Nottingham Tree-ring Dating Laboratory
Dendrochronology, timber analysis & historic building consultants

TREE-RING ANALYSIS OF TIMBERS FROM THE AISLED BARN, YEW TREE FARM, NORTH LEVERTON, NOTTINGHAMSHIRE

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SUMMARY

Dendrochronological analysis was undertaken on a number of timbers at this building resulting in the construction and dating of two site sequences.

The first, NLVASQ01, contains five samples and spans the period AD 1476–1618. Interpretation of the heartwood/sapwood boundary on these samples suggest the five timbers represented were felled some time within the range AD 1627–47.

The second site sequence, NLVASQ02, contains two samples and spans the period AD 1622–1714. One of these samples has a felling date of AD 1714 with it being likely that the other sample was also felled at this time.

Prior to tree-ring analysis being undertaken this barn was believed to date to the eighteenth century. It has now thought likely that this building was constructed shortly after the felling of some of its timbers in AD 1714 but incorporates a number of reused timbers of the second quarter of the seventeenth century.

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Introduction

The Grade II listed barn at Yew Tree farm is located on the south side of Main Street at North Leverton, within the Bassetlaw district (Fig 1). It is a two storey, three bay structure of timber framed construction with brick walls and a half hipped pantile roof. There are central pairs of doors to the south side and north sides and single flanking lean-to wings.

The interior has post and truss framing with large arch braces (Fig 2), and the roof is of principal rafter type with collars and clasped purlins (Fig 3). A number of the timbers have redundant mortices, suggesting they may be reused from an earlier building; there have also been softwood replacements of some of the common and hip rafters.

The building is believed to date to the eighteenth century.

Tree-ring Sampling

Samples were taken from nine timbers; from posts, tiebeams, aisle plates, and collars. Each core sample was given the code NLV-A (for North Leverton, site 'A') and numbered 01–09. The location of each sample was noted at the time of sampling and these have been marked on Figures (4–8). Further details can be found in Table 1. Timbers have been numbered from east to west.

Principles of Tree-ring Dating

Tree-ring dating relies on a few simple, but quite fundamental, principals. Firstly, as is commonly known, trees (particularly oak trees, the most frequently used building timber in England) grow by adding one, and only one, growth-ring to their circumference each, and every, year. Each new annual growth-ring is added to the outside of the previous year's growth just below the bark. The width of this annual growth-ring is largely, though not exclusively, determined by the weather conditions during the growth period (roughly March – September). In general, good conditions produce wider rings and poor conditions produce narrower rings. Thus, over the lifetime of a tree, the annual growth-rings display a climatically determined pattern. Furthermore, and importantly, all trees growing in the same area at the same time will be influenced by the same growing conditions and the annual growth-rings of all of them will respond in a similar, though not identical, way.

Secondly, because the weather over any number of consecutive years is unique, so too is the growth pattern of the tree. The pattern of a short period of growth, 20, 30 or even 40 consecutive years, might conceivably be repeated two or even three times in the last one thousand years. A short pattern might also be repeated at different time periods in different parts of the country because of differences in regional micro-climates. It is less likely, however, that such problems would occur with the pattern of a longer period of growth, that

is, anything is excess of 60 years or so. In essence, a short period of growth, anything less than 50 rings, is not reliable, and the longer the period of time under comparison the better.

The third principal of tree-ring dating is that, until the early- to mid-nineteenth century, builders of timber-framed houses usually obtained all the wood needed for a given structure by felling the necessary trees in a single operation from one patch of woodland or from closely adjacent woods. Furthermore, and contrary to popular belief, the timber was used "green" and without seasoning, and there was very little long-term storage as in timber-yards of today. This fact has been well established from a number of studies where tree-ring dating has been undertaken in conjunction with documentary studies. Thus, establishing the felling date for a group of timbers gives a very precise indication of the date of their use in a building.

Tree-ring dating relies on obtaining the growth pattern of trees from sample timbers of unknown date by measuring the width of the annual growth-rings. This is done to a tolerance of 1/100 of a millimeter. The growth patterns of these samples of unknown date are then compared with a series of reference patterns or chronologies, the date of each ring of which *is* known. When a sample "cross-matches" repeatedly at the same date against a series of different relevant reference chronologies the sample can be said to be dated. The degree of cross-matching, that is the measure of similarity between sample and reference, is denoted by a "*t*-value"; the higher the value the greater the similarity. The greater the similarity the greater is the probability that the patterns of samples and references have been produced by growing under the same conditions *at the same time*. The statistically accepted fully reliable minimum *t*-value is 3.5.

