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9 Market Street Chipping Norton Oxfordshire

Tree-Ring Analysis of Elm and Oak Timbers

Martin Bridge and Cathy Tyers

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Front Cover: 9 Market Street, Chipping Norton, Oxfordshire. Photograph Martin Bridge

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9 MARKET STREET
CHIPPING NORTON
OXFORDSHIRE

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SUMMARY
Four elm ceiling timbers and three oak roof timbers were sampled. Sampling was curtailed when it was found that the timbers did not contain enough rings to make dendrochronological analysis viable. The largest ceiling timber yielded a 62-year elm ring-width sequence, but this did not give any matches with either other elm series from this project, oak data from Chipping Norton or the oak reference data.

CONTRIBUTORS
Martin Bridge and Cathy Tyers

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We are very grateful to the owner for allowing access for this work to be carried out. The building was one of several examined as part of the Historic Fabric in Historic Towns: Chipping Norton project, and we thank Rebecca Lane for managing the project on behalf of Historic England. We are indebted to members of the Oxfordshire Buildings Record and Chipping Norton Buildings Record, especially Victoria Hubbard for her extensive input on coordinating the project, and her friendly encouragement, and Jan Cliffe for permission to reproduce her drawings in Figures 3 - 5. We'd also like to thank Shahina Farid for commissioning the work, and her input into preparing this report.

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County Archaeology
Planning Regulation
Communities
County Hall
New Road
Oxford OX1 1ND

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CONTACT DETAILS
Martin Bridge
UCL Institute of Archaeology
31-34 Gordon Square
London WC1H 0PY
martin.bridge@ucl.ac.uk

Cathy Tyers
Historic England
Cannon Bridge House
25 Dowgate Hill
London EC4R 2YA
cathy.tyers@historicengland.org.uk

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INTRODUCTION

The investigation of the elm timbers from 9 Market Street, Chipping Norton, contributes to two on-going research programmes, funded by Historic England through its Heritage Protection Commissions programme. One is led by Martin Bridge from the Institute of Archaeology, University College London, whilst the other is led by Victoria Hubbard representing the Chipping Norton Buildings Record in association with the Oxfordshire Buildings Record.

Developing the dendrochronology of elm in historic buildings

Ring-width dendrochronology of oak timbers from historic buildings in England is well established, with dating having been obtained on more than 3000 buildings (or parts thereof), with nearly one third of these having been funded by Historic England (and its predecessors). Dendrochronological evidence is a valuable component underpinning the discovery and identification of assets in the historic environment, aiding decisions relating to protection, management, and conservation, and enhancing appreciation and enjoyment of these buildings.

During this work on oak timbers, a significant amount of historic fabric constructed from timbers other than oak, most notably elm, has been identified, but this has previously been rejected as unsuitable for dendrochronological investigation. Elm in buildings has been identified in counties from Cornwall to Kent and up into the Midlands and beyond, but formal records of the presence of elm are scant as such buildings were generally dismissed for dating purposes and thus the presence of elm in the published record is rare. The inability to date historic buildings (or sections of buildings) constructed of elm by ring-width dendrochronology is seen as problematic in some areas of the country which have a comparatively high proportion of such buildings; buildings which nevertheless form a significant part of the historic environment but could not be afforded the same level of understanding in comparison to their oak counterparts.

Prior to the start of this project, only four instances of dating elm by ring-width dendrochronology have been successful (Groves and Hillam 1997; Haddon-Reece *et al* 1989, 1990; Bridge and Miles 2015). Each of these studies involved matching elm with oak from the same site, although the Ashdon, Essex example matched oak chronologies over a wide area (Bridge and Miles 2015). This project aimed to establish whether the use of standard ring-width dendrochronology could be extended to the dating of historic buildings in England where elm (*Ulmus* sp.) is the sole, or predominant species used rather than oak (*Quercus* sp.). A systematic approach was adopted concentrating on elm in the geographical areas where it is most commonly found. Buildings were thus sought that contained a significant number of elm timbers with sufficient numbers of rings that might be matched against either oak timbers in the same building or oak chronologies from the surrounding area (Fig 1).

An article will summarise the overall outcomes of the project (Bridge and Tyers forthcoming). However, each building sampled for dendrochronology has an associated building survey report or similar publication, whilst the primary archive of the dendrochronological analysis is reported in the Historic England Research Report Series.

