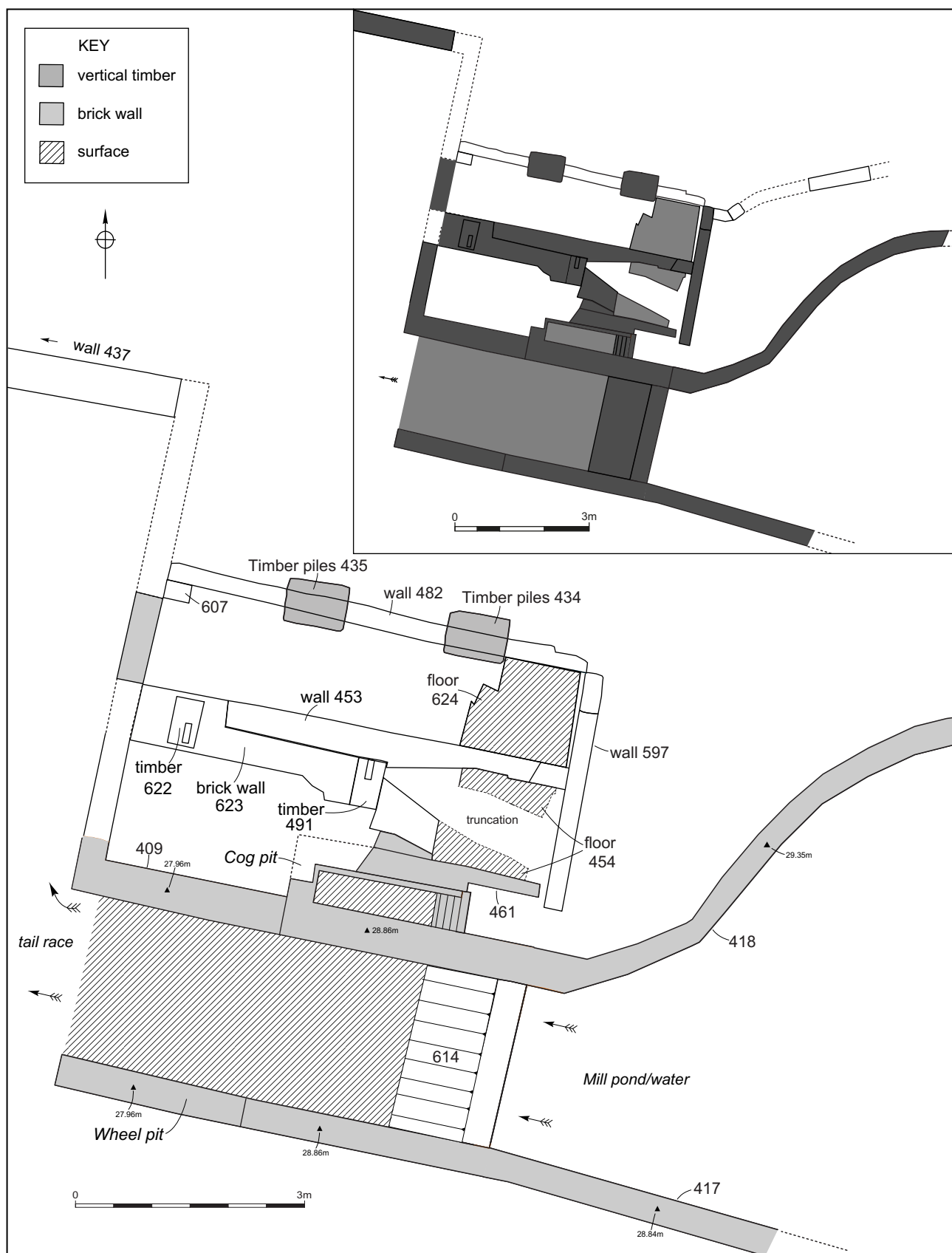
Figure 39: Mill 3 (Phase 5b). Wooden block (491) in wall (623) right and foundations centre left opposite. View looking north, 1m scales.



Figure 40: Close-up of wooden block (622). View looking north-east, 0.30m scales.



Figure 41: Stake alignment, including stakes (555, 556, 557, 558, 559, 560). View looking north, 0.20m scale.



Plan of Mill 4 (inset showing its location in relation to earlier structural elements of Mill 3)



Figure 43: Mill 4 stake groups 434 (left) and 435 (right) with contemporary wheel pit visible in background. View looking south, 1m scale.



Figure 44: Mills 4-5 pond wall (417 and 418) and entrance to wheel pit view looking west, 1m scale



Figure 45: Entrance to Mill 4 ashlar breast work of wheel pit CG11. View looking east, 1m scale



Figure 46: Wheel pit (CG11) of Mills 4-5, showing wheel-pit wall (409) to left and ashlar breast work (614) to centre right obscured by rubble below.



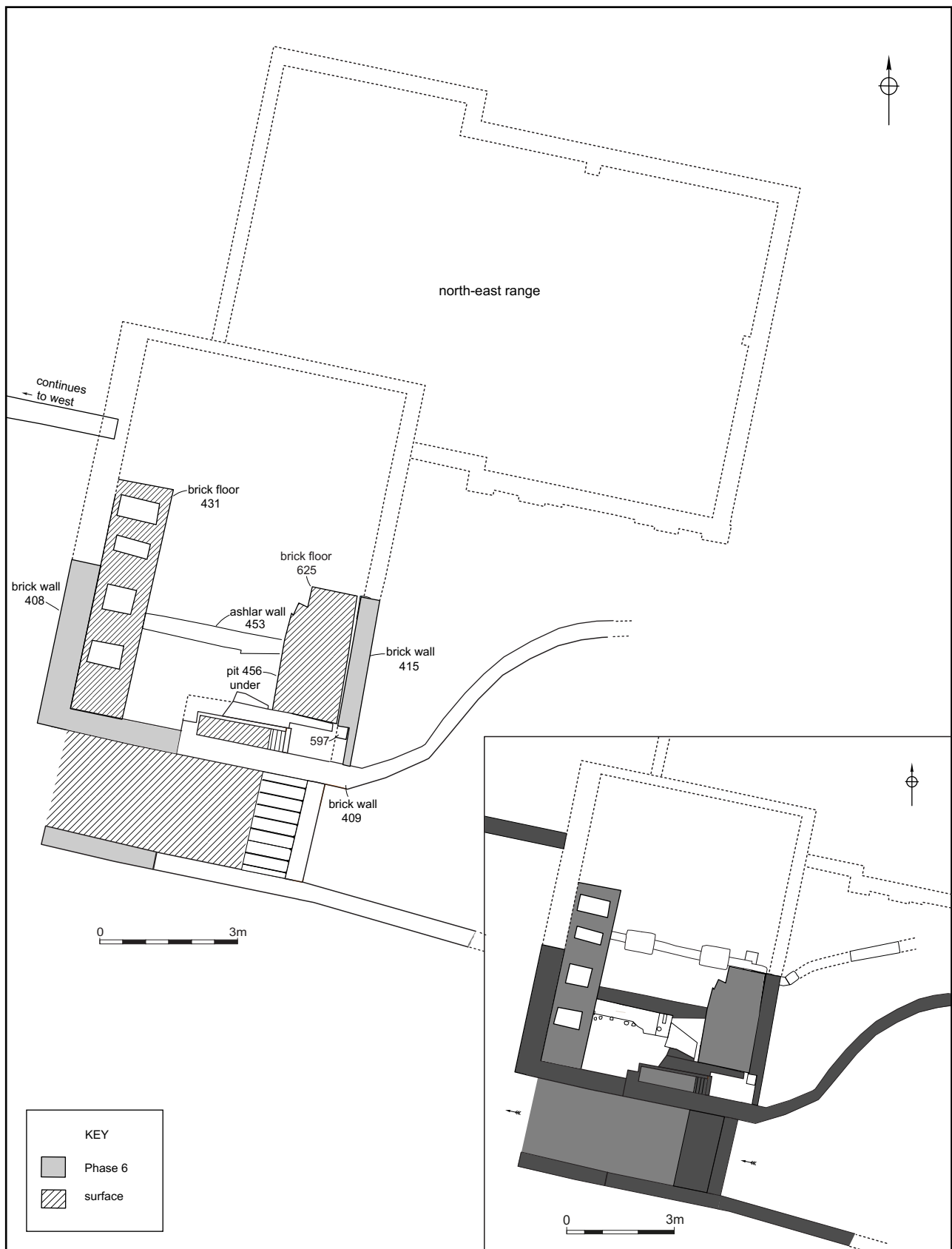
Figure 47: Cog pit of Mills 4-5 with wheel pit to right beneath spoil. View looking south-east, 1m scale.



Figure 48: Drainage hole , through wall (409) between cog pit and wheel pit



Figure 49: Mills 4-5 pond walls (417 to left and 418 centre). View looking east.



Plan of Mill 5 (inset showing its location in relation to earlier structural elements of Mill 4). North - east range and north end of main mill derived from Tyler (2014) survey.

Figure 50



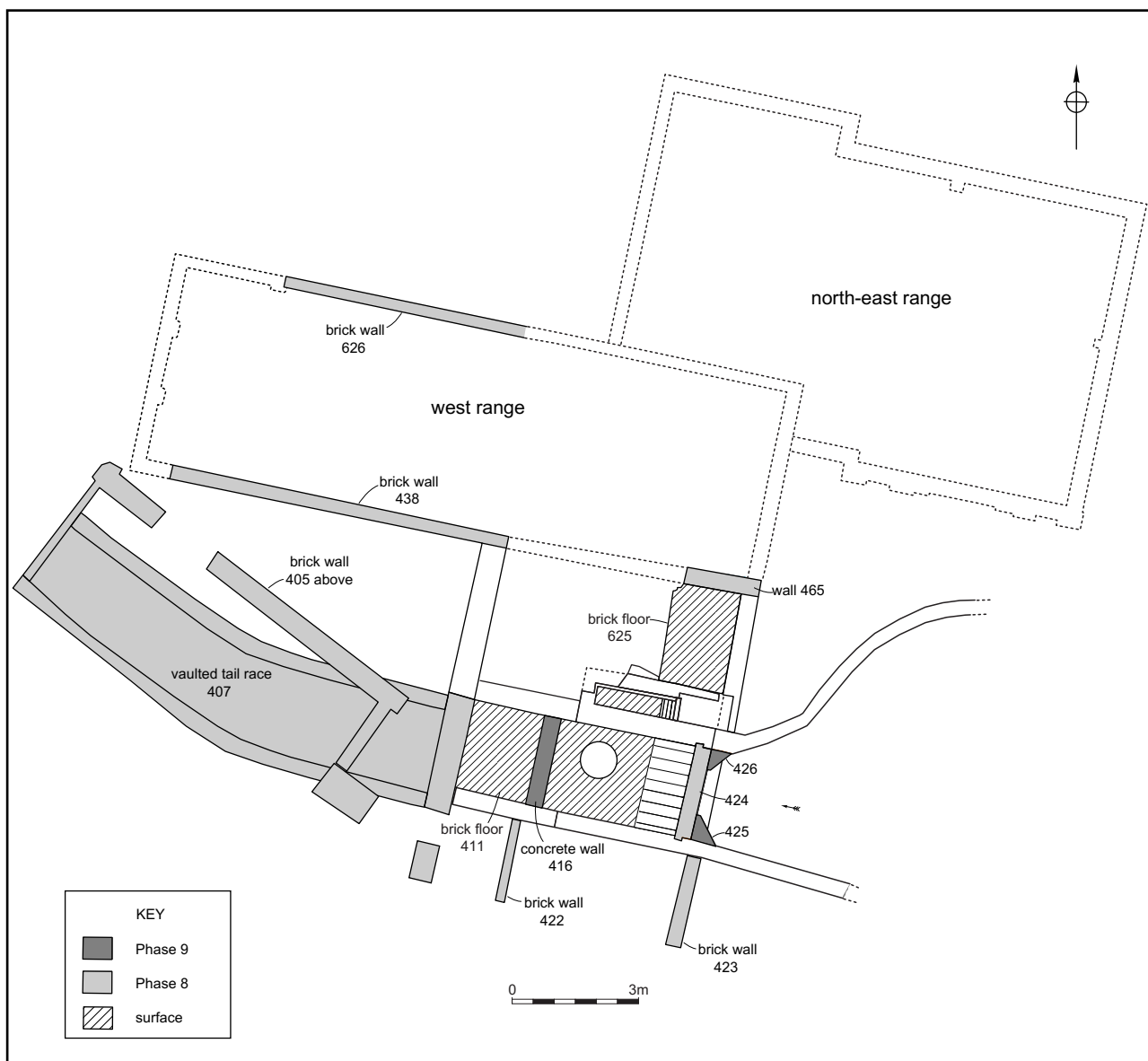
Figure 51: Mill 5 brick floors (624) top centre and (454) in foreground. View looking north, 1m scale.



Figure 52: Millstone fragments (469) in pit (468) below floor 624 (excavated) of Mill 5. View looking north-west, 1m scale.