However, rather than attempt to date each sample individually it is usual to first compare all the samples from a single building, or phases of a building, with one another, and attempt to cross-match each one with all the others from the same phase or building. When samples from the same phase do cross-match with each other they are combined at their matching positions to form what is known as a "site chronology". As with any set of data, this has the effect of reducing the anomalies of any one individual (brought about in the case of tree-rings by some non-climatic influence) and enhances the overall climatic signal. As stated above, it is the climate that gives the growth pattern its distinctive pattern. The greater the number of samples in a site chronology the greater is the climatic signal of the group and the weaker is the non-climatic input of any one individual.

Furthermore, combining samples in this way to make a site chronology usually has the effect of increasing the time-span that is under comparison. As also mentioned above, the longer the period of growth under consideration, the greater the certainty of the cross-match. Any site chronology with less than about 55 rings is generally too short for satisfactory analysis.

Analysis and Results

At this point it was found that one of the samples (NLV-A07), taken from a collar, had too few growth rings to make secure dating a possibility and so this was discarded prior to preparation and analysis. The other eight samples were prepared by sanding and polishing and their growth-ring widths measured. These growth-ring widths were then compared with each other, resulting in seven of the samples forming two groups.

Firstly, five samples matched each other and were combined at the relevant offset positions to form a site sequence of 143 rings (Fig 9). This site sequence, NLVASQ01, was then compared against a series of relevant reference chronologies where it was found to have a consistent match at a first ring date of AD 1476 and a last-ring date of AD 1618. The evidence for this dating is given by the *t*-values in Table 2.

Secondly, two samples matched each other and were combined at the relevant offset positions to form a site sequence of 93 rings (Fig 10). This site sequence, NLVASQ02, was again compared against the reference chronologies where it was found to span the period AD 1622–1714. The evidence for this dating is given by the *t*-values in Table 3.

Attempts to date the remaining ungrouped sample (NLV-A04) by individually comparing it against the reference material were unsuccessful and this remains undated.

Interpretation

Tree-ring analysis undertaken on samples taken from this structure has resulted in the construction and successful dating of two site sequences.

The first, NLVASQ01, contains five samples, taken from aisle plates, collars, and a tiebeam, and spans the period AD 1476–1618. All five of these samples have the heartwood/sapwood boundary ring which is broadly contemporary suggesting they were felled at the same time as each other. The average heartwood/sapwood boundary ring date for these five samples is AD 1612, which allows an estimated felling date to be calculated for them of AD 1627–47.

The second, NLVASQ02, contains two samples, both taken from posts, and spans the period AD 1622–1714. One of these samples, NLV-A01, has complete sapwood and the last measured ring date of AD 1714, the felling date of the timber represented. The second sample, NLV-A02, has the heartwood/sapwood boundary ring date of AD 1689, which allows an estimated felling date range to be calculated for the timber represented of AD 1713–24 (allowing for this sample to have a last-measured ring date of AD 1712 with incomplete sapwood), consistent with this timber also having been felled in AD 1714.

All felling dates have been calculated using the estimate that 95% of mature oak trees in this area have between 15–35 sapwood rings.

Discussion

Prior to tree-ring dating this barn was thought to date to the eighteenth century; additionally, it had been suggested that it might contain some timber reused from an earlier structure. It is now known that the barn structure contains at least five timbers which were felled in AD 1627–47 and two timbers which were felled in AD 1714.

At least one of the earlier timbers (a tiebeam) shows definite evidence, in the form of empty mortices, for previous use, and although no signs of reuse were noted on the other four

timbers it is possible that further study might identify this. Due to the difficulties involved it is unlikely that the two main posts dated to AD 1714 were inserted after the initial construction of the barn. Therefore, it is likely that the two eighteenth century posts relate to the construction date of the building and that construction incorporated a number of reused timbers of the seventeenth century.

Acknowledgements:

This work was commissioned and funded by Mr and Mrs Woodward, the owners of the building. Graham Beaumont kindly allowed us to use his survey drawings of the building which have been used to illustrate this report and locate the sampled timbers. Graham also discussed the results and provided useful comments.