Early Fabric in Chipping Norton Project

This particular building was initially investigated as part of the dendrochronology programme for the Chipping Norton Early Fabric in Historic Towns project but was one of two, the other being 1 Middle Row, rejected at assessment stage as the timbers were predominantly elm.

Whilst Chipping Norton features in a study on historic towns in Oxfordshire (Rodwell 1975), and some buildings have been recorded and published in detail (eg Simons and Phimester 2005), no systematic research had been undertaken on the buildings of the town before this project.

The project examined vernacular historic buildings in the centre of Chipping Norton, aiming to improve understanding of the morphology and development of the historic town plan and to understand this within the framework of economic and social change. It aimed to identify early plan forms and to understand the dates of the introduction of vernacular architectural details (eg in materials, carpentry, fenestration, and decorative features), thus mapping the survival of early (pre-1900) fabric and revealing the architectural evolution of the town's buildings.

Initially, 21 properties were identified that were thought to be key to understanding the town's architectural development for a programme of comprehensive investigation. These properties were assessed for their suitability for dendrochronology and 12 that contained oak timber considered suitable for analysis were initially sampled and analysed. Oak timbers from seven of these buildings could be dated by ring-width dendrochronology, whilst radiocarbon wiggle-matching was undertaken for one of the buildings where the ring-width dendrochronology had produced an undated site master chronology.

The results of the project are presented by Rosen and Cliffe (2017). The reports produced on the historic buildings recorded as part of this project by the Chipping Norton Buildings Record/Oxfordshire Buildings Record (OBR) will be deposited in the Oxfordshire Historic Environment Record. The primary archive of the dendrochronological analysis is, as with the elm project, reported in the Historic England Research Report Series.

9 MARKET STREET

Part of the terrace that forms many properties along Market Street (Fig 2), this Grade II listed property (LEN 1052628) has two storeys and an attic with elm ceiling beams visible on the ground and first floors, and an oak roof. It is listed as seventeenth century but it may have earlier origins. It has three bays parallel to the street. There is a long 2-storey rear range to the north, and a shorter 2½-storey range at the southern end. The construction is coursed and squared rubble oollitic limestone with a plain tiled roof and with a capped chimneystack to the south (shared with 8 Market Street), and a further chimneystack to the north.

METHODOLOGY

Fieldwork for the present study was carried out in January 2017, following an initial assessment of the potential for elm dendrochronology some weeks beforehand. In the initial assessment, based on the general criteria used for oak timbers, accessible elm timbers with more than 50 rings and where possible traces of sapwood were sought, although slightly shorter sequences may be sampled if little other material is available. Those timbers judged to be potentially useful were cored using a 16mm auger attached to an electric drill. The cores were labelled, and stored for subsequent analysis. Additional oak timbers with complete sapwood were also sampled to provide same-site comparative material to increase the chances of producing dating evidence. It was hoped that this would refine the dating for this site, currently based on typological understanding of the form of the timberwork.

The cores were polished on a belt sander using 80 to 400 grit abrasive paper to allow the ring boundaries to be clearly distinguished. The samples had their tree-ring sequences measured to an accuracy of 0.01mm, using a specially constructed system utilising a binocular microscope with the sample mounted on a travelling stage with a linear transducer linked to a PC, which recorded the ring widths into a dataset. The software used in measuring and subsequent analysis was written by Ian Tyers (2004). Cross-matching was attempted by a combination of visual matching and a process of qualified statistical comparison by computer. The ring-width series were compared for statistical cross-matching, using a variant of the Belfast CROS program (Baillie and Pilcher 1973). Ring sequences were plotted on the computer monitor to allow visual comparisons to be made between sequences. This method provides a measure of quality control in identifying any potential errors in the measurements when the samples cross-match.

In comparing one oak sample or site master against other samples or chronologies, *t*-values over 3.5 are considered significant, although in reality it is common to find demonstrably spurious *t*-values of 4 and 5 because more than one matching position is indicated. For this reason, dendrochronologists prefer to see some *t*-value ranges of 5, 6, and higher, and for these to be well replicated from different, independent chronologies with both local and regional chronologies well represented, except where imported timbers are identified. Where two individual oak samples match together with a *t*-value of 10 or above, and visually exhibit exceptionally similar ring patterns, they may have originated from the same parent tree. Same-tree matches can also be identified through the external characteristics of the timber itself, such as knots and shake patterns. Lower *t*-values however do not preclude same tree derivation. Threshold values for elm samples are as yet unknown, but are likely to be of similar value.