Figure 53: Mill 5a brick floor (431) showing holes in floor. View looking south, 1m scale



Plan of Mill 5b-c (Phases 8-9)

Figure 54



Figure 55: Canal basin brick walls 203 (by archaeologist) and 205 (foreground). View looking north-east, 1m scale.



Figure 56: Vaulted cellars (105), in Trench 1. View looking north-east, 1m scale



Figure 57: Mills 5b-c vaulted tail race (407) on left side with steam engine house foundations (405) to its right. View looking west, 1m scale



Figure 58: Vaulted tail race 407. View looking west, 1m scale



Figure 59: Only surviving floor of Mill 5c (625). View looking west, 1m scales.



Figure 60: Iron sill plate (427) to left of ranging pole. Triangular corner pillars (425) and (426) at either end form part of the turbine stage modifications. View looking north, 1m scale



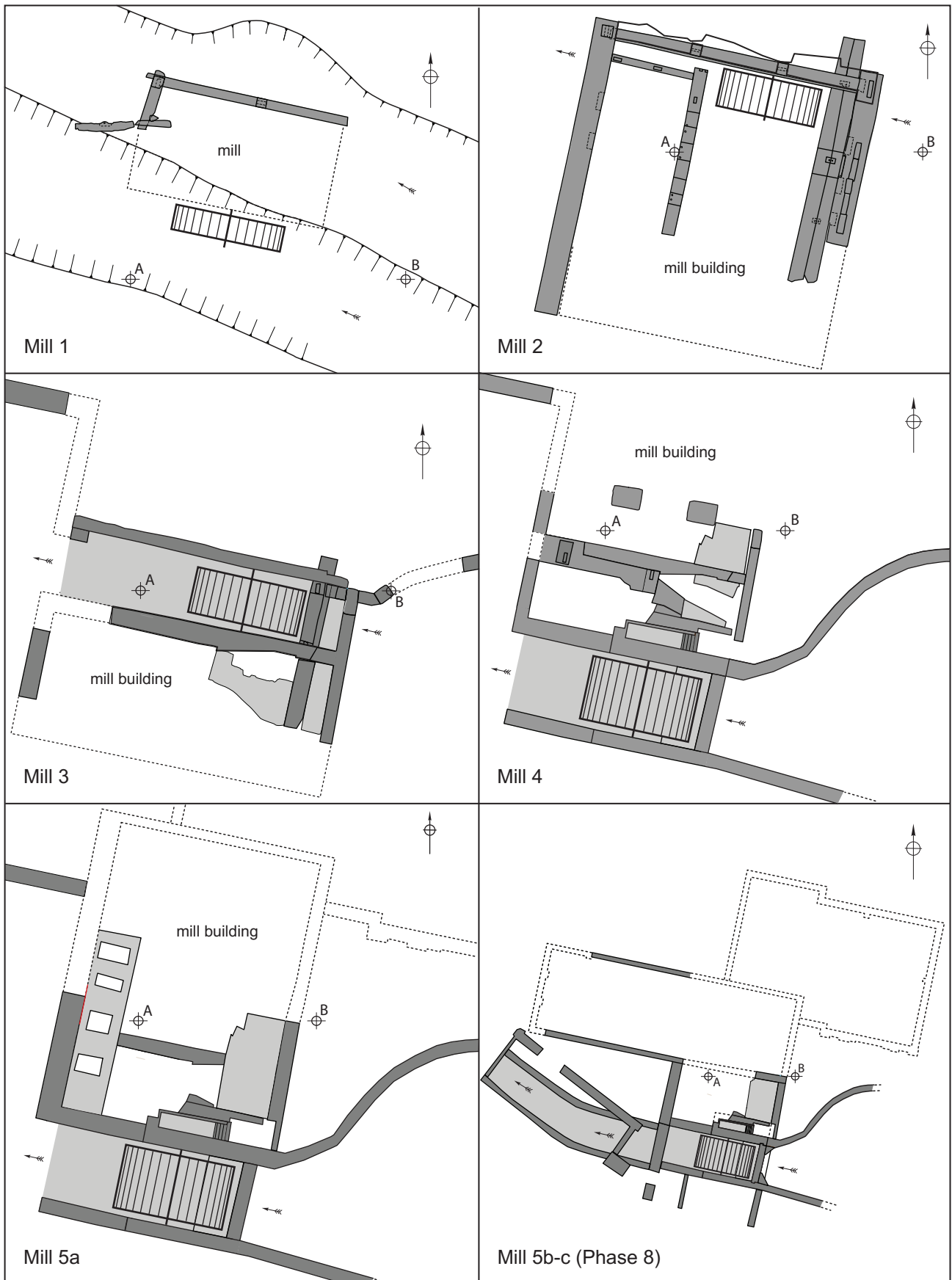
Figure 61: Exit hole for water in base of wheel pit above which turbine (627) of Mill 5c was located. View looking west, 1m scale



Figure 62: Entrance to wheel pit now constricted by triangular brickwork left and right in front of original breast work (behind) to provide water access point (here obscured behind brick rubble) into turbine chamber of Mill 5c. View looking west, 1m scale.



Figure 63: Metal turbine parts (627) of Mill 5c. 1m scale



Schematic sequence of mills

Figure 64

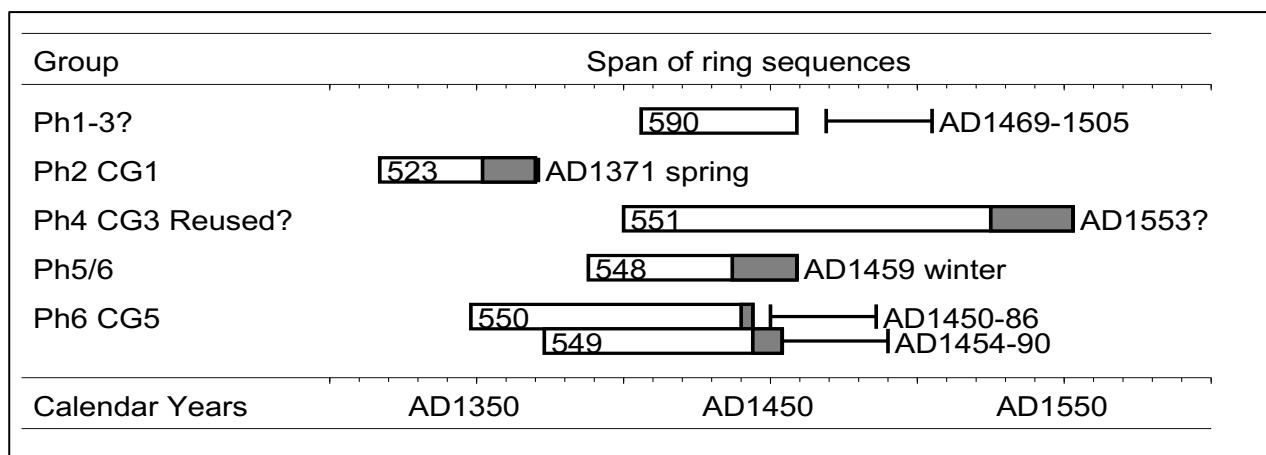


Figure 65: Bar diagram showing the date ranges of absolutely dated tree-ring series and implied dates of felling of the parent trees

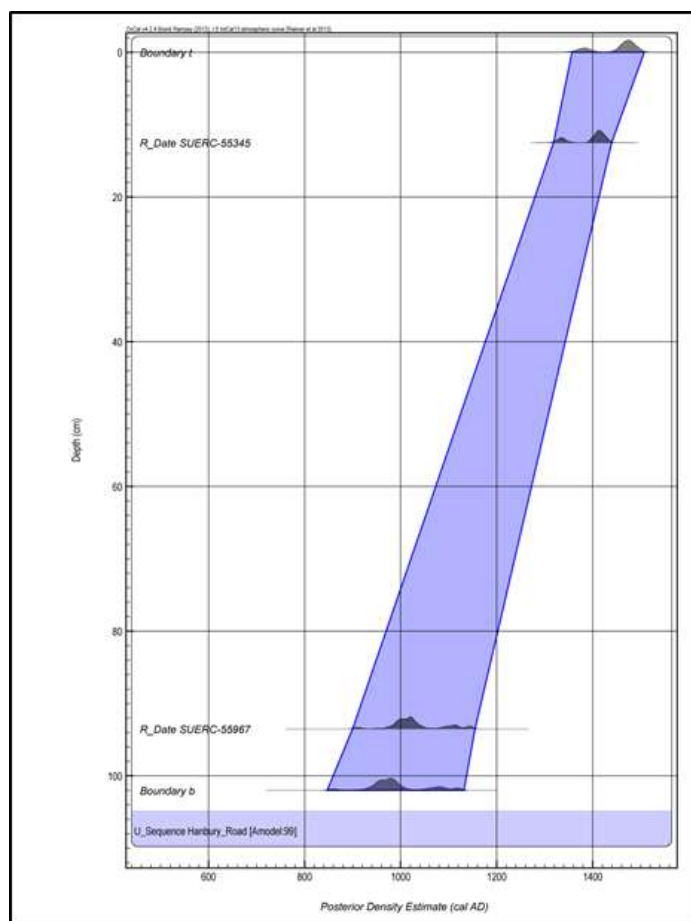


Figure 66: Bayesian age-depth model of the chronology of the sediment sequence at Hanbury Road (monolith 3 - [505]) using OxCal 4.2 (U_Sequence model; Bronk Ramsey 2008). The coloured band shows the estimated date of the sediment at the corresponding depth at 95% probability.

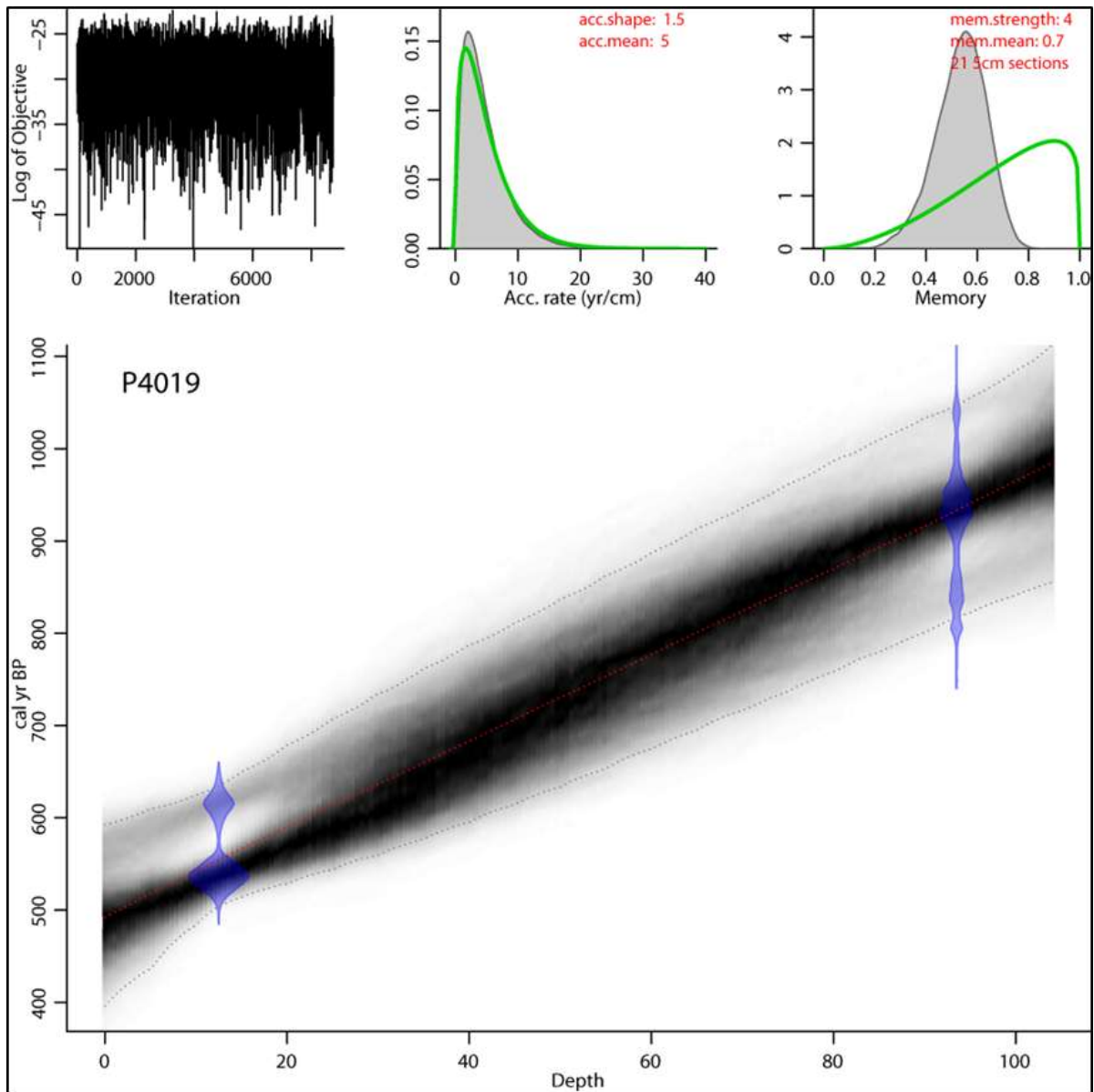


Figure 67: Bayesian age-depth model of the chronology of the sediment sequence at Hanbury Road (monolith 3) produced in BACON (Blaauw and Christen 2011). The grey band shows the estimated date of the sediment at the corresponding depth at 95% probability.

