

Ancient Monuments Laboratory
Report 29/2000

TREE-RING ANALYSIS OF OAK
TIMBERS FROM PRIOR'S HALL BARN,
WIDDINGTON, ESSEX

I Tyers

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Summary

A tree-ring dating programme was commissioned on the Prior's Hall Barn, Widdington, by English Heritage in the early spring of AD 2000. This barn has previously been the subject of at least two unsuccessful tree-ring dating programmes during the late AD 1970's or early AD 1980's. These earlier attempts were undertaken using slices removed from timbers whilst the barn was the subject of an extensive renovation programme funded by the then Department of the Environment. This new attempt has involved taking cores from extant timbers and this has allowed more suitable timbers to be sampled and a positive result to be obtained. The results indicate the barn includes material felled in AD 1417-42. These dated timbers appear to be primary to the structure. No re-used timbers were positively identified.

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Introduction

This document is a technical archive report on the tree-ring analysis of oak timbers from Prior's Hall Barn, Widdington, Essex (NGR TL 53713176). It is beyond the dendrochronological brief to describe the building in detail or to undertake the production of detailed drawings. As part of a multifaceted and multidisciplinary study of the building, elements of this report may be combined with detailed descriptions, drawings, and other technical reports at some point in the future to form either a comprehensive publication or an archive deposition on the building. The conclusions may therefore have to be modified in the light of subsequent work.

The barn at Prior's Hall, Widdington, lies in the north-west corner of the county of Essex (Figs 1 and 2). This Scheduled Ancient Monument is eight bays long, aligned east-west, and has aisles to both north and south sides (Plate 1). There are two porches on the southern side. The land was owned by the French priory of St Valery sur Somme from the time of the conquest until its seizure in AD 1377. The land was given as an endowment to New College Oxford by William of Wykeham *c* AD 1379 and it remained in their hands run as a tenant farm until AD 1920. After it was sold into private hands the property continued as a working barn until it was placed into Department of the Environment guardianship in AD 1976. In AD 1977-83 the barn was the subject of an extensive survey and restoration programme following significant damage in a gale. The building is now in the care of English Heritage and is open to the public two days a week during summer, it remains in private ownership. The trusses are of crown-post type and there are curving braces from the aisle posts to the tiebeam (Fig 3). The remedial works replaced some of the original timbers entirely, and the ends of many others. Some of the replaced timbers are displayed within the barn with interpretative panels.

A tree-ring sampling programme of the timbers in the barn was requested by John Etté, the local English Heritage Inspector, in order to elucidate the date of the primary construction of the barn.

Methodology

The general methodology and working practises used at the Sheffield Dendrochronology Laboratory are described in English Heritage (1998). The methodology used for this building was as follows.

An initial assessment was undertaken to ensure that there were some suitable timbers visible in the barn. This assessment aimed to identify those oak timbers with the most suitable ring sequences for analysis. Those with more than 50 annual rings and some survival of the original sapwood and bark-edge were sought. The sampling request covered only the primary construction timbers. The dendrochronological sampling programme attempted to cover this phase by obtaining samples from as broad a range of timbers, in terms of structural element types, scantling sizes, carpentry features, and surface condition as was possible within the terms of the request.

The most promising timbers were sampled using a 15mm diameter corer attached to an electric drill. The cores were taken as closely as possible along the radius of the timbers so that the maximum number of rings could be obtained for subsequent analysis. The core holes were filled with plugs made of modern oak. The ring sequences in the cores were revealed by sanding.

The complete sequences of growth rings in the samples that were selected for dating purposes were measured to an accuracy of 0.01mm using a micro-computer based travelling stage (Tyers 1999). The ring sequences were plotted onto semi-log graph paper to enable visual comparisons to be made between sequences. In addition a cross-correlation algorithm (Baillie and Pilcher 1973) was employed to search for positions where the ring sequences were highly correlated. These positions were checked visually using the graphs and, where these were satisfactory, new mean sequences were constructed from the synchronised sequences. The *t*-values reported below 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 these positions are supported by satisfactory visual matching.