Table 1: Details of samples from the Aisled Barn, Yew Tree Farm, North Leverton, Nottinghamshire

Sample number	Sample location	*Total rings	**Sapwood rings	First measured ring date (AD)	Last heartwood ring date (AD)	Last ring date (AD)
NLV-A01	North post, cross-frame III	86	18C	1629	1696	1714
NLV-A02	South post, cross-frame III	91	23	1622	1689	1712
NLV-A03	Tiebeam, cross-frame I	140	02	1479	1616	1618
NLV-A04	Tiebeam, cross-frame III	63	h/s	----	----	----
NLV-A05	North aisle plate, cross-frame III	121	01	1497	1616	1617
NLV-A06	North aisle plate, cross-frame I	131	h/s	1476	1606	1606
NLV-A07	Collar I	NM	--	----	----	----
NLV-A08	Collar VI	137	02	1479	1613	1615
NLV-A09	Collar VII	118	04	1495	1608	1612

*NM = not measured; **h/s = the heartwood/sapwood boundary is the last ring on the sample; C = complete sapwood on sample, last measured ring is the felling date

Table 2: Results of the cross-matching of site sequence NLVASQ01 when the first-ring date is AD 1476 and a last-ring date of AD 1618

Reference chronology	Span of chronology (AD)	*t*-value
East Midlands	AD 882–1981	9.4
England	AD 401–1981	9.1
103 Church Street, Misterton, Notts	AD 1480–1653	8.5
Langford Manor, Notts	AD 1467–1632	8.2
Mansfield Woodhouse Priory, Notts	AD 1432–1579	7.8
Saltby Church, Leics	AD 1446–1625	7.3
Hill Top Farm, Heathcote, Derbys	AD 1425–1578	7.3
Sherwood Trees	AD 1426–1981	7.7

Table 3: Results of the cross-matching of site sequence NLVASQ03 when the first-ring date is AD 1622 and the last-ring date is AD 1714

Reference chronology	Span of chronology (AD)	*t*-value
Bols Castle, Derby (Riding house)	AD 1494–1744	6.7
15 Halton Village, near Aylesbury, Bucks	AD 1559–1678	6.2
Bolsover (Little Castle), Derbys	AD 1532–1749	6.0
Bay Hall, Bennington, Lincs	AD 1591–1717	6.0
Kenilworth Castle Gatehouse, Warwicks	AD 1623– 1727	5.9
Combermere, Whitworth, Cheshire	AD 1595–1727	5.8
Rufford Mill, Notts	AD 1571–1727	5.6
Halstead Manor, Stixwold, Lincs	AD 1593–1736	5.3

Figure 1: Map to show the general location of Low Farmhouse, Maplebeck, Nottinghamshire