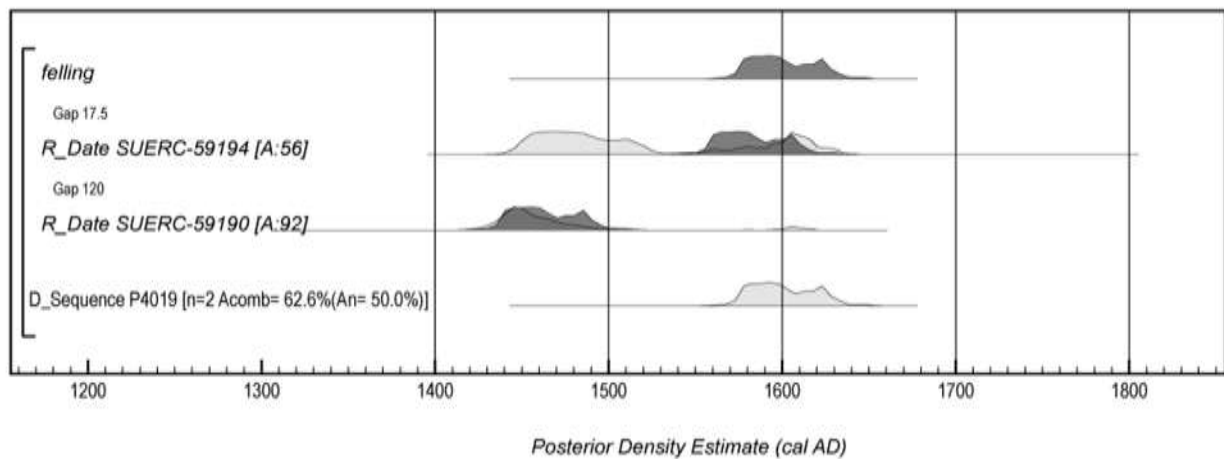


Figure 68: Probability distributions of dates from timber 568. The large square brackets down the left-hand side along with the OxCal keywords define the overall model exactly.

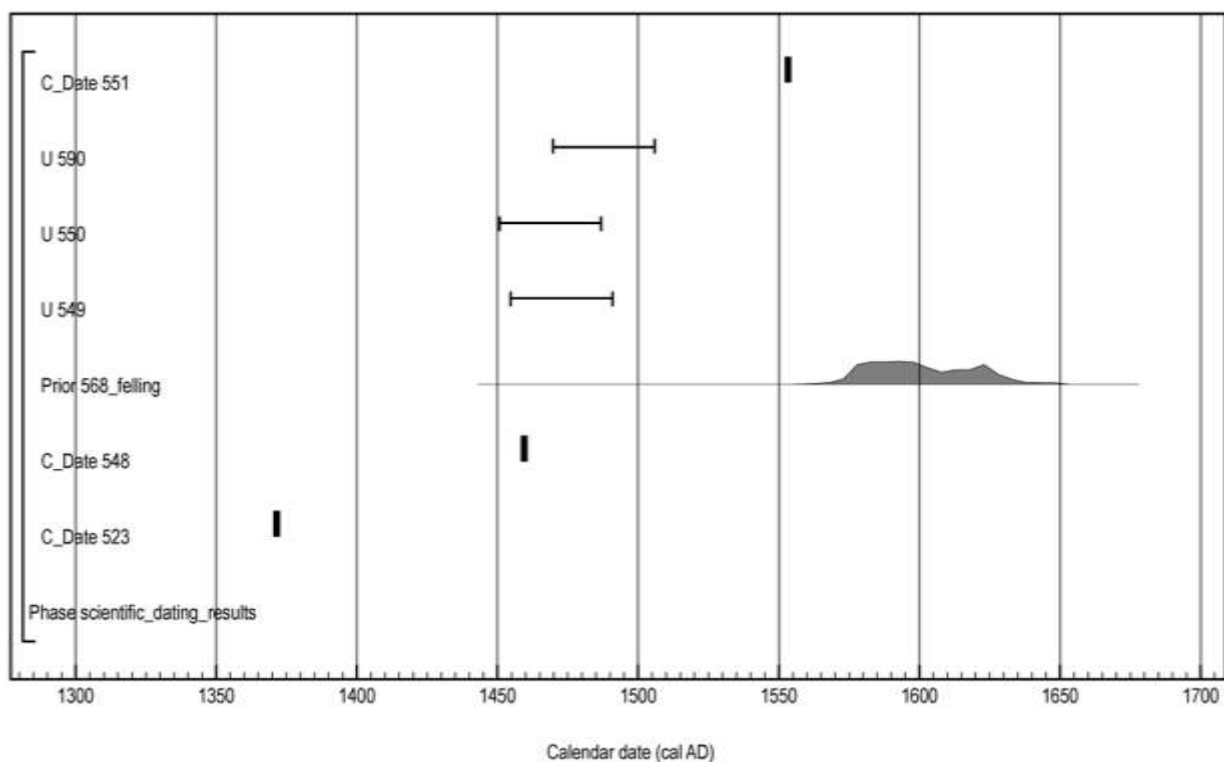


Figure 69: Scientific dating results for all known timber felling dates (derived from Fig xxxBW; 568_felling and dendrochronological results Section 6.1).



Figure 70: Copper alloy dress pins with wire-wound heads dating to c mid 15th–16th century (569; Phase 3/4). Scale in mm



Figure 71: Copper alloy buckle (569, Phase 3/4). Scale in mm

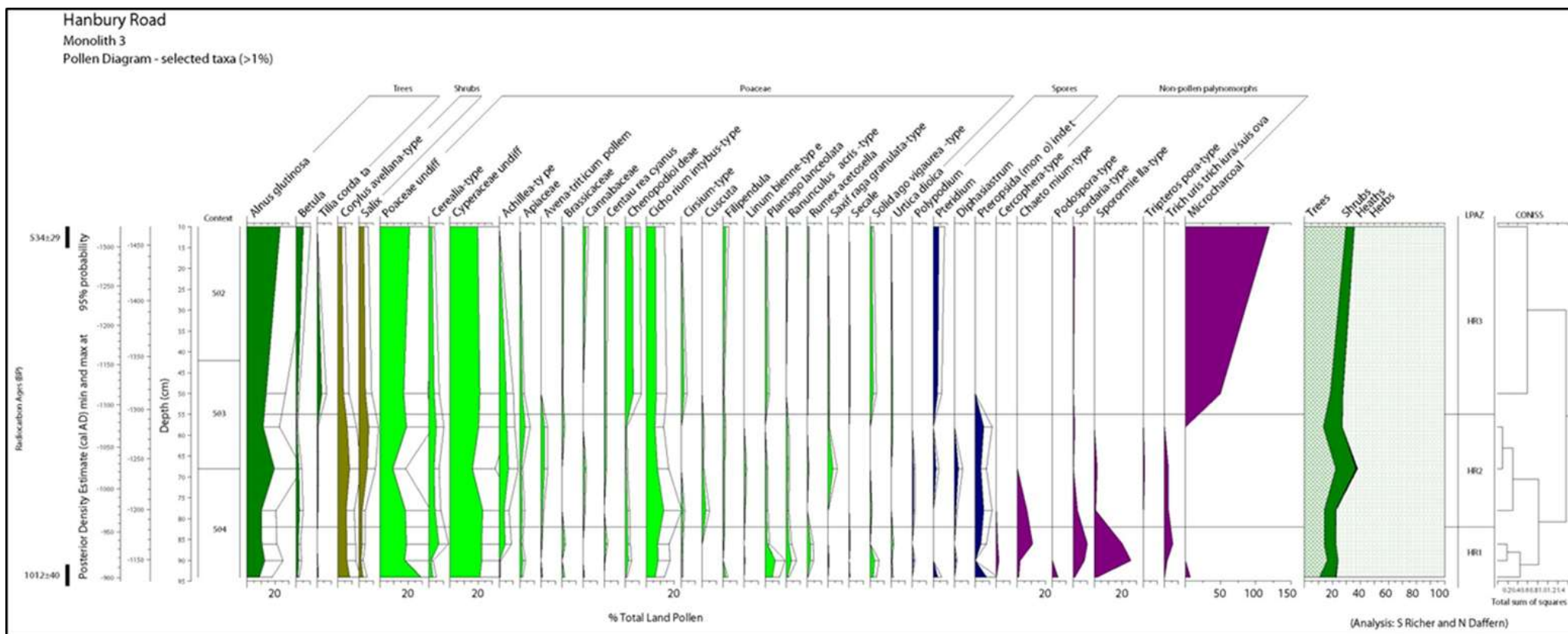


Figure 72: Monolith 3 pollen diagram

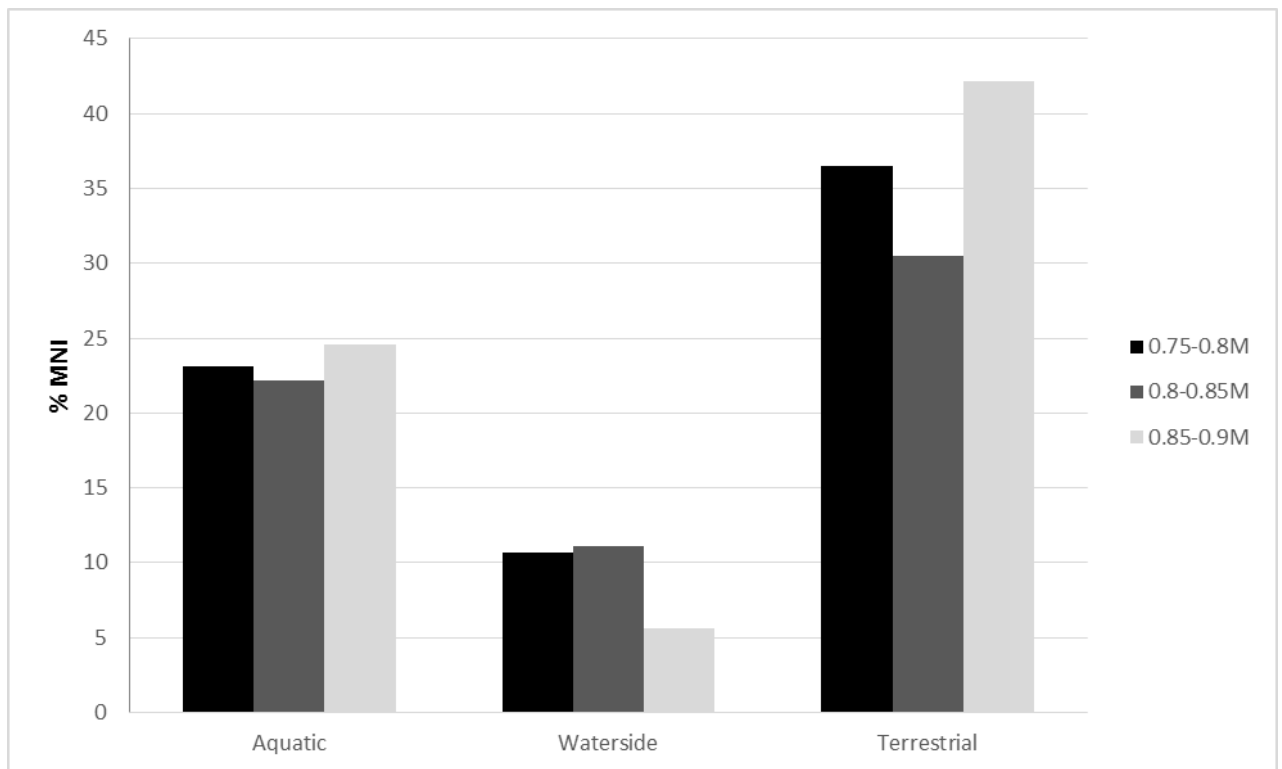


Figure 73: Proportions of the aquatic ecological groups of Coleoptera compared to combined terrestrial species proportions

