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1–4 St Paul's Square, Bedford, Bedfordshire

Tree-ring Analysis of Timbers

Martin Bridge

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SUMMARY

Sampling was confined to timbers thought to be associated with the primary phase of construction of 1 St Paul's Square, the other phases/areas proving unsuitable for dendrochronology. Three of the ten samples taken proved to be elm, but the remaining seven oak samples were successfully dated. The timbers are clearly coeval and have a likely felling date range of AD 1438–59. This indicates that the original two-storeyed jettied building is of mid-fifteenth century origin and shows that at least some of the timbers reused in the extant roof were associated with the primary phase of construction.

CONTRIBUTORS

Dr M C Bridge

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INTRODUCTION

The buildings forming 1–4 St Paul's Square, also known as Buildings 1, 1a, and 2, are Grade II listed town houses located on the south side of the square in the historic centre of Bedford (Figs 1 and 2). Outwardly, this complex of buildings, once used as offices by Bedfordshire County Council, appear to be Georgian, but internally earlier fabric is evident, and at least part of the complex, at the eastern end, is thought to date to the sixteenth century. The northern part of Building 1 (Fig 3) is thought to be the oldest section, and has evolved out of a two-storey timber-framed house, jettied at the first floor. This building was extended in 1794, and a second storey was added in softwood, probably at this time, although the roof appears to reuse the original oak timbers. The building was extended rearwards (south) in the nineteenth century and there are twentieth-century alterations which also obscure the earlier phases. Building 1a (Fig 3) is thought to be an eighteenth-century extension, although maps show buildings have existed on this part of the site since at least 1610.

Dendrochronological dating was requested by Zoe Outram to inform understanding and significance of this prominent group of town houses, located in the Bedford Conservation Area, in relation to planning consent for the repair and renovation of the property, which has lain vacant since 1969.

METHODOLOGY

An assessment of the potential for dendrochronological work was carried out in October 2014. At this time, extensive repair and renovation work was being undertaken on the buildings.

Those timbers judged to be potentially useful were cored using a 15mm auger attached to an electric drill. The cores were glued to wooden laths, labelled, and stored for subsequent analysis. 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.

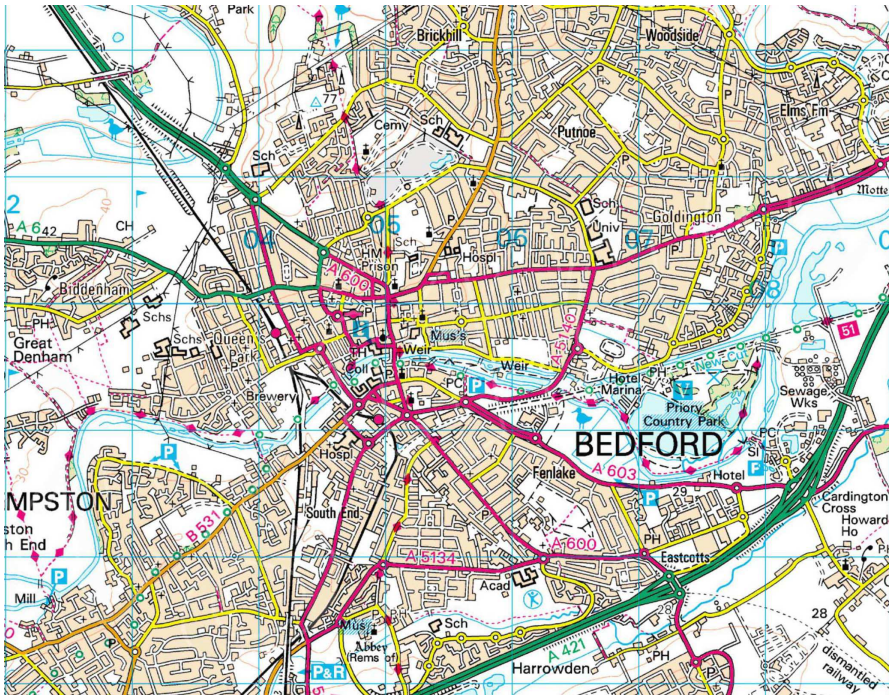

Figure 1: Map showing the town of Bedford in its environs. © Crown Copyright and database right 2015. All rights reserved. Ordnance Survey Licence number 100024900

Figure 2: Map showing the location of Nos 1–4 St Paul's Square, Bedford (within the red elipse) in the historic centre of Bedford. © Crown Copyright and database right 2015. All rights reserved. Ordnance Survey Licence number 100024900.