All the measured sequences from this assemblage were compared with each other and any found to cross-match were combined to form a site master curve. These, and any remaining unmatched ring sequences, were tested against a range of reference chronologies, using the same matching criteria: high *t*-values, replicated values against a range of chronologies at the same position, and satisfactory visual matching. Where such positions are found these provide calendar dates for the ring-sequence.

The tree-ring dates produced by this process initially only date the rings present in the timber. The interpretation of these dates relies upon the nature of the final rings in the sequence. If the sample ends in the heartwood of the original tree, a *terminus post quem* (*tpq*) for the felling of the tree is indicated by the date of the last ring plus the addition of the minimum expected number of sapwood rings which are missing. This *tpq* may be many decades prior to the real felling date. Where some of the outer sapwood or the heartwood/sapwood boundary survives on the sample, a felling date range can be calculated using the maximum and minimum number of sapwood rings likely to have been present. The sapwood estimates applied throughout this report are a minimum of 10 and maximum of 46 annual rings, where these figures indicate the 95% confidence limits of the range (Tyers 1998). These figures are applicable to oaks from England and Wales. Alternatively, if bark-edge survives, then a felling date can be directly utilised from the date of the last surviving ring. The dates obtained by the technique do not by themselves necessarily indicate the date of the structure from which they are derived. It is necessary to incorporate other specialist evidence concerning the re-use of timbers and the repairs of structures before the dendrochronological dates given here can be reliably interpreted as reflecting the construction date of phases within the structure.

Results

During sampling no original truss numbers were identified which formed a coherent sequence. There are small metal tags on many of the timbers, possibly an architects numbering scheme used for the remedial works, and many of the timbers on display have a cardboard tag with long numeric code which may be a Department of the Environment timber number. Neither seemed suitable for the identification of sampling location and a new scheme was imposed by simply labelling each truss T1-T9 from the west (Fig 4). Sample locations were recorded by a combination of the truss number and the structural element description (Table 1; Figs 3 and 4).

To cover the terms of the request a series of core samples was taken. The initial assessment had identified that there was an absence of slow growing longer lived trees employed in the construction of the barn. Instead it was clear that the barn was built using faster grown younger trees. The initial assessment identified that the most recently repaired timbers were readily recognisable. It should be expected that, in common with other barns in Essex, there have been earlier repairs which are not always evident on initial inspection. A total of 10 timbers were selected as most suitable for sampling (Table 1). These new samples were numbered **1-10** inclusive. There are in addition a number of timber offcuts that had been located in an English Heritage store (Bayliss pers comm 1999) that may have been used for one of the previous attempts to date the barn, as well as other measured data extant from another previous attempt to date the barn (Bridge 1983, and pers comm 2000). Although these data are from Prior's Hall barn, Widdington, these timbers and data sets are not precisely provenanced within the structure; what little information can be gleaned from these is provided in Appendix 1.

One of the new samples (number **4**) when examined in the laboratory was rejected because it had too few rings for reliable analysis. The remaining 9 samples were measured and the resultant series were then compared with each other. Four sequences were found to match together to form an internally consistent group (Table 2; Fig 5). A 91-year site mean chronology was calculated, named WIDD_PHB. The site mean, and the five unmatched samples were then compared with dated reference chronologies from throughout the British Isles and northern Europe. A single well correlated position was identified for the WIDD_PHB sequence. Table 3 shows example correlations of the WIDD_PHB mean sequence at the dating position identified, AD 1317 - 1407 inclusive, against independent reference chronologies. The remaining five measured samples did not match either the rest of the material from Widdington nor dated reference chronologies and are thus undated by this analysis.

Discussion

The 91-year chronology WIDD_PHB is dated AD 1317 to 1407 inclusive. It was created from four timbers. All of the dated samples were complete to the heartwood/sapwood boundary (Table 1) and this boundary has dates varying between AD 1396 and AD 1407 on the different samples. Inspection of the bar diagram (Fig 5) suggests they are most likely derived from a single felling period. Assuming this to be correct and applying an estimate for the number of missing sapwood rings to each dated timber provides a likely felling period between AD 1417 and AD 1442 (Table 1; Fig 5).