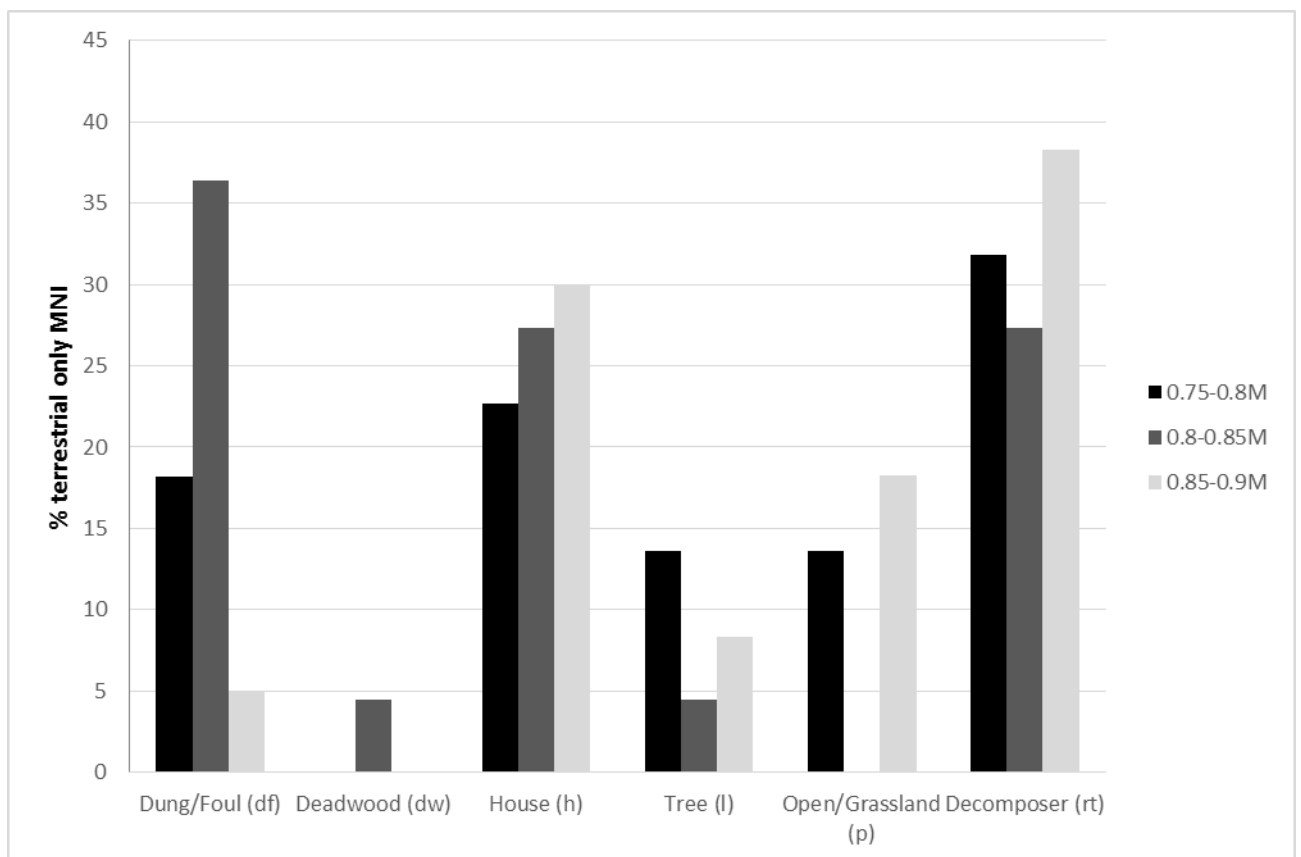


Table 74: Proportions of the terrestrial ecological groups of Coleoptera



Figure 75: Overall view of site under excavation: timber ground frames of mills in centre. Note temporary large water storage tanks to right to store water pumped away from excavation

Appendix 1

Pollen processing methodology (Tim Mighall, Department of Geography & Environment, University of Aberdeen)

A) SOLUTION OF HUMIC COMPOUNDS

1) Switch on hotplate to heat water bath. Prepare 12 to 16 samples concurrently.

HCl. is an irritant and can cause burns. Wear gloves. Wash with water if spilt on your skin.

Using a clean spatula, place a known volume or weight of sediment (c. 2cm³) and one spore tablet in each 50ml centrifuge tube. Add a few cm³ of distilled water (enough to cover the pellet and tablets) and a few drops of 2M HCl. Wait until effervescence ceases, then half fill tubes with 10% KOH; place in a boiling water bath for 15 minutes. Stir to break up sediment with clean glass rod. Return HCl and KOH bottles to the chemical cabinet.

2) Centrifuge at 3,000 rpm for 5–6 minutes, ensuring first that tubes are filled to the same level. This applies throughout the schedule (Mark 7 on centrifuge).

3) Carefully decant, i.e. pour away liquid from tube, retaining residue. Do it in one smooth action.

4) Disturb pellet using vortex mixer; add distilled water, centrifuge and decant.

5) Using a little distilled water, wash residue through a fine (180 micron) sieve sitting in filter funnel over a beaker. NB Be especially careful in keeping sieves, beakers and all tubes in correct number order. Wash residue on sieve mesh into petri dish and label the lid. If beaker contains mineral material, stir contents, wait four seconds, then decant into clean beaker, leaving larger mineral particles behind. Repeat if necessary. Clean centrifuge tube and refill with contents of beaker.

6) Centrifuge the tubes and decant.

B) HYDROFLUORIC ACID DIGESTION

(Only required if mineral material clearly still present. Otherwise, go to stage 13)

NB Hydrofluoric acid is extremely corrosive and toxic; it can cause serious harm on contact with eyes and skin. Rubber gloves and mask/ goggles MUST be worn up to and including stage 11. Please fill sink with H₂O; have CaCO₃ gel tablets ready. Place pollen tube rack into tray filled with sodium bicarbonate.

7) Disturb pellet with vortex mixer. Add one cm³ of 2M HCl.

8) With the fume cupboard sash lowered between face and sample tubes, very carefully one-third fill tubes with concentrated HF (40%). Place tubes in water bath and simmer for 20 minutes.

9) Remove tubes from water bath, centrifuge and decant down fume cupboard sink, flushing copiously with water.

10) Add 8cm³ 2H HCl to each tube. Place in water bath for 5 minutes. Do not boil HCl.

11) Remove tubes, centrifuge while still hot, and decant.

12) Disturb pellet, add distilled water, centrifuge and decant.

C) ACETYLATION

NB Acetic acid is highly corrosive and harmful on contact with skin. Wash with H₂O if spilt on skin.

13) Disturb pellet, add 10cm³ glacial acetic acid, and centrifuge. Decant into fume cupboard sink with water running during and after.

14) Acetic Anhydride is anhydrous. Avoid contact with water. The acetylation mixture can cause severe burns if spilt on skin. Wash with water.

15) Make up 60cm³ of acetylation mixture, just before it is required. Using a measuring cylinder; mix acetic anhydride and concentrated sulphuric acid in proportions 9:1 by volume. Measure out 54cm³ acetic anhydride first, then add (dropwise) 6cm³ concentrated H₂SO₄ carefully, stirring to prevent heat build-up. Stir again just before adding mixture to each tube.

Disturb pellet; then add 7cm³ of the mixture to each sample.

16) Put in boiling water bath for 1–2 minutes. (Stirring is unnecessary—never leave glass rods in tubes as steam condenses on the rods and runs down into the mixture reacting violently). One minute is usually adequate; longer acetylation makes grains opaque. Switch off hot plate.

17) Centrifuge and decant all tubes into large (1,000ml) beaker of water in fume cupboard. Decant contents of beaker down fume cupboard sink.

18) Disturb pellet, add 10cm³ glacial acetic acid, centrifuge and decant.

19) Disturb pellet, add distilled water and a few drops of 95% ethanol centrifuge and decant carefully.

D) DEHYDRATION, EXTRACTION AND MOUNTING IN SILICONE FLUID

20) Disturb pellet; add 10cm³ 95% ethanol, centrifuge and decant.

21) Disturb pellet; add 10cm³ ethanol (Absolute alcohol), centrifuge and decant. Repeat.

22) Toluene is an irritant. Avoid fumes.

Disturb pellet; add about 8cm³ toluene, centrifuge and decant carefully into 'WASTE TOLUENE' beaker in fume cupboard (leave beaker contents to evaporate overnight).

23) Disturb pellet; then using as little toluene as possible, pour into labelled specimen tube.

24) Add a few drops of silicone fluid - enough to cover sediment.

25) Leave in fume cupboard overnight, uncorked, with fan switched on. Write a note on the fume cupboard '*Leave fan on overnight - toluene evaporation*', and date it. Collect specimen tubes next morning and cork them. Turn off fan.

26) Using a cocktail stick, stir Contents and transfer one drop of material onto a clean glass slide and cover with a cover slip (22mm x 22mm). Label the slide.

27) Wash and clean everything you have used. Wipe down the fume cupboard worktop. Remove water bath from fume cupboard if not needed by the next user. Refill bottles and replace them in chemical cabinets.

Appendix 2: Pollen assessment and full analysis results

Species	Family	Common Name(s)	<1>				<3>							
			473	474	474	475	502	503	503	503	503	503	503	504
			0.12m	0.60m	0.92m	1.32m	0.10m	0.50m	0.58m	0.68m	0.86m	0.78m	0.90m	0.94m
<i>Pinus sylvestris</i>	Pinaceae	Scots pine	1		2		1							
<i>Ulmus</i>	Ulmaceae	elm			1							2	3	
<i>Quercus</i>	Fagaceae	oak	1	2	2	4		1	2	1	6	1	3	1
<i>Betula</i>	Betulaceae	birch	7	1	6	2	8	4	2	7	5	8	7	9
<i>Alnus glutinosa</i>	Betulaceae	alder	42	40	31	47	36	45	35	66	34	32	45	60
<i>Corylus avellana</i> -type	Betulaceae	hazel	7	8	7	5	4	18	20	28	20	18	22	17
<i>Salix</i>	Salicaceae	willow	3	5	4	2	5	20	21	20	7	7	5	2
<i>Tilia cordata</i>	Malvaceae	small-leaved lime		1	1	1		1	1	2		1	1	
<i>Fraxinus excelsior</i>	Oleaceae	ash				1			1					
<i>Ilex aquifolium</i>	Aquifoliaceae	holly		1	1	2		1		2				1
<i>Calluna vulgaris</i>	Ericaceae	heather		2	1	4		1		4		1		3
<i>Papaver rhoeas</i> -type	Papaveraceae	common poppy							4	1				1
<i>Ranunculus acris</i> -type	Ranunculaceae	meadow buttercup		1			1		3	4	6	3	13	4
<i>Ranunculus cf flammula</i>	Ranunculaceae	lesser spearwort		1										
<i>Saxifraga granulata</i> -type	Saxifragaceae	meadow saxifrage			1			2	1	1			1	
<i>Chrysosplenium</i>	Saxifragaceae	golden saxifrage	1							1		2		
<i>Umbilicus rupestris</i> -type	Crassulaceae	navelwort/ pigmyweeds		1										
<i>Vicia sylvatica</i> -type	Fabaceae	vetches/ vetchlings/ peas		1										
<i>Trifolium</i> -type	Fabaceae	clovers		1	1	2		1						
Rosaceae	Rosaceae	rose family	1	1	4	2		2						
<i>Filipendula</i>	Rosaceae	meadowsweet	1	1			3	1	3	2	1	2		7
<i>Cannabis</i> -type	Cannabaceae	hop/ hemp	1						3	4		2		2
<i>Urtica dioica</i>	Urticaceae	stinging nettle	7	9	12	4		2	2		3		1	3
<i>cf Euphorbia</i>	Euphorbiaceae	spurges		1										
<i>Linum bienne</i> -type	Linaceae	flax	1	1					5	3		1	1	
<i>Reseda</i>	Resedaceae	weld	3		1									
Brassicaceae	Brassicaceae	cabbage family	1				1	1	3		4		4	3
<i>Rumex acetosella</i>	Polygonaceae	sheep's sorrel	1			3	1	1		2	7		8	1
<i>Rumex acetosa</i>	Polygonaceae	common sorrel		1										
<i>Chenopodiaceae</i>	<i>Chenopodiaceae</i>	goosefoot family	2	2	4	5	8	19	2	3	6	5	8	3
Caryophyllaceae	Caryophyllaceae	pink family				1								
Rubiaceae	Rubiaceae	bedstraw family	1											
<i>Cuscuta</i>	Convolvulaceae	doddgers							2	1		8		
<i>Plantago lanceolata</i>	Plantaginaceae	ribwort plantain	1		3	2	1	5		3	5	3	25	21
<i>Scrophularia</i> -type	Scrophulariaceae	figworts												1
<i>Centaurea scabiosa</i>	Asteraceae	greater knapweed						1						
<i>Centaurea cyanus</i>	Asteraceae	cornflower		2	2		2	3	3	3	4		1	
<i>Cichorium intybus</i> -type	Asteraceae	chicory/ dandelion	4	12	15	19	10	14	19	27	25	39	30	27
<i>Solidago virgaurea</i> -type	Asteraceae	daisies/ goldenrods	7	5	3	5	2	7				2	11	9