Ascribing felling dates and date ranges

Once a tree-ring sequence has been firmly dated in time, a felling date, or date range, is ascribed where possible. With samples which have sapwood complete to the underside of, or including bark, this process is relatively straightforward. Depending on the completeness of the final ring, ie if it has only the spring vessels or early wood formed, or the latewood or summer growth, a precise felling date and season can be given. If the sapwood is partially missing, or if only a heartwood/sapwood transition boundary survives, then an estimated felling date range can be given for each sample. In oak, the number of sapwood rings can be estimated by using an empirically derived sapwood estimate with a given confidence limit. If no sapwood or heartwood/sapwood boundary survives then the minimum number of sapwood rings from the appropriate sapwood estimate is added to the last measured ring to give a *terminus post quem* (*tpq*) or felled-after date.

A review of the geographical distribution of dated sapwood data from historic oak timbers has shown that a sapwood estimate relevant to the region of origin should be used in interpretation, which in this area is 9–41 rings (Miles 1997). The equivalent values for elm are as yet unknown, but the results of this project suggest that the range of the number of sapwood rings in elm timbers is likely to be much lower. One problem that has been encountered in considering elm is that it has often proved very difficult to determine the position of the heartwood/sapwood boundary, even when it is known that the complete sapwood is present on a timber. It must be emphasised that dendrochronology can only date when a tree has been felled, not when the timber was used to construct the structure or object under study.

RESULTS AND DISCUSSION

The locations of the samples and their details are given in Table 1, and illustrated in Figures 3–5. Sampling was curtailed when it became apparent that the timbers did not contain enough rings to be suitable for dendrochronological analysis – all except one elm timber having fewer than 30 rings, whilst the oak samples contained fewer than 40 rings. Only one elm sample, from the large (12″ x 12″) ceiling beam in the ground-floor north room was measured. This had 62 rings, and was from a tree felled in summer, but as in many other elm samples seen during the project, it was not possible to determine the position of the heartwood/sapwood transition. The ring width measurements are given in the Appendix. The series was compared to all other elm and oak series taken as part of both the elm project and the Chipping Norton project, as well as an extensive database of relevant oak reference chronologies. No consistent acceptable matches were identified.

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TABLES

Table 1: Details of the samples taken from 9 Market Street, Chipping Norton

Sample number	Timber and position	No of rings	Mean ring width (mm)	Sapwood rings	Mean sensitivity
Elm samples from ceilings					
cn9mkt01	East ceiling beam, ground floor north room	62	2.97	½C	0.24
cn9mkt02	East joist, 3rd from south, ground floor north room	<30	NM	h/s	-
cn9mkt03	South secondary cross beam, first floor north room	<30	NM	h/s	-
cn9mkt04	North secondary cross beam, first floor north room	<30	NM	C	-
Oak roof timbers					
cn9mkt05	North-west lower purlin	<40	NM	C	-
cn9mkt06	Collar to north truss	<40	NM	C	-
cn9mkt07	West principal rafter, north truss	<40	NM	?C	-

Key: NM = not measured; h/s = heartwood-sapwood boundary; C = complete sapwood, winter felled; ½C = complete sapwood, felled the following summer