The sampling of the timbers attempted to identify a date for the primary timbers. The dated timbers include three of the aisle posts and one of the wall posts. There is no published suggestion that these elements are other than primary components of the original structure. Both the dated and the undated material includes short-lived and somewhat fast grown timbers. Both these features combine to yield samples that are intrinsically less likely to be datable by dendrochronological techniques. Although these timbers were all sampled in the expectation that they would be part of the original construction phase this is not necessarily the case for the undated samples. In particular although there is no direct evidence the samples from the two end walls (samples **2**, **9**, and **10**) are derived from areas more likely to have been repaired and re-built over the intervening centuries than the more central areas of the barn.

Conclusion

The dendrochronological analysis of timbers from the Priors Hall barn at Widdington has identified four principal timbers that appear to be contemporary and to be part of the primary phase of construction of the barn. The dendrochronological results obtained from these indicate a construction date in the first half of the fifteenth century. The result is of great help since it provides a date for this important building about which there has hitherto been some argument over its construction date. Of greater importance is that the joint types present in the structure can now take their proper place in the typological series. This is particularly useful for the bridled and pegged scarf in the arcade plates since most other examples of this joint have hitherto been thought to date principally to the second half of the fourteenth century. Of equal use is the evidence that a documentary reference to repairs to the foundations of a barn at Prior's Hall in the early AD 1400's probably does not refer to the extant structure (both these are quoted in English Heritage 1991, 10).

Acknowledgements

The sampling and analysis programme was funded by English Heritage. Mr Darrell Webb kindly facilitated access to his property and also allowed me to assess the suitability of his house and another outbuilding for future dendrochronological work. John and Pam Walker kindly came to the barn during the sampling and provided useful observations. Peter Marshall from English Heritage kindly put together the request documentation at short notice. Martin Bridge kindly supplied data from his PhD, Alex Bayliss kindly despatched some samples found in the Ancient Monuments Laboratory, and Cathy Groves provided useful discussion.

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Plate 1 Prior's Hall barn, Widdington in use in 1916. Reproduced with permission © Crown Copyright



Figure 1 Location of Widdington within England and Wales, based upon Ordnance Survey map