<i>Cirsium</i> -type	Asteraceae	thistles				1		7			2	4	2	2
<i>Achillea</i> -type	Asteraceae	yarrows/ chamomiles	1	3	3	2		17	17	3	15	11	2	2
Apiaceae	Apiaceae	carrot family	3	5	6			14	11	23	3	5		2
cf <i>Tamus communis</i>	Dioscoreaceae	black bryony												1
Cyperaceae undiff	Cyperaceae	sedge	16	6	13	9	30	70	62	54	72	72	81	82
Poaceae undiff	Poaceae	grasses	35	40	33	37	30	53	57	31	60	56	62	122
<i>Cerealia</i> indet	Poaceae	indeterminable cereal	5	5		4	3	14	16	12	22	13	5	14
<i>Avena/ Triticum</i> -type	Poaceae	oat/wheat							7	8	1	3		2
<i>Hordeum</i> -type	Poaceae	barley									3	1		
<i>Secale cereale</i>	Poaceae	rye						1						1
TLP Grains counted			153	159	157	164	146	326	302	316	311	302	341	403
<i>Myriophyllum spicatum</i>	Haloragaceae	spiked water-milfoil		1										
<i>Butomus umbellatus</i>	Butomaceae	flowering-rush			1									
<i>Sparganium erectum</i>	Typhaceae	branched bur-reed												1
<i>Sparganium emersum</i> -type	Typhaceae	unbranched bur-reed/ lesser bulrush				1								
<i>Typha latifolia</i>	Typhaceae	bulrush		2										
<i>Pteridium aquilinum</i>	Dennstaedtiaceae	bracken	2		1	1		2		1				3
<i>Polypodium</i>	Polypodiaceae	polypody	2	4	5	4		3		2		1	1	
<i>Pteropsida</i> (mono) indet	Polypodiaceae	ferns	10	4	3	7		3	6	4	4	6		8
<i>Ophioglossum</i>	Ophioglossaceae	adder's-tongue ferns										3		
<i>Diphasiastrum</i>	Lycopodiaceae	club moss family										1		
<i>Sphagnum</i>	Sphagnaceae	peat moss				1								

Table 1: Results of the pollen assessment and analysis from channels (472) and (505) - monoliths 1 and 3

			<5>			<7>				
			502	506	506	585	585	587	581	600
Species	Family	Common Name(s)	0.12m	0.26m	0.42m	0.02m	0.50m	0.96m	1.47m	1.87 - 1.92m
<i>Pinus sylvestris</i>	Pinaceae	Scots pine			2				1	
<i>Ulmus</i>	Ulmaceae	elm						1		2
<i>Quercus</i>	Fagaceae	oak				3		1	4	3
<i>Betula</i>	Betulaceae	birch			2	3	7	4	6	12
<i>Alnus glutinosa</i>	Betulaceae	alder	4	2	5	35	28	41	46	43
<i>Corylus avellana</i> -type	Betulaceae	hazel		3	4	6	7	10	15	14
<i>Salix</i>	Salicaceae	willow			2	6	6	2	3	5
<i>Tilia cordata</i>	Malvaceae	small-leaved lime			5	2	1	1	2	3
<i>Ligustrum vulgare</i>	Oleaceae	wild privet						1		
<i>Ilex aquifolium</i>	Aquifoliaceae	holly				2			1	1
<i>Calluna vulgaris</i>	Ericaceae	heather				1		4	5	3
<i>Vaccinium</i> -type	Ericaceae	bilberry/ heath/ bog-rosemary						10	1	4
<i>Papaver argemone</i>	Papaveraceae	prickly poppy							1	
<i>Ranunculus acris</i> -type	Ranunculaceae	meadow buttercup							1	4
<i>Vicia cracca</i>	Fabaceae	tufted vetch						1		

<i>Trifolium</i> -type	Fabaceae	clovers				1				1
Rosaceae	Rosaceae	rose family				5	1	3	3	8
<i>Filipendula</i>	Rosaceae	meadowsweet			1			1	1	2
<i>Cannabis</i> -type	Cannabaceae	hop/ hemp				2	1			
<i>Urtica dioica</i>	Urticaceae	stinging nettle			3	9	16	4	6	5
<i>Circaea</i>	Onagraceae	enchanter's-nightshade			1					
<i>Daphne laureola</i>	Thymelaeaceae	spurge-laurel							1	
Brassicaceae	Brassicaceae	cabbage family						3	1	1
<i>Polygonum</i>	Polygonaceae	knotgrass								2
<i>Fallopia</i>	Polygonaceae	black bindweed					2	3		1
<i>Rumex acetosella</i>	Polygonaceae	sheep's sorrel			1	6		2	4	3
<i>Rumex acetosa</i>	Polygonaceae	common sorrel							1	1
<i>Rumex obtusifolius</i> -type	Polygonaceae	broad-leaved dock				3		1	1	1
Caryophyllaceae	Caryophyllaceae	pink family					1			1
<i>Scleranthus</i>	Caryophyllaceae	knavels			1					
Chenopodiaceae	Chenopodiaceae	goosefoot family				2	3	1		5
Rubiaceae	Rubiaceae	bedstraw family					1			
<i>Cuscuta</i>	Convolvulaceae	dodders						1	1	
<i>Plantago major</i>	Plantaginaceae	greater plantain						1	1	1
<i>Plantago lanceolata</i>	Plantaginaceae	ribwort plantain			3	3	1	4	4	3
<i>Centaurea scabiosa</i>	Asteraceae	greater knapweed						1	3	1
<i>Centaurea nigra</i>	Asteraceae	common knapweed							1	
<i>Centaurea cyanus</i>	Asteraceae	cornflower				1				
<i>Cichorium intybus</i> -type	Asteraceae	chicory/ dandelion	9		5	18	7	12	16	12
<i>Solidago virgaurea</i> -type	Asteraceae	daisies/ goldenrods				3	8	4	6	13
<i>Cirsium</i> -type	Asteraceae	thistles				1		2		2
<i>Artemisia</i> -type	Asteraceae	mugworts							1	
<i>Achillea</i> -type	Asteraceae	yarrows/ chamomiles	1			1	1	2	3	4
<i>Valeriana dioica</i>	Valerianaceae	marsh valerian				2	1			
Apiaceae	Apiaceae	carrot family			1	7	4	3	1	13
<i>Apium</i> -type	Apiaceae	marshwort					1	1		
Cyperaceae undiff	Cyperaceae	sedge	1	2	4	14	7	12	8	7
Poaceae undiff	Poaceae	grasses	7	5	15	47	50	41	41	32
<i>Cereal</i> ia indet	Poaceae	indeterminable cereal				2	2	6	4	12
<i>Avena</i> / Triticum-type	Poaceae	oat/wheat				2				
<i>Hordeum</i> -type	Poaceae	barley						1	2	
<i>Secale cereale</i>	Poaceae	rye				1		1		
TLP Grains counted			22	12	55	188	156	186	196	225
<i>Pteridium aquilinum</i>	Dennstaedtiaceae	bracken			9	8	5	3	2	7
<i>Polypodium</i>	Polypodiaceae	polypody			6	1	2	4	1	11
<i>Pteropsida</i> (mono) indet		ferns	4	3	10	2	16	12	10	10
<i>Sphagnum</i>	Sphagnaceae	peat moss						1		

Table 2: Results of the pollen assessment and analysis from channels (472) and (505) - monoliths 5 and 7

Appendix 3: Scientific dating



Scottish Universities Environmental Research Centre

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RADIOCARBON DATING CERTIFICATE

07 October 2014

Laboratory Code GU35048

Submitter Suzi Richer
Worcestershire Archaeology
The Hive,
Sawmill Walk, The Butts,
Worcester,, WR1 3PB

Site Reference P4019 Hanbury Road
Context Reference 504
Sample Reference WSM47458/504/3

Material Waterlogged plant : various

Result Failed: insufficient carbon.

N.B. Any questions directed to the Radiocarbon Laboratory should quote the GU coding given above.

The contact details for the laboratory are email g.cook@suerc.gla.ac.uk or telephone 01355 270136 direct line.

Checked and signed off by :-

Date :- 07/10/2014





Scottish Universities Environmental Research Centre

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RADIOCARBON DATING CERTIFICATE

07 October 2014

Laboratory Code SUERC-55344 (GU35049)

Submitter Suzi Richer
Worcestershire Archaeology
The Hive,
Sawmill Walk, The Butts,
Worcester,, WR1 3PB

Site Reference P4019 Hanbury Road
Context Reference 587
Sample Reference WSM47458/587/7

Material Waterlogged plant : Ranunculus acris/repens/bulbosus

$\delta^{13}\text{C}$ relative to VPDB -25.0 ‰ assumed

Radiocarbon Age BP 541 \pm 29

N.B. The above ^{14}C age is quoted in conventional years BP (before 1950 AD). The error, which is expressed at the one sigma level of confidence, includes components from the counting statistics on the sample, modern reference standard and blank and the random machine error.

The calibrated age ranges are determined from the University of Oxford Radiocarbon Accelerator Unit calibration program (OxCal4).

Samples with a SUERC coding are measured at the Scottish Universities Environmental Research Centre AMS Facility and should be quoted as such in any reports within the scientific literature. Any questions directed to the Radiocarbon Laboratory should also quote the GU coding given in parentheses after the SUERC code. The contact details for the laboratory are email g.cook@suerc.gla.ac.uk or telephone 01355 270136 direct line.

Conventional age and calibration age ranges calculated by :- *E. Dunbar*

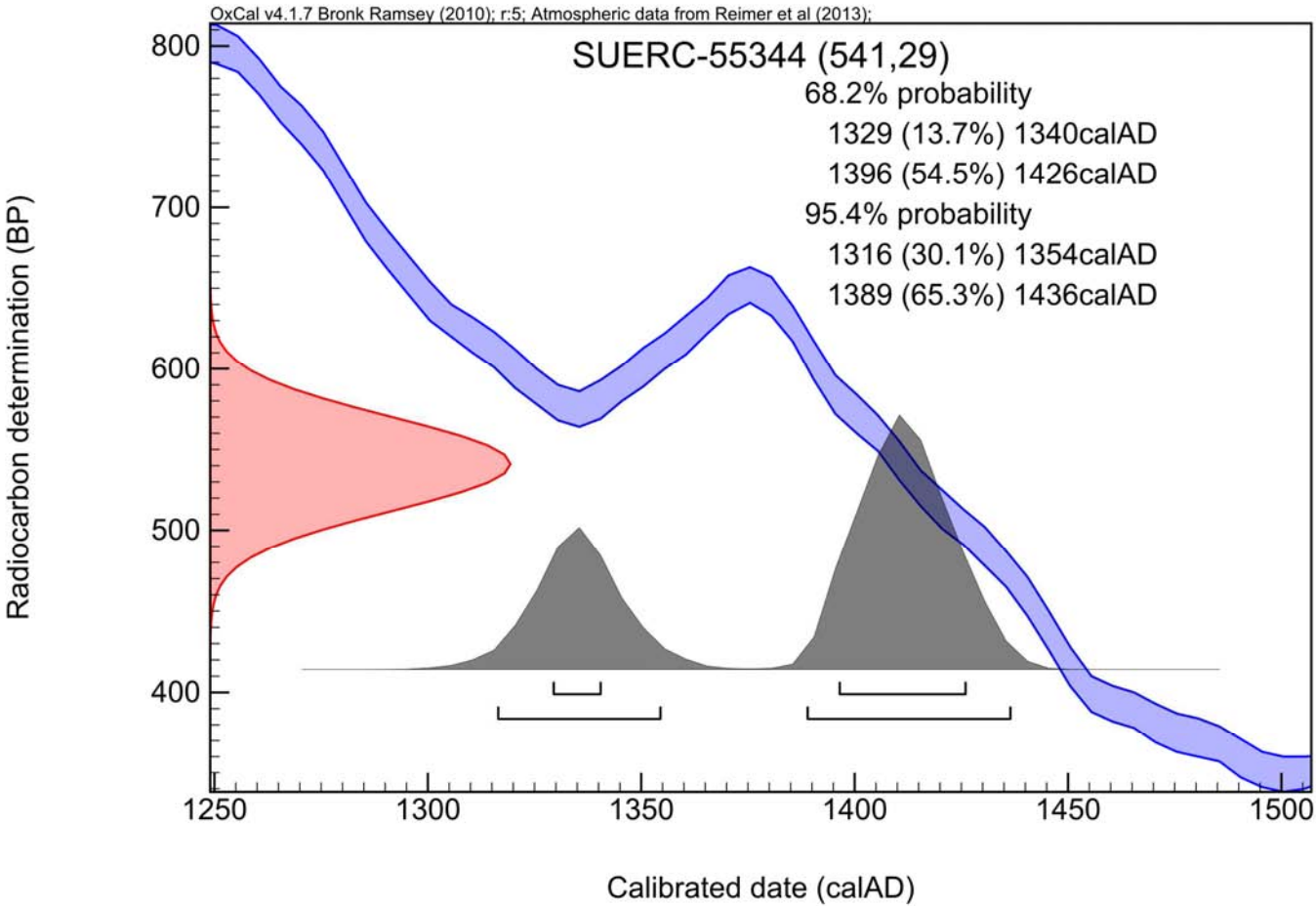
Date :- 07/10/2014

Checked and signed off by :- *N. Rull*

Date :- 07/10/2014



Calibration Plot





Scottish Universities Environmental Research Centre

Director: Professor R M Ellam

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RADIOCARBON DATING CERTIFICATE

07 October 2014

Laboratory Code SUERC-55345 (GU35050)

Submitter Suzi Richer
Worcestershire Archaeology
The Hive,
Sawmill Walk, The Butts,
Worcester,, WR1 3PB

Site Reference P4019 Hanbury Road
Context Reference 502
Sample Reference WSM47458/502/4

Material Waterlogged plant : various

$\delta^{13}\text{C}$ relative to VPDB -25.0 ‰ assumed

Radiocarbon Age BP 534 \pm 29

N.B. The above ^{14}C age is quoted in conventional years BP (before 1950 AD). The error, which is expressed at the one sigma level of confidence, includes components from the counting statistics on the sample, modern reference standard and blank and the random machine error.