Low Farmhouse

Figure 2: The barn, taken from the west

Figure 3: The barn roof, collar 6 in foreground

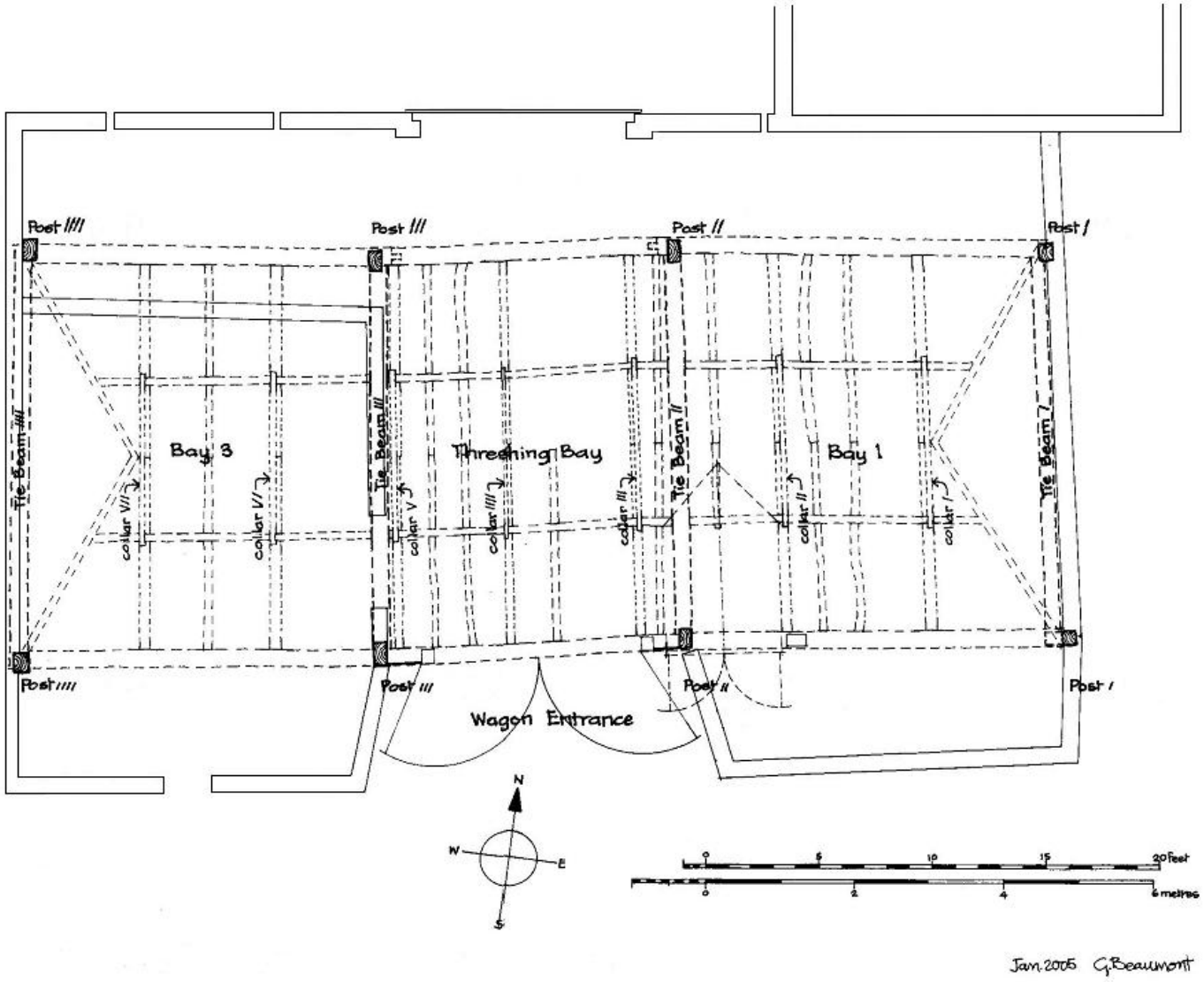


Figure 4: The barn; plan (Graham Beaumont)