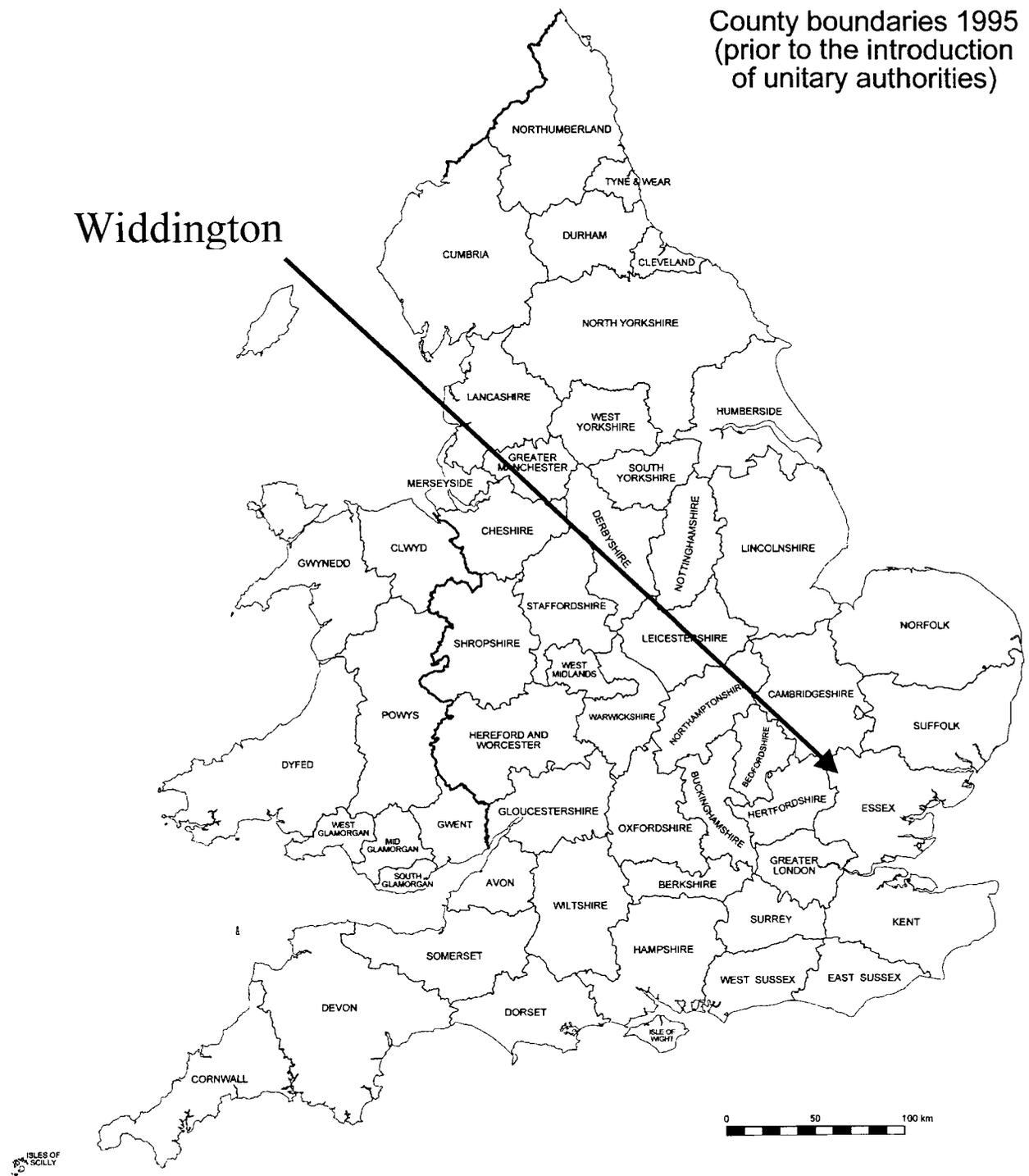


Figure 2 Location of Prior's Hall Barn, Widdington

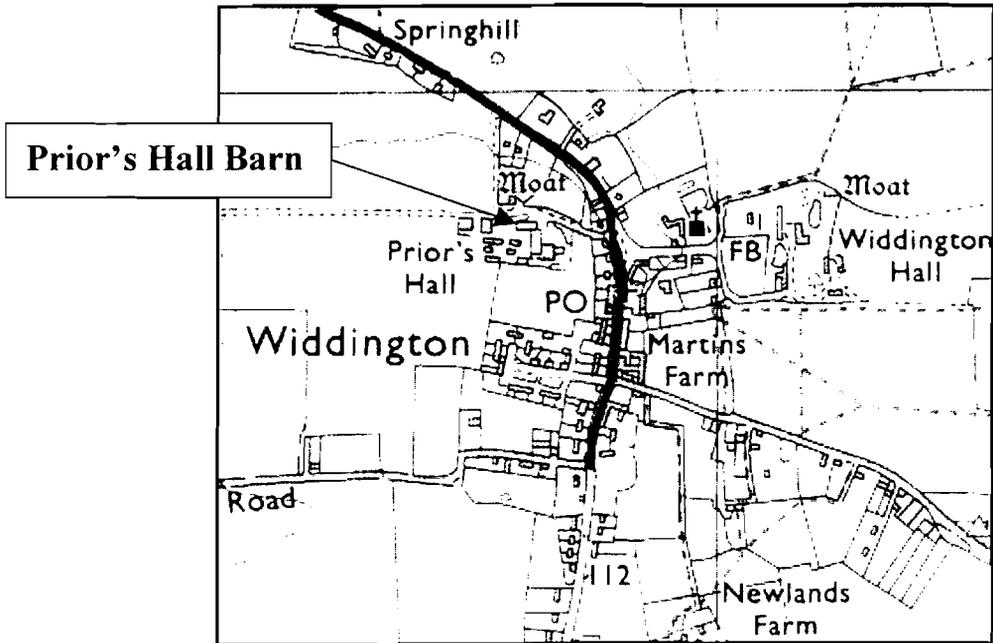


Figure 3 Section of the barn at Priors Hall, Widdington (after English Heritage 1991, 5) showing the nomenclature employed in the report