The calibrated age ranges are determined from the University of Oxford Radiocarbon Accelerator Unit calibration program (OxCal4).

Samples with a SUERC coding are measured at the Scottish Universities Environmental Research Centre AMS Facility and should be quoted as such in any reports within the scientific literature. Any questions directed to the Radiocarbon Laboratory should also quote the GU coding given in parentheses after the SUERC code. The contact details for the laboratory are email g.cook@suerc.gla.ac.uk or telephone 01355 270136 direct line.

Conventional age and calibration age ranges calculated by :- *E. Dunbar*

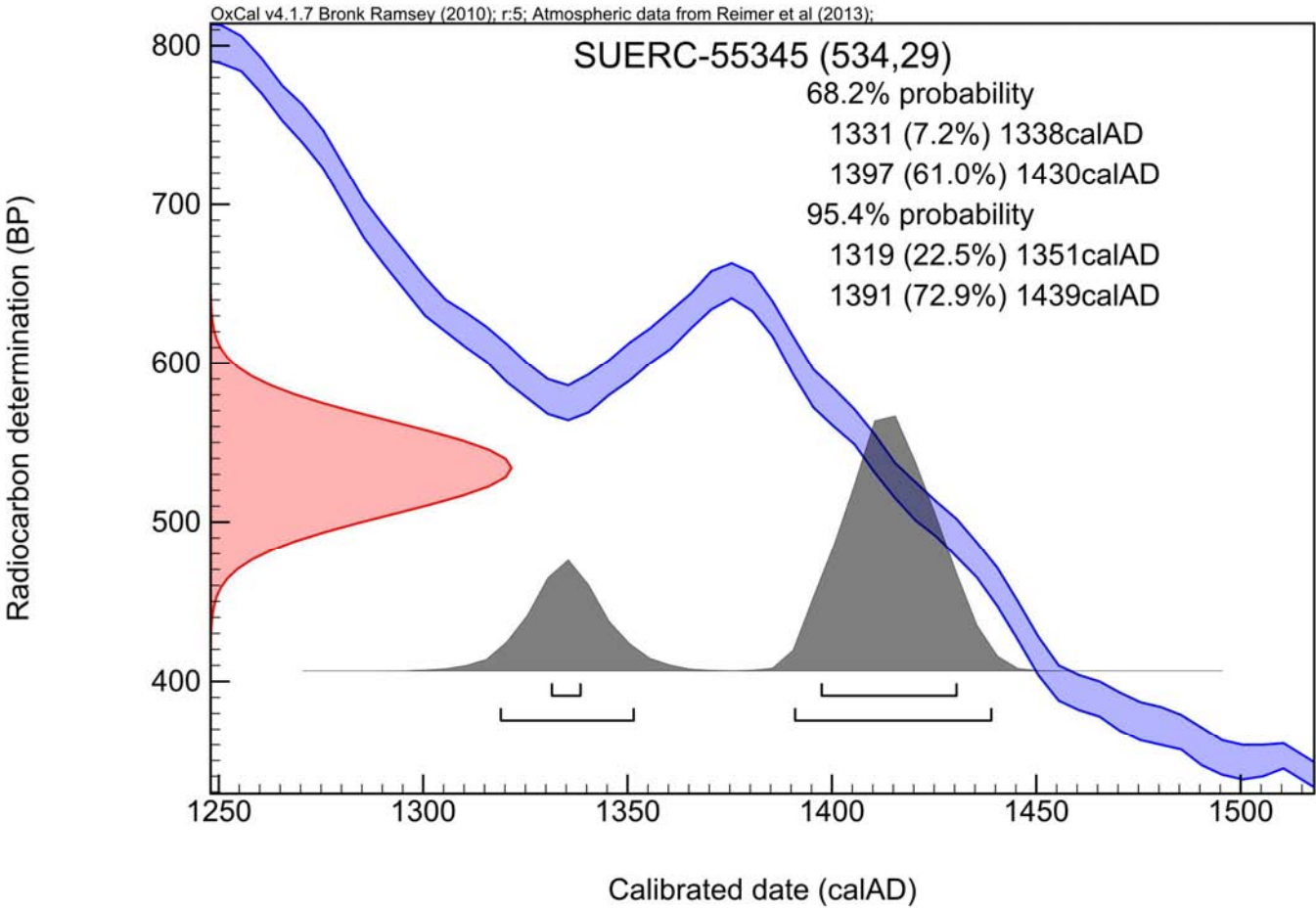
Date :- 07/10/2014

Checked and signed off by :- *N. Rull*

Date :- 07/10/2014



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RADIOCARBON DATING CERTIFICATE

07 October 2014

Laboratory Code GU35051

Submitter Suzi Richer
Worcestershire Archaeology
The Hive,
Sawmill Walk, The Butts,
Worcester,, WR1 3PB

Site Reference P4019 Hanbury Road
Context Reference 586
Sample Reference WSM47458/586/7

Material Waterlogged plant : various

Result Failed: insufficient carbon.

N.B. Any questions directed to the Radiocarbon Laboratory should quote the GU coding given above.

The contact details for the laboratory are email g.cook@suerc.gla.ac.uk or telephone 01355 270136 direct line.

Checked and signed off by :-

N. Rull

Date :- 07/10/2014





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RADIOCARBON DATING CERTIFICATE

07 October 2014

Laboratory Code SUERC-55346 (GU35052)

Submitter Suzi Richer
Worcestershire Archaeology
The Hive,
Sawmill Walk, The Butts,
Worcester,, WR1 3PB

Site Reference P4019 Hanbury Road
Context Reference 473
Sample Reference WSM47458/473/1

Material Waterlogged plant : Ranunculus acris/repens/bulbosus

$\delta^{13}\text{C}$ relative to VPDB -25.0 ‰ assumed

Radiocarbon Age BP 697 \pm 29

N.B. The above ^{14}C age is quoted in conventional years BP (before 1950 AD). The error, which is expressed at the one sigma level of confidence, includes components from the counting statistics on the sample, modern reference standard and blank and the random machine error.

The calibrated age ranges are determined from the University of Oxford Radiocarbon Accelerator Unit calibration program (OxCal4).

Samples with a SUERC coding are measured at the Scottish Universities Environmental Research Centre AMS Facility and should be quoted as such in any reports within the scientific literature. Any questions directed to the Radiocarbon Laboratory should also quote the GU coding given in parentheses after the SUERC code. The contact details for the laboratory are email g.cook@suerc.gla.ac.uk or telephone 01355 270136 direct line.

Conventional age and calibration age ranges calculated by :- *E. Dunbar*

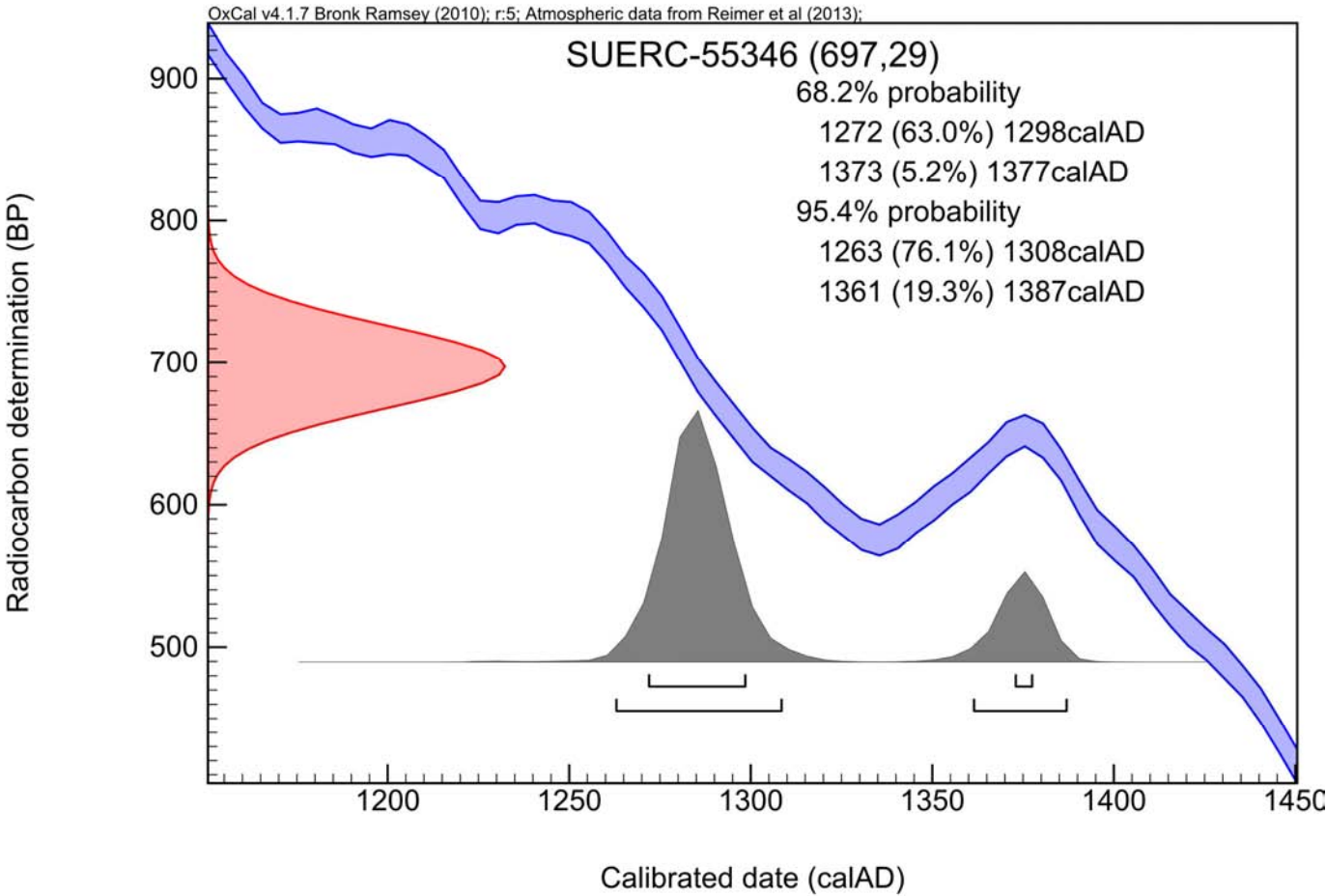
Date :- 07/10/2014

Checked and signed off by :- *N. Rull*

Date :- 07/10/2014



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RADIOCARBON DATING CERTIFICATE

10 November 2014

Laboratory Code SUERC-55967 (GU35549)

Submitter Suzi Richer
Worcestershire Archaeology
The Hive,
Sawmill Walk, The Butts,
Worcester., WR1 3PB

Site Reference P4019 Hanbury Rd, Droitwich, Worcs

Context Reference 504

Sample Reference WSM47458 / 504 / 3

Material Seeds : mixed

$\delta^{13}\text{C}$ relative to VPDB -25.0 ‰ assumed

Radiocarbon Age BP 1012 \pm 40

N.B. The above ^{14}C age is quoted in conventional years BP (before 1950 AD). The error, which is expressed at the one sigma level of confidence, includes components from the counting statistics on the sample, modern reference standard and blank and the random machine error.

The calibrated age ranges are determined from the University of Oxford Radiocarbon Accelerator Unit calibration program (OxCal4).

Samples with a SUERC coding are measured at the Scottish Universities Environmental Research Centre AMS Facility and should be quoted as such in any reports within the scientific literature. Any questions directed to the Radiocarbon Laboratory should also quote the GU coding given in parentheses after the SUERC code. The contact details for the laboratory are email g.cook@suerc.gla.ac.uk or telephone 01355 270136 direct line.