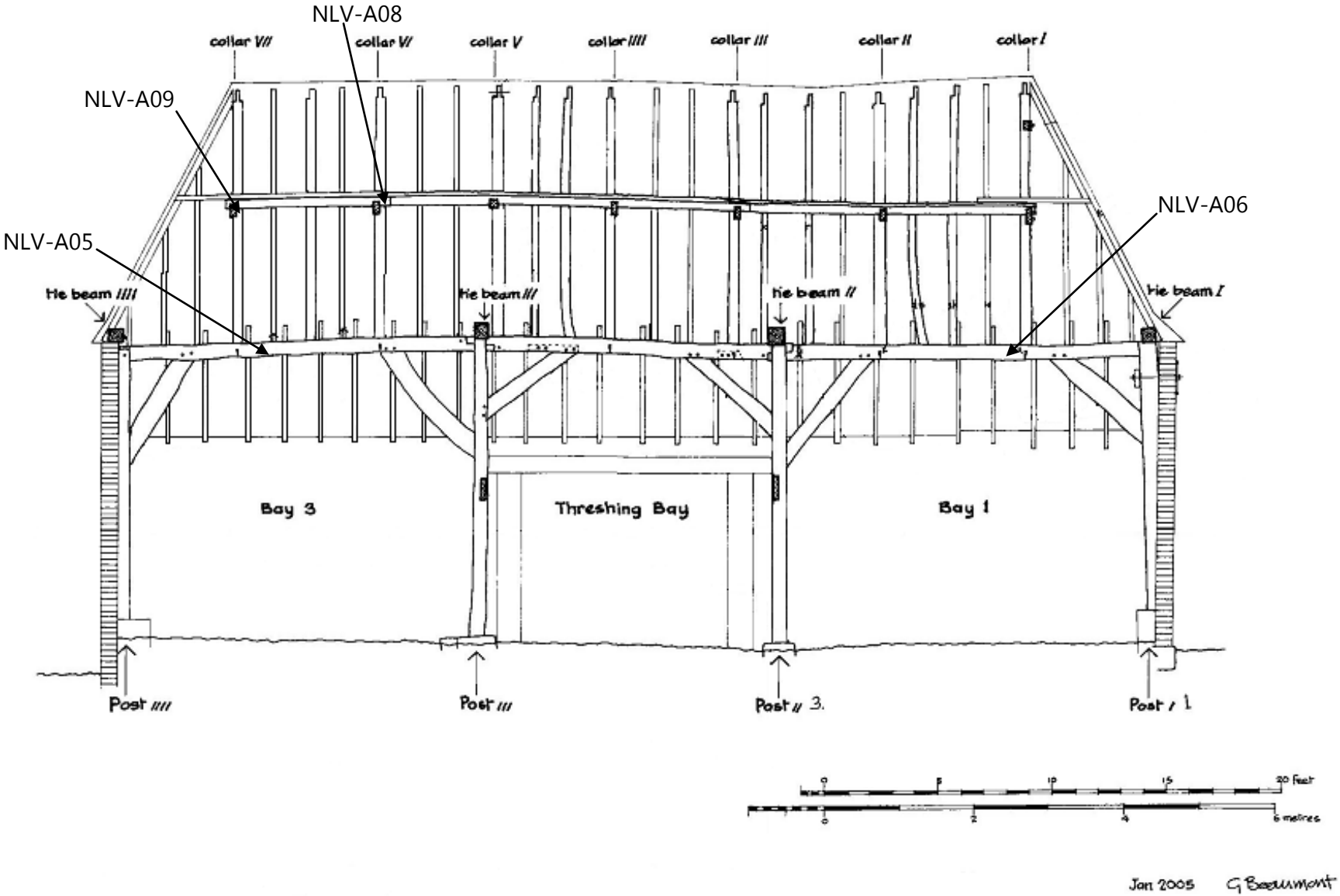


Figure 5: The barn; long section (north side), showing the location of samples NLV-A05–06 and NLV-A08–09 (Graham Beaumont)