FIGURES

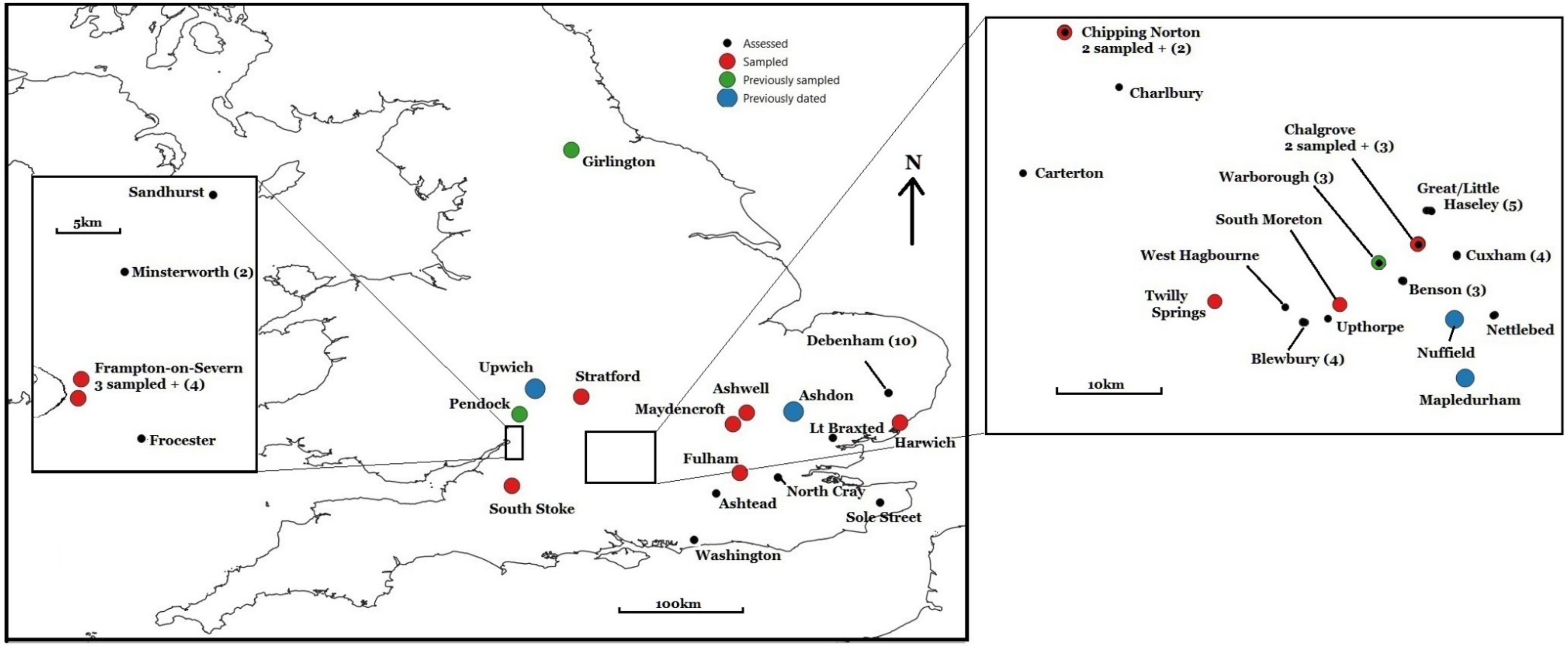

Figure 1: Map showing the distribution of sites sampled, some of which were dated, prior to the start of this project, and sites assessed and sampled properties for this project. Numbers in brackets after a place name represent the number of properties assessed in that location

Figure 2: Maps to show the location of 9 Market Street within Chipping Norton, marked in red. Scale: top right 1:15000; bottom 1:1500. © Crown Copyright and database right 2020. All rights reserved. Ordnance Survey Licence number 100024900. © British Crown and SeaZone Solutions Ltd 2020. All rights reserved. Licence number 102006.006. © Historic England