Conventional age and calibration age ranges calculated by :- *E. Dunbar*

Date :- 10/11/2014

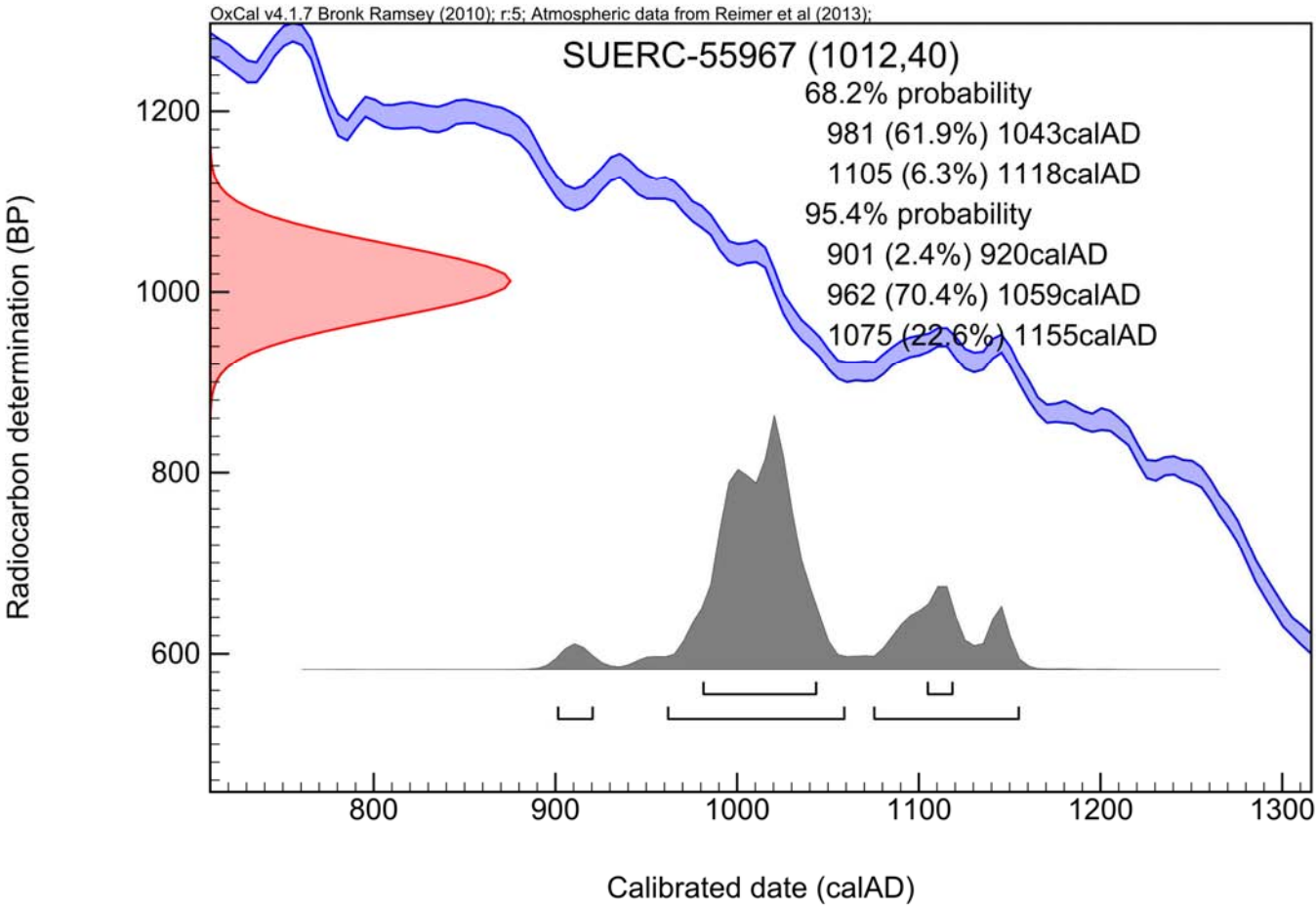
Checked and signed off by :-

P. Naynab

Date :- 10/11/2014



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RADIOCARBON DATING CERTIFICATE

10 November 2014

Laboratory Code GU35550

Submitter Suzi Richer
Worcestershire Archaeology
The Hive,
Sawmill Walk, The Butts,
Worcester,, WR1 3PB

Site Reference P4019 Hanbury Rd, Droitwich, Worcs

Context Reference 586

Sample Reference WSM47458/ 586 / 7

Material Seeds : mixed

Result Failed: insufficient carbon.

N.B. Any questions directed to the Radiocarbon Laboratory should quote the GU coding given above.

The contact details for the laboratory are email g.cook@suerc.gla.ac.uk or telephone 01355 270136 direct line.

Checked and signed off by :-

P. Naynab

Date :- 10/11/2014



RADIOCARBON DATING CERTIFICATE

13 April 2015

Laboratory Code SUERC-59190 (GU37036)

Submitter Suzi Richer
Worcestershire Archaeology
The Hive,
Sawmill Walk, The Butts,
Worcester., WR1 3PB

Site Reference P4019 Hanbury Rd, Droitwich, Worcs

Context Reference 568

Sample Reference WSM47458/568/1-10

Material Waterlogged wood : Quercus

$\delta^{13}\text{C}$ relative to VPDB -24.0 ‰

Radiocarbon Age BP 430 \pm 31

N.B. The above ^{14}C age is quoted in conventional years BP (before 1950 AD). The error, which is expressed at the one sigma level of confidence, includes components from the counting statistics on the sample, modern reference standard and blank and the random machine error.

The calibrated age ranges are determined from the University of Oxford Radiocarbon Accelerator Unit calibration program (OxCal4).

Samples with a SUERC coding are measured at the Scottish Universities Environmental Research Centre AMS Facility and should be quoted as such in any reports within the scientific literature. Any questions directed to the Radiocarbon Laboratory should also quote the GU coding given in parentheses after the SUERC code. The contact details for the laboratory are email Gordon.Cook@glasgow.ac.uk or telephone 01355 270136 direct line.

Conventional age and calibration age ranges calculated by :- *E. Dunbar*

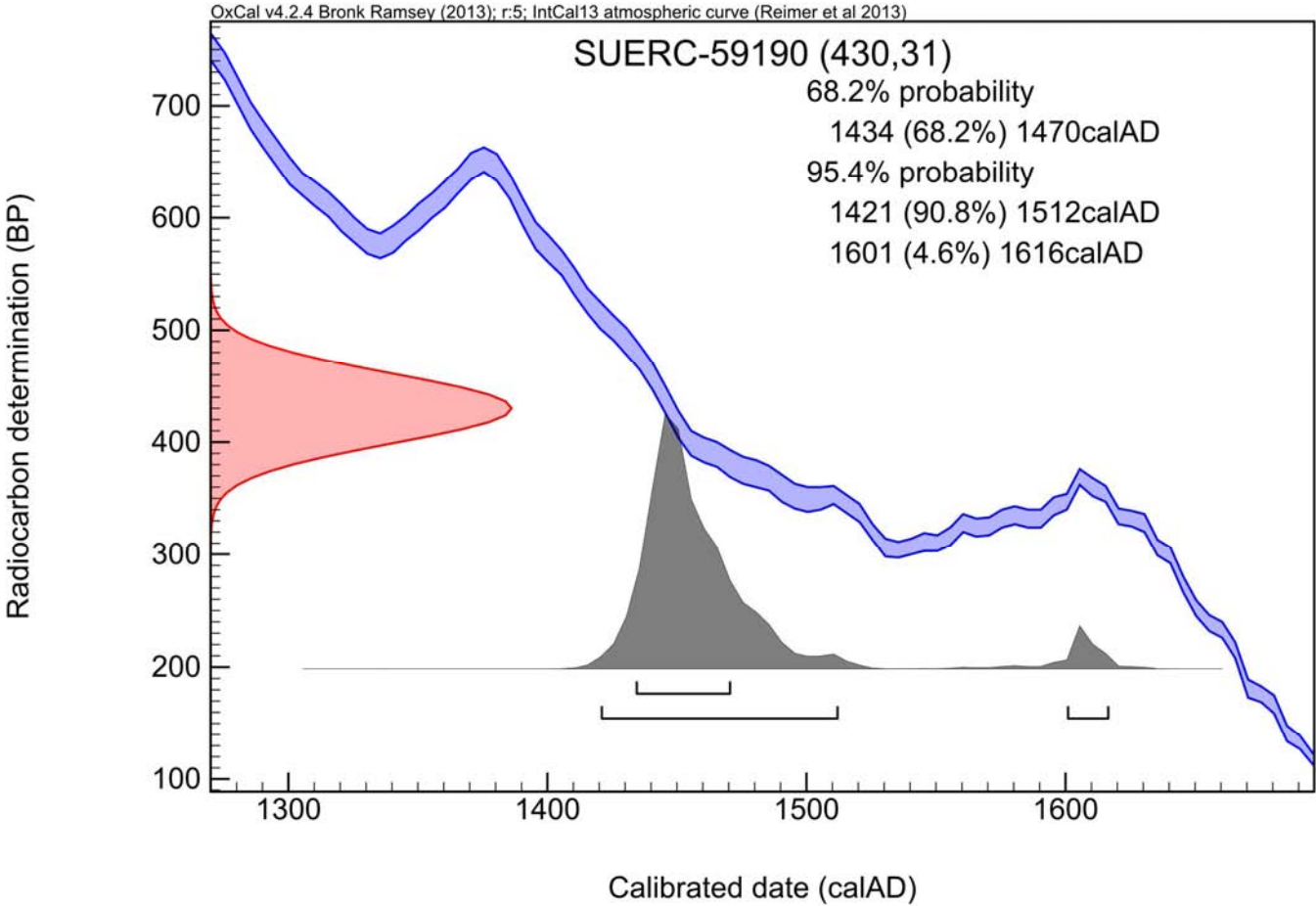
Date :- 13/04/2015

Checked and signed off by :-

P. Naynab

Date :- 13/04/2015

Calibration Plot



RADIOCARBON DATING CERTIFICATE

13 April 2015

Laboratory Code SUERC-59194 (GU37037)

Submitter Suzi Richer
Worcestershire Archaeology
The Hive,
Sawmill Walk, The Butts,
Worcester., WR1 3PB

Site Reference P4019 Hanbury Rd, Droitwich, Worcs

Context Reference 568

Sample Reference WSM47458/568/121-130

Material Waterlogged wood : Quercus

$\delta^{13}\text{C}$ relative to VPDB -27.6 ‰

Radiocarbon Age BP 383 \pm 31

N.B. The above ^{14}C age is quoted in conventional years BP (before 1950 AD). The error, which is expressed at the one sigma level of confidence, includes components from the counting statistics on the sample, modern reference standard and blank and the random machine error.

The calibrated age ranges are determined from the University of Oxford Radiocarbon Accelerator Unit calibration program (OxCal4).

Samples with a SUERC coding are measured at the Scottish Universities Environmental Research Centre AMS Facility and should be quoted as such in any reports within the scientific literature. Any questions directed to the Radiocarbon Laboratory should also quote the GU coding given in parentheses after the SUERC code. The contact details for the laboratory are email Gordon.Cook@glasgow.ac.uk or telephone 01355 270136 direct line.

Conventional age and calibration age ranges calculated by :- E. Dunbar

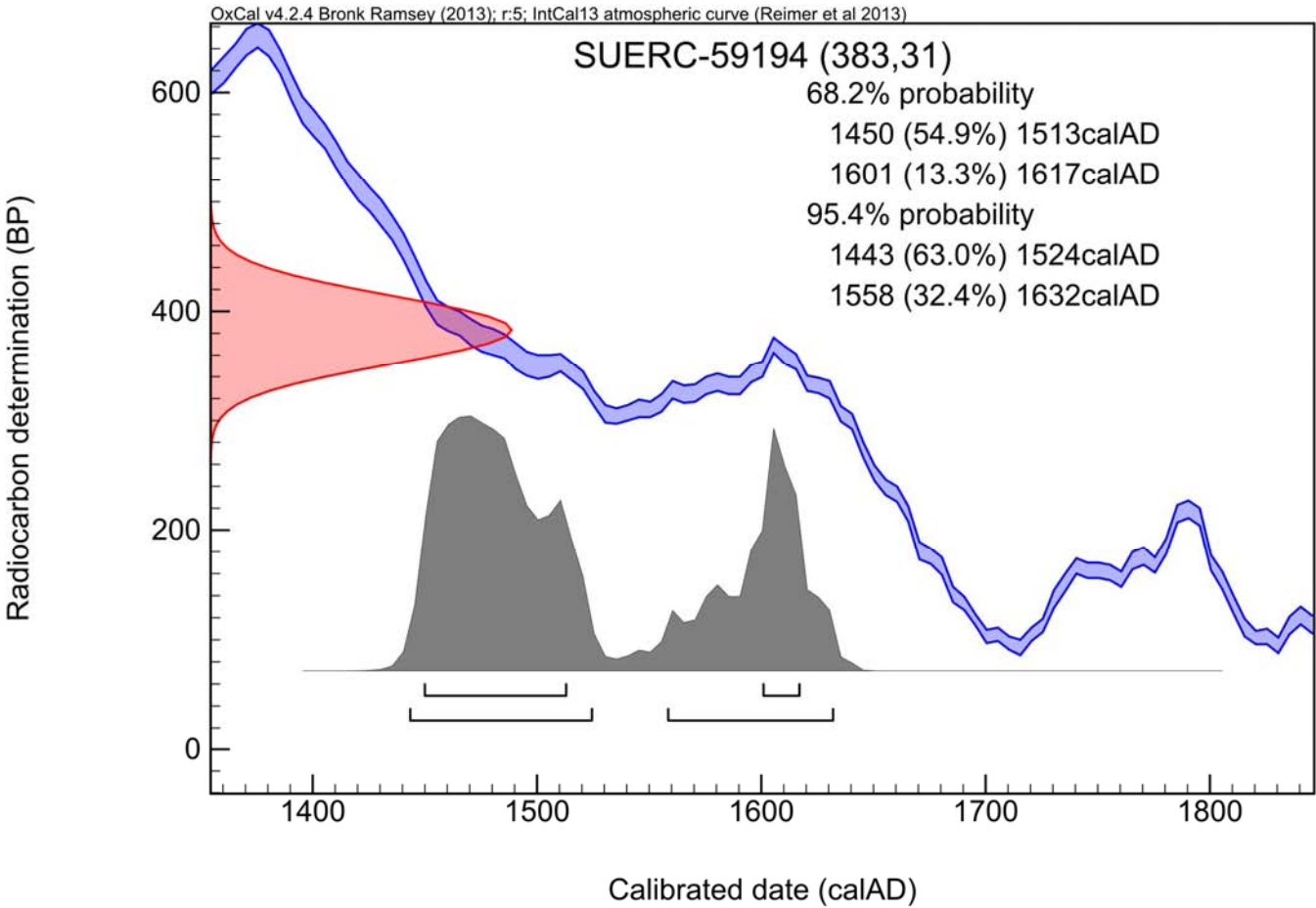
Date :- 13/04/2015

Checked and signed off by :-

P. Naynab

Date :- 13/04/2015

Calibration Plot





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RADIOCARBON DATING CERTIFICATE

03 February 2014

Laboratory Code SUERC-50174 (GU32490)

Submitter Derek Hurst
Worcestershire Archaeology
The Hive, Sawmill Walk
The Butts
Worcester WR1 3PB

Site Reference P4019 Hanbury Rd, Droitwich, Worcs

Context Reference 475

Sample Reference WSM47458 / 475 / 2

Material Seed : Ranunculus sp

$\delta^{13}\text{C}$ relative to VPDB -26.8 ‰

Radiocarbon Age BP 470 ± 42

N.B. The above ^{14}C age is quoted in conventional years BP (before 1950 AD). The error, which is expressed at the one sigma level of confidence, includes components from the counting statistics on the sample, modern reference standard and blank and the random machine error.