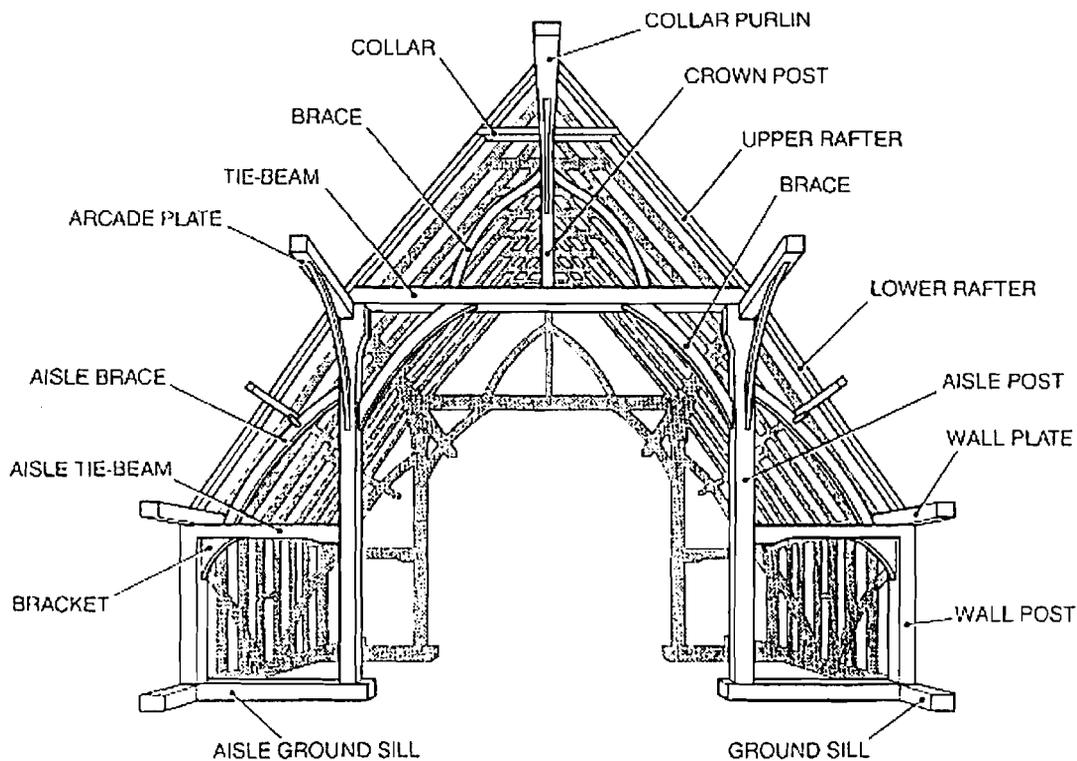


Figure 4 Sketch plan of the barn at Prior's Hall, Widdington showing the truss numbering scheme followed in this report (after English Heritage 1991, 4). Trusses were labelled T1-T9 from the west. The approximate location and direction of sampling for samples 1-10 are also shown. Not to scale