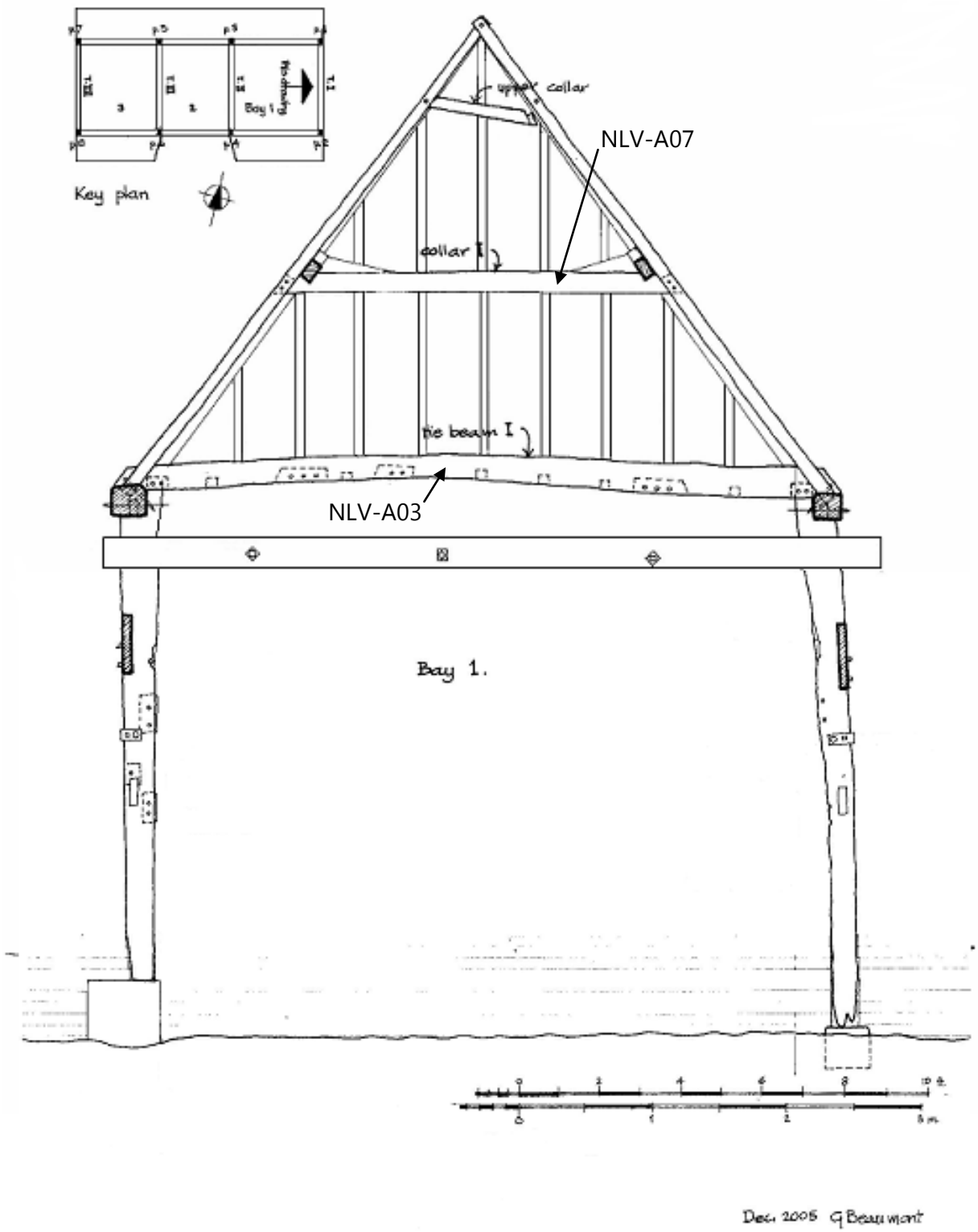


Figure 6: The barn; cross-frame I (west face), showing the location of samples NLV-A03 and NLV-A07 (Graham Beaumont)

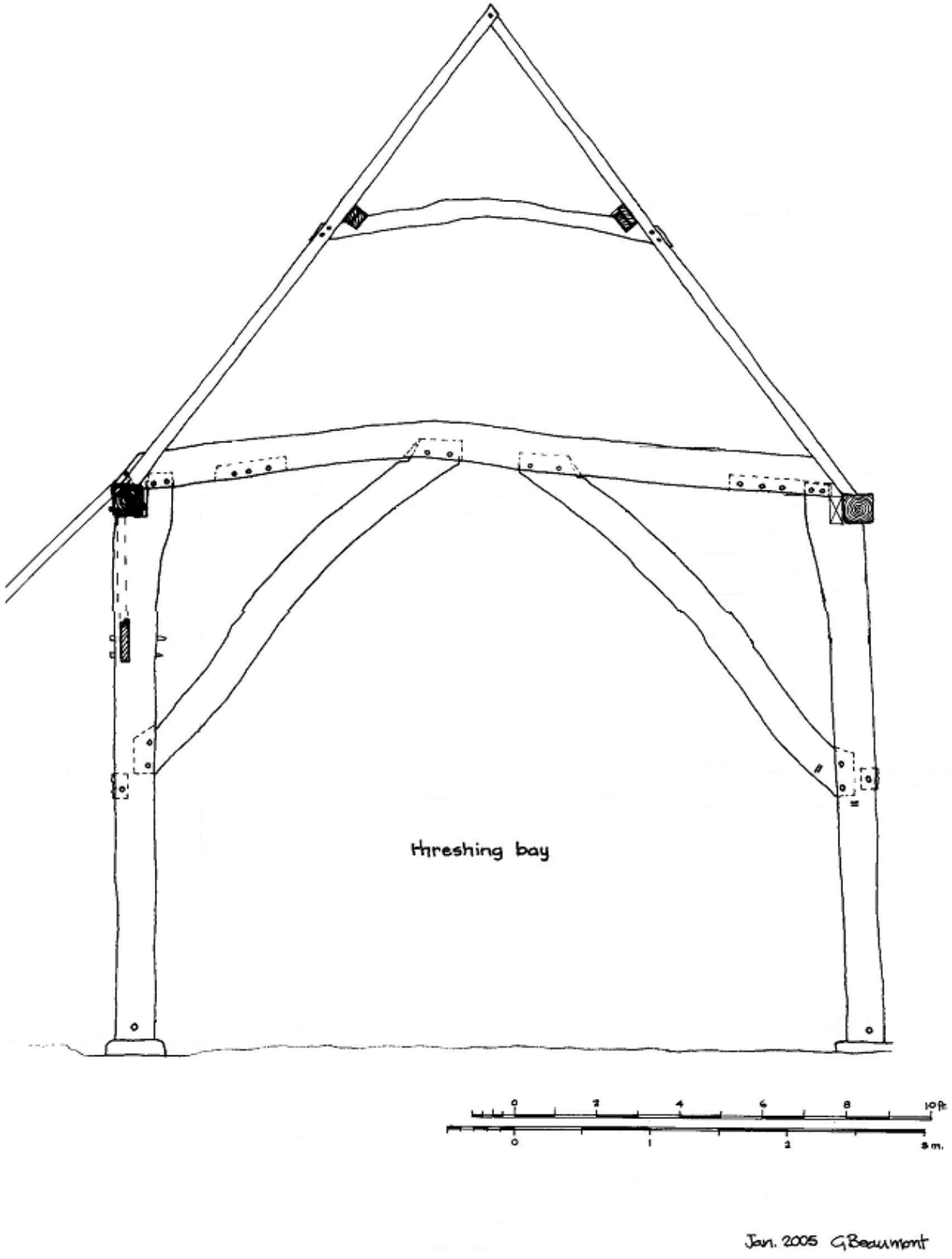


Figure 7: The barn; cross-frame II (west face; Graham Beaumont)