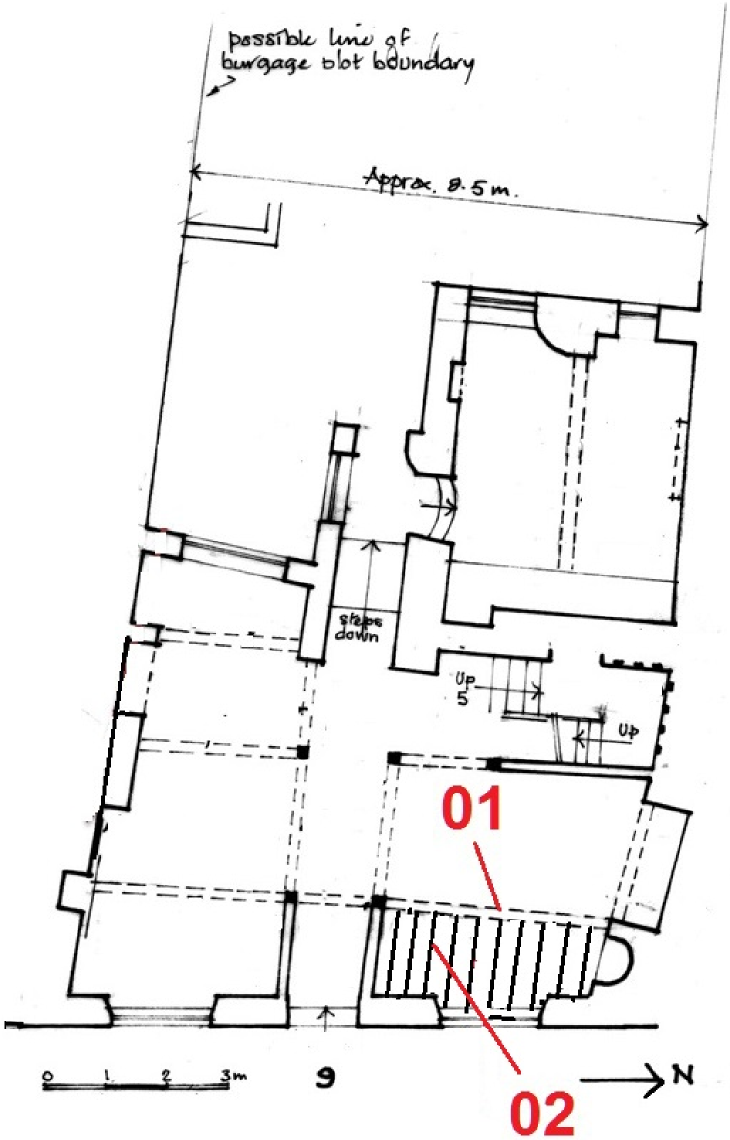

Figure 3: Plan of the ground floor of 9 Market Street, showing the locations of samples taken for dendrochronology (after Jan Cliffe for OBR)