The calibrated age ranges are determined from the University of Oxford Radiocarbon Accelerator Unit calibration program (OxCal4).

Samples with a SUERC coding are measured at the Scottish Universities Environmental Research Centre AMS Facility and should be quoted as such in any reports within the scientific literature. Any questions directed to the Radiocarbon Laboratory should also quote the GU coding given in parentheses after the SUERC code. The contact details for the laboratory are email g.cook@suerc.gla.ac.uk or telephone 01355 270136 direct line.

Conventional age and calibration age ranges calculated by :- *E. Dunbar*

Date :- 03/02/2014

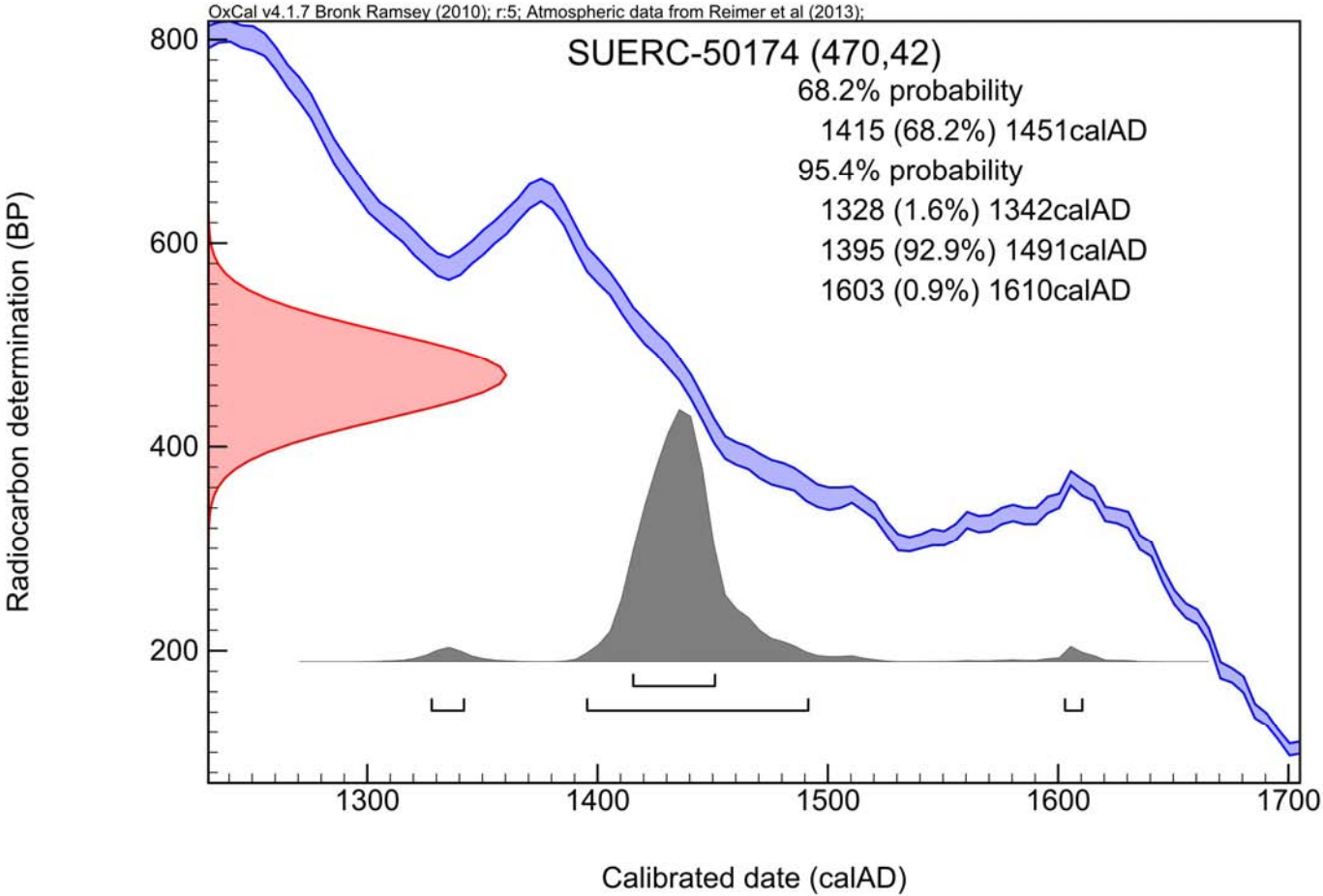
Checked and signed off by :-

P. Naynab

Date :- 03/02/2014



Calibration Plot





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RADIOCARBON DATING CERTIFICATE

03 February 2014

Laboratory Code SUERC-50175 (GU32491)

Submitter Derek Hurst
Worcestershire Archaeology
The Hive, Sawmill Walk
The Butts
Worcester WR1 3PB

Site Reference P4019 Hanbury Rd, Droitwich, Worcs

Context Reference 534

Sample Reference WSM47458 / 534 / 8

Material Seed : Ranunculus sp

$\delta^{13}\text{C}$ relative to VPDB -26.4 ‰

Radiocarbon Age BP 291 \pm 42

N.B. The above ^{14}C age is quoted in conventional years BP (before 1950 AD). The error, which is expressed at the one sigma level of confidence, includes components from the counting statistics on the sample, modern reference standard and blank and the random machine error.

The calibrated age ranges are determined from the University of Oxford Radiocarbon Accelerator Unit calibration program (OxCal4).

Samples with a SUERC coding are measured at the Scottish Universities Environmental Research Centre AMS Facility and should be quoted as such in any reports within the scientific literature. Any questions directed to the Radiocarbon Laboratory should also quote the GU coding given in parentheses after the SUERC code. The contact details for the laboratory are email g.cook@suerc.gla.ac.uk or telephone 01355 270136 direct line.

Conventional age and calibration age ranges calculated by :- *E. Dunbar*

Date :- 03/02/2014

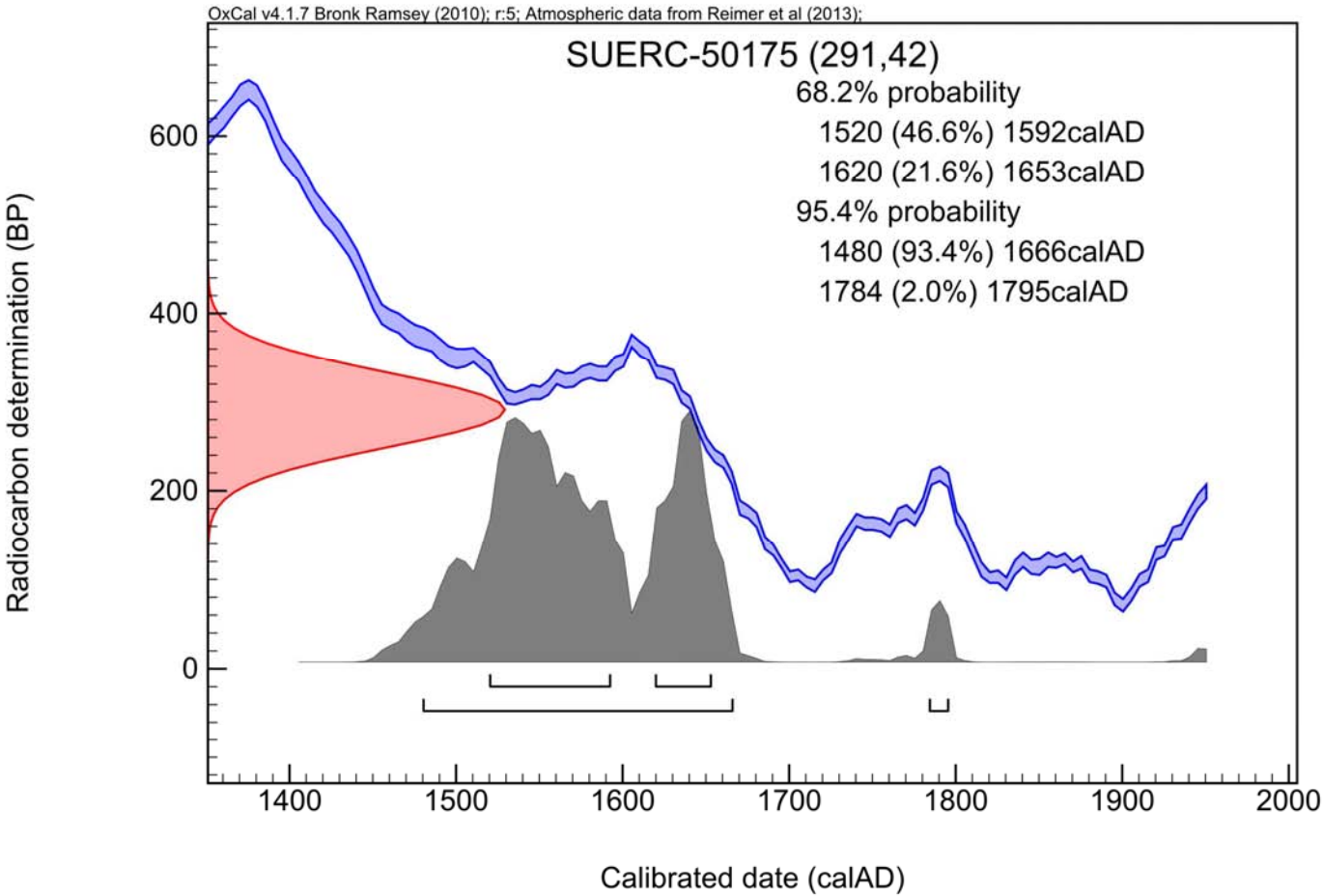
Checked and signed off by :-

P. Naynab

Date :- 03/02/2014



Calibration Plot



Appendix 4: Technical information

The archive (site code: WSM 47458)

The archive consists of:

- 199 Context records AS1
- 6 Field progress reports AS2
- 15 Photographic records AS3
- 1113 Digital photographs
- 1 Drawing catalogue AS4
- 13 Drawings
- 3 Context number catalogues AS5
- 1 Sample number catalogues AS18
- 28 Flot records AS21
- 20 Pollen score sheet AS35
- 1 Box of finds
- 1 CD-Rom/DVDs
- 1 Copy of this report (bound hard copy)

The project archive is intended to be placed at:

Worcestershire County Museum
Museums Worcestershire
Hartlebury Castle
Hartlebury
Near Kidderminster
Worcestershire DY11 7XZ
Tel Hartlebury (01299) 250416

Summary of data for Worcestershire HER

WSM 47458

Methods of retrieval	Yes/No
Bulk sample	Yes
Spot sample	-
Auger	-
Monolith	Yes
Observed	

Type	Preservation	Date (note 1)	Specialist report? Y/N (note 2)	Key assemblage? Y/N (note 3)
Environmental deposit – peat	waterlogged	Late Saxon (10 th C) to medieval	yes	no
Insect remains	waterlogged	Late Saxon (10 th C) to medieval	yes	yes
Plant remains – macrofossils	waterlogged	Late Saxon (10th C) to medieval	yes	yes
Plant remains – macrofossils	charred	Late Saxon (10th C) to medieval	no	no
Plant remains – pollen	waterlogged	Late Saxon (10th C) to medieval	yes	yes
Pottery		Roman, Late Saxon (10th C) to medieval	yes	no
CBM		medieval	yes	no
metalwork		late med	no	no