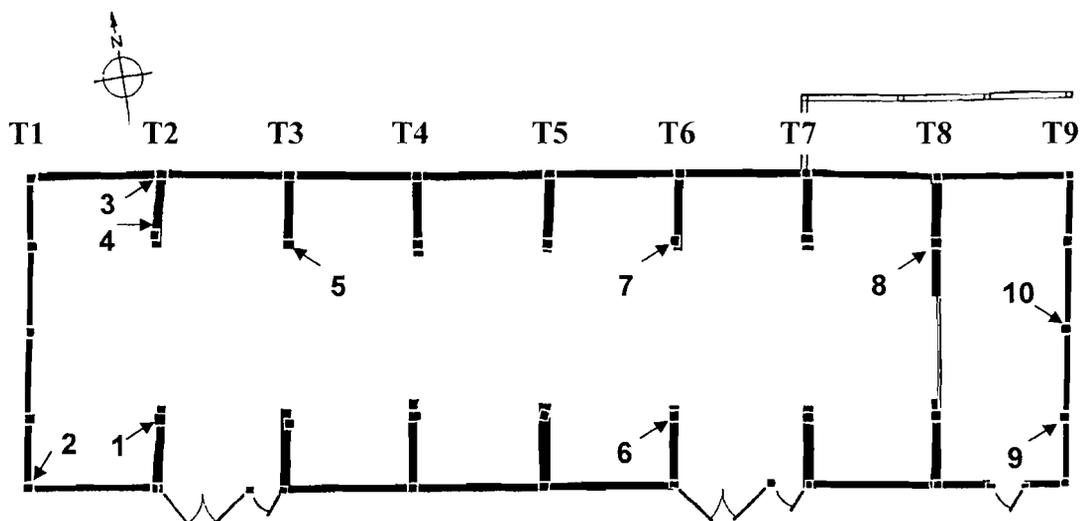


Table 1

List of core samples from the Prior's Hall Barn, Widdington

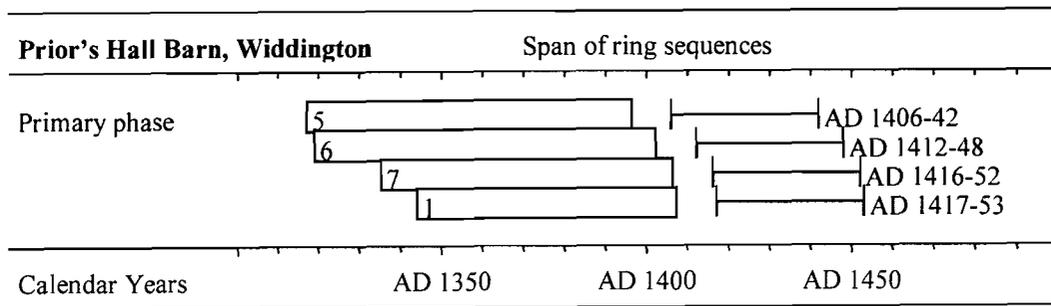
Core No	Origin of core	Cross-section size (mm)	Cross-section of tree	Total rings	Sapwood rings	ARW (mm/year)	Date of sequence	Felling period
1	South aisle post T2	340 x 320	Whole	64	H/S	3.34	AD 1344-AD 1407	AD 1417-53
2	South wall post T1	280 x 230	Whole	55	H/S	3.01	Undated	-
3	North wall post T2	280 x 180	Whole	71	12	2.05	Undated	-
4	North aisle tie-beam T2	210 x 140	Half	-	-	-	Not measured	-
5	North aisle post T3	320 x 300	Whole	80	H/S	2.07	AD 1317-AD1396	AD 1406-42
6	South aisle post T6	350 x 310	Quarter	84	H/S	1.84	AD 1319-AD 1402	AD 1412-48
7	North aisle post T6	330 x 320	Whole	72	H/S	3.19	AD 1335-AD 1406	AD 1416-52
8	North aisle post T8	310 x 300	Whole	54	H/S	2.82	Undated	-
9	South aisle post T9	330 x 270	Quarter	51	H/S	4.25	Undated	-
10	Centre wall post T9	280 x 240	Half	67	H/S	2.22	Undated	-

KEY

Total rings = all measured rings

Sapwood rings: H/S heartwood/sapwood boundary, ARW = average ring width of the measured rings

Figure 5 Bar diagram showing the chronological positions of the four dated timbers from the barn at Prior's Hall, Widdington. The estimated felling period for each sequence is also shown



KEY

 heartwood

Table 2

t-value matrix for the timbers forming the chronology WIDD_PHB

	5	6	7
1	5.66	4.58	6.66
5		6.27	4.43
6			4.54

Table 3

Dating the mean sequence WIDD_PHB, AD 1317-1407 inclusive. *t*-values with independent reference chronologies

<u>Area</u>	<u>Reference chronology</u>	<u><i>t</i>-values</u>
Bedfordshire	Chicksands Priory (Howard <i>et al</i> 1998)	6.80
Essex	Cressing Temple, Barley Barn (Tyers 1992a)	5.37
Essex	Cressing Temple, Wheat Barn (Tyers 1992b)	6.60
Essex	Falconers Hall, Good Easter (Bridge 1996)	5.30
Essex	Fyfield Hall (Bridge 1998)	8.66
Essex	Netteswellbury Barn, Harlow (Tyers 1997a)	7.06
Essex	St Aylotts, Saffron Walden (Tyers 1996)	5.31
Greater London	Upminster Tithe Barn (Tyers 1997b)	6.93
Hertfordshire	Ware Priory, High St, Ware (Howard <i>et al</i> 1997)	6.30
Midlands region	East Midlands regional master (Laxton and Litton 1988)	5.52