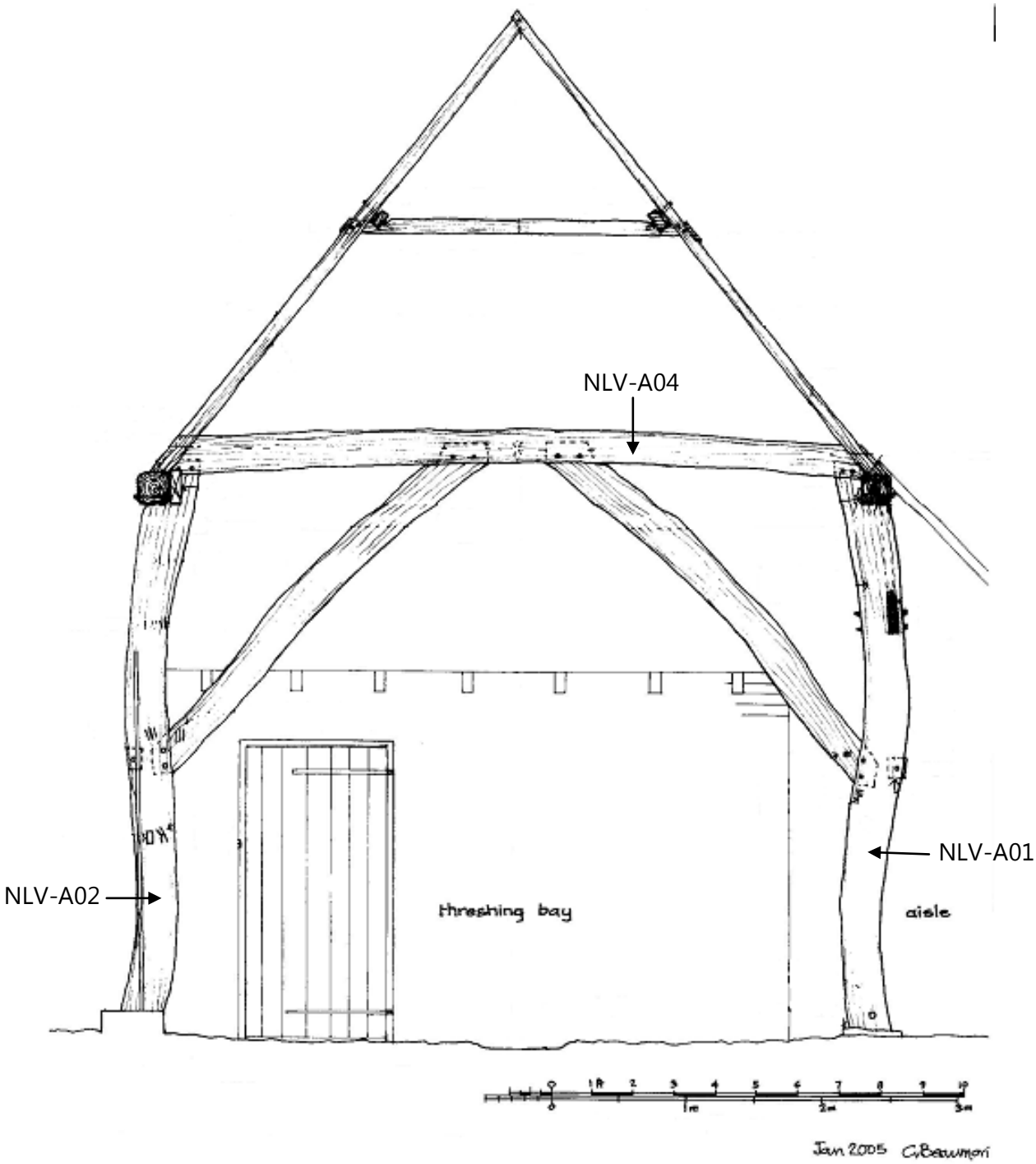
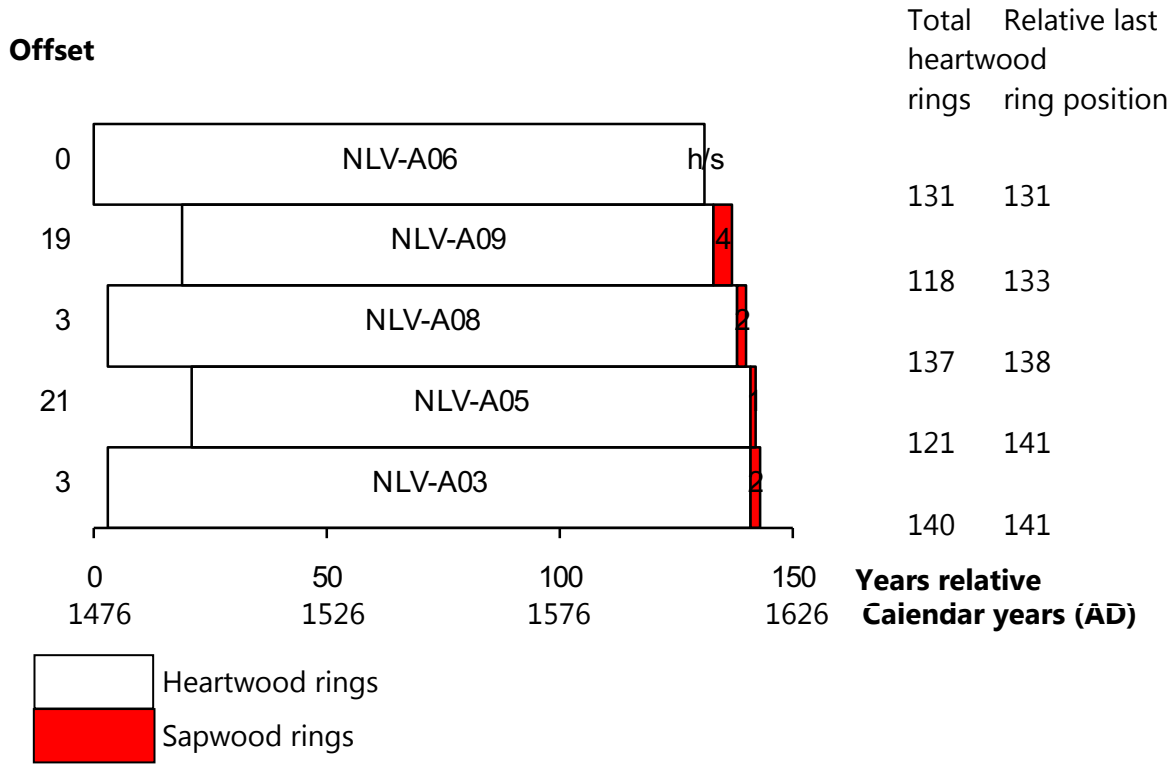
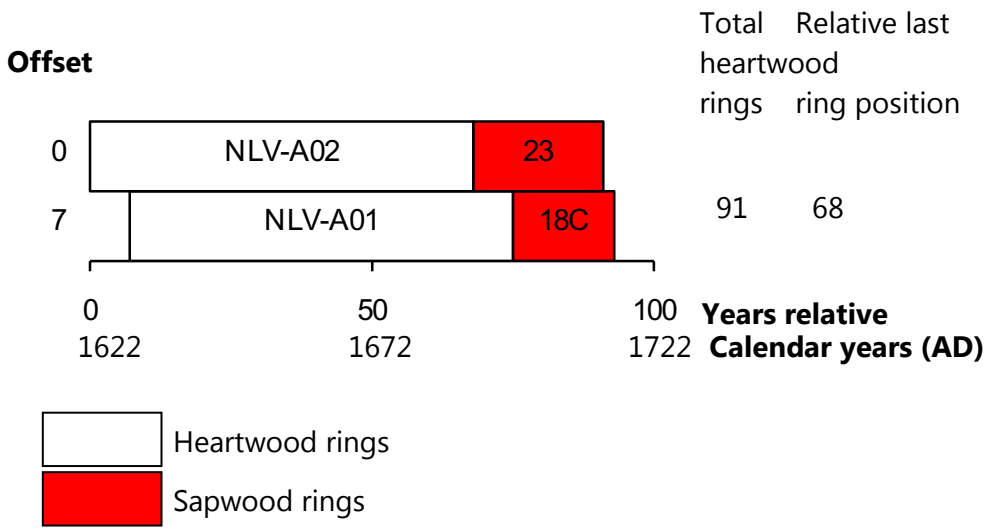


Figure 8: The barn; cross-frame III (east face), showing the location of samples NLV-A01–02, and NLV-A04 (Graham Beaumont)



h/s = the heartwood/sapwood boundary ring is the last measured ring on the sample

Figure 9: Bar diagram of samples in site sequence NLVASQ01



C = complete sapwood retained on sample, last measured ring is the felling date

Figure 10: Bar diagram of samples in site sequence NLVASQ02