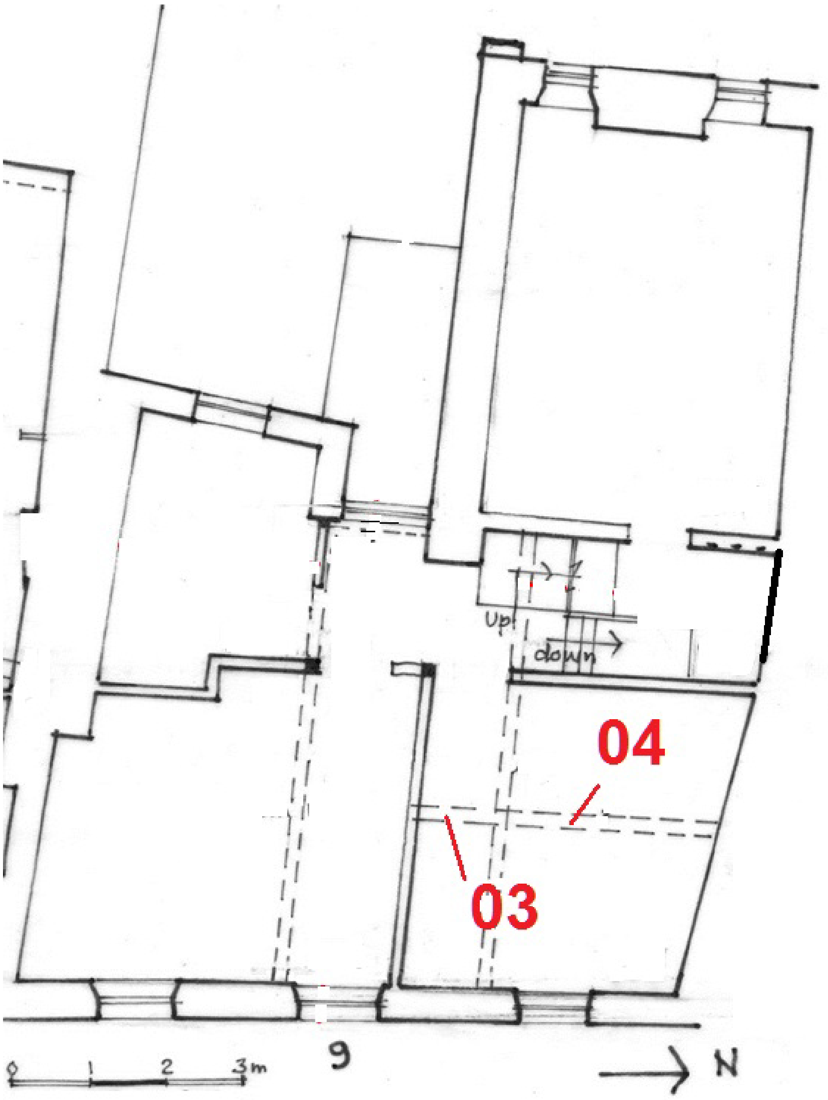

Figure 4: Plan of the first floor of 9 Market Street, showing the locations of samples taken for dendrochronology (after Jan Cliffe for OBR)

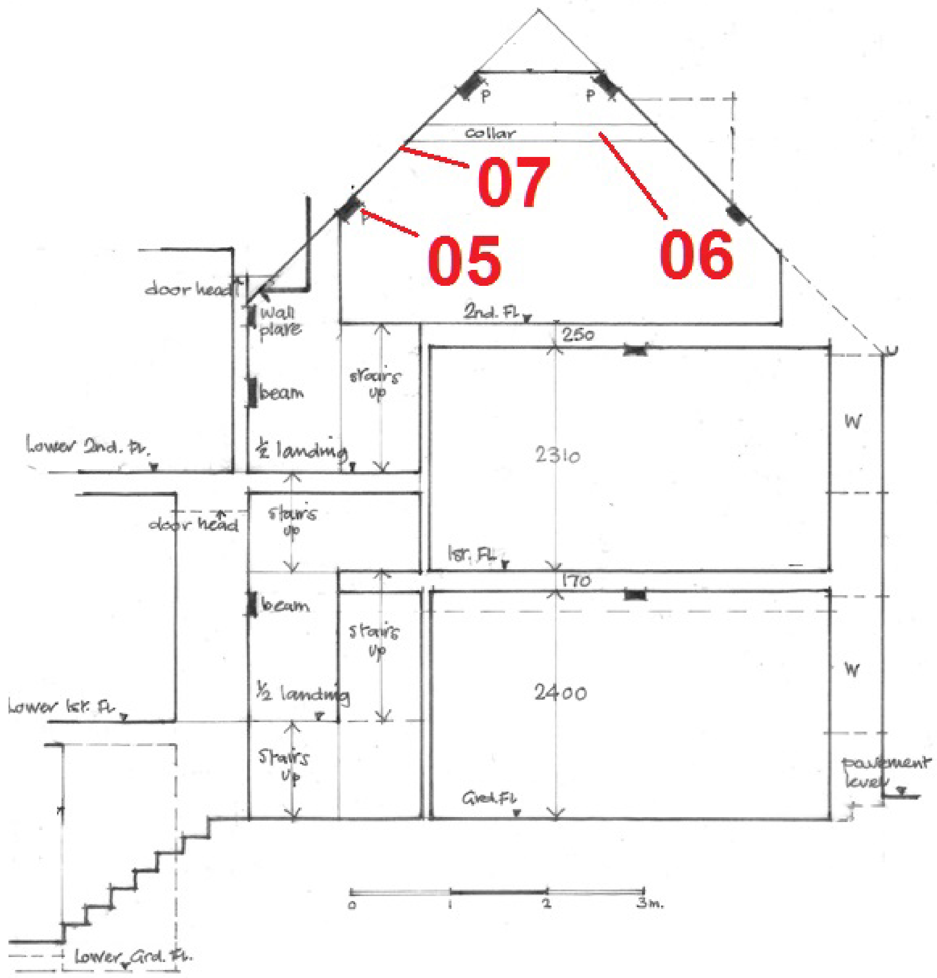

Figure 5: Section through 9 Market Street (looking north), showing the location of samples taken for dendrochronology (after Jan Cliffe for OBR)

APPENDIX

Ring width values (0.01mm) for the sequences measured

cn9mkt01

123	133	247	150	168	178	193	182	291	224
234	223	299	345	346	336	221	141	95	207
290	311	323	185	173	147	272	422	296	227
255	511	431	478	437	476	519	491	433	293
240	208	314	273	250	332	352	327	445	382
371	507	459	562	706	149	154	131	123	271
289	283								

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