Table 4

Ring-width data from site master WIDD_PHB dated AD 1317-1407 inclusive

<u>Date</u>	<u>Ring widths (0.01mm)</u>										<u>No of samples</u>											
AD 1317							219	227	211	298								1	1	2	2	
	329	259	298	169	179	134	255	337	357	234	2	2	2	2	2	2	2	2	2	2	2	
	210	209	222	264	352	412	282	259	367	403	2	2	2	2	3	3	3	3	3	3	3	
	317	348	237	400	431	455	435	445	358	183	3	3	3	4	4	4	4	4	4	4	4	
AD 1351	239	205	250	262	244	272	347	313	296	234	4	4	4	4	4	4	4	4	4	4	4	
	159	236	314	309	236	204	216	265	334	299	4	4	4	4	4	4	4	4	4	4	4	
	245	259	225	188	140	187	173	278	210	224	4	4	4	4	4	4	4	4	4	4	4	
	232	194	212	150	192	240	236	240	203	134	4	4	4	4	4	4	4	4	4	4	4	
	148	110	159	213	178	224	244	230	221	208	4	4	4	4	4	4	4	3	3	3	3	
AD 1401	183	212	329	269	242	305	248				3	3	2	2	2	2	1					

Appendix 1

List of older data and/or samples from Prior's Hall barn, Widdington

Group A

The barn is known to have been examined between AD 1975 and AD1984 by David Haddon-Reece of the Ancient Monuments Laboratory, Department of the Environment. The location of the data from this analysis is unknown. The samples recorded in Group C below were collected by David Haddon-Reece in 1983, although it is apparent that he worked on further material from this building. These samples were not recorded in the laboratory accession system and did not remain in the laboratory stores in AD1999. However the author (*c* AD 1983-4) suggests that more data was in the DoE computers at this stage than is produced by combining Bridges data (Group B) and the recently located slices (Group C). None of the material was dated and no report was produced.

Group B

This material was examined by Martin Bridge in the Ancient Monuments Laboratory between AD 1979-82 as part of his PhD (Bridge 1983). He kindly supplied the following data, note these data are not the same as those from the samples listed in group C below, nor do these series cross-match with either the new samples, the group C data, or with reference data.

Group B data, KEY as for Table 1

Sample No	Total rings	Sapwood rings	ARW (mm/year)	Result
WTB01	58	-	3.65	Undated
WTB03	71	14	1.65	Undated
WTB05	66	H/S	1.58	Undated

Group C

These samples were sent to the author by English Heritage staff in AD 1999 during the removal of the Ancient Monuments Laboratory from London to Portsmouth. The samples were measured and analysed prior to the commission reported in the main body of this report. One of these timbers certainly appears to date to the later fifteenth century, but in the absence of both a detailed provenance and its replication by any other material, it is uncertain precisely what this result may imply for the history of the building, although it may hint at the presence of later repairs. The other series do not correlate with the new samples, the group B data, or with reference data.

Group C data, KEY as for Table 1

Sample No	Total rings	Sapwood rings	ARW (mm/year)	Result
AML-831499	71	?H/S	2.18	Undated
AML-831500	72	?H/S	1.94	Undated
AML-831501	70	-	2.27	AD 1421-AD 1490
AML-831502	58	?H/S	2.70	Undated

Illustrative *t*-values for AML-831501 are: 5.72 Chicksands Priory, Bedfordshire (Howard *et al* 1998), 5.47 Falconers Hall, Essex (Bridge 1996), 4.65 East Midlands master (Laxton and Litton 1988).

No reference to Widdington has ever appeared in the *Vernacular Architecture* date lists, and apart from Bridges PhD (1983) there are no other reports, until this one, that I am aware of that discuss any attempt to date the barn. This omission demonstrates once again the utility of using the *Vernacular Architecture* lists and the AML report series to record unsuccessful attempts to date buildings.