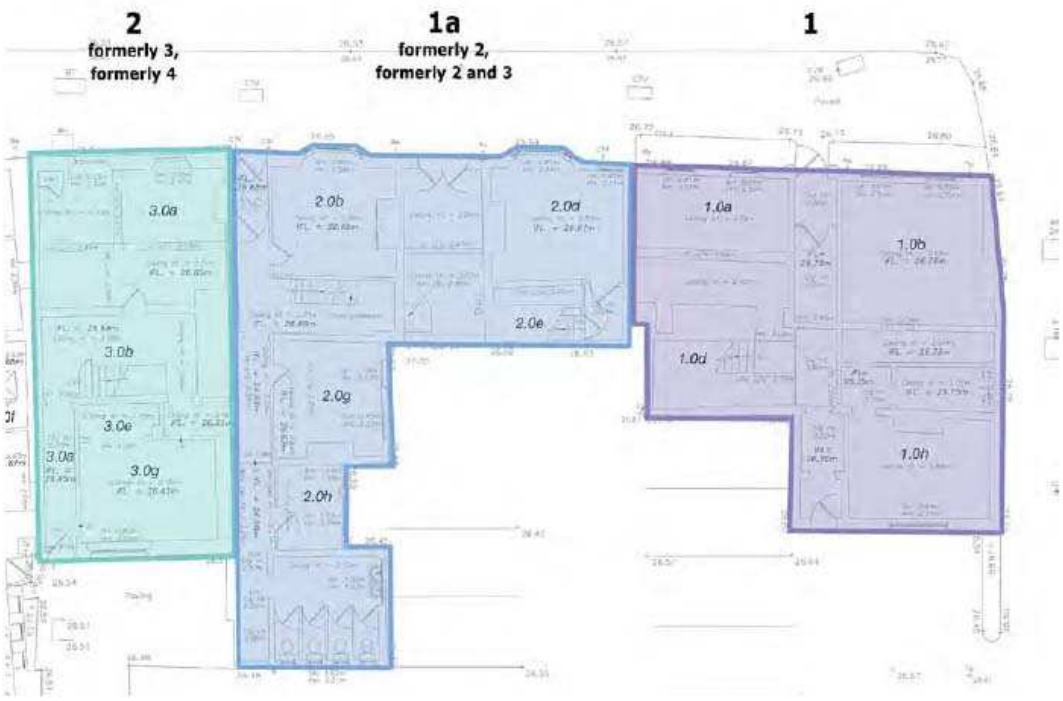

Figure 3: Plan of the property showing the current and historical numbering, reproduced from Purcell Miller Tritton LLP (2009)

In comparing one 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 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.

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. 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 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). 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 assessment failed to find any timbers in Buildings 1a or 2 that were considered suitable for dendrochronology. The ground and first floors of Building 1 did, however, contain several timbers considered worthy of sampling. The second floor, thought to be of eighteenth-century origin, was found to be of softwood construction and was not sampled. The roof over this was of oak, and was thought potentially to be the original roof of the former two-storey building raised up and reset. Most of the roof timbers contained too few rings for dating, but two of the more promising looking rafters were sampled. The approximate positions of the samples taken from the ground, first floor, and roof are shown in Figures 4 and 5. Details of the samples and their locations are given in Table 1.

Three timbers, two studs in the ground-floor west wall, and an axial beam in the first-floor front east room were found to be of elm (*Ulmus* spp) and these were not further analysed. The remaining seven timbers, all oak (*Quercus* spp) were analysed and their ring width series are given in the Appendix. Two samples were taken from the south-west corner post in the first-floor west room (stpb07a and stpb07b) to maximise the information from this timber, the two series matching with a *t*-value of 23.6 and being combined to form a single series (stpb07) for further analysis.

Cross-matching was found between all the oak timbers (Table 2), although series stpb10 had only 35 rings, and therefore had insufficient overlap with many of the other series to yield meaningful statistical values in relation to the cross-matching. Such a short sequence would often be disregarded, however, the strong statistical matches found with two other timbers, combined with the good visual matches, allowed this series to be included on this occasion. Two series (stpb07 and stpb09) matched with a *t*-value of over 10, however, one was a large post and the other a common rafter, and whilst it is entirely possible they were derived from the same tree, with no other evidence available, they were considered as separate series when combining the tree-ring sequences to form the 90-year long site master, STPBEDFD. This series was dated to the period AD 1349–1438, the strongest

matches being shown in Table 3. The strongest matches are with sites from the same county, suggesting that the trees used were grown locally.

Although some of the timbers retained complete sapwood, this was very fragile and was lost on sampling, but all of the dated timbers retained some sapwood. The mean heartwood-sapwood boundary date for the seven dated timbers was AD 1418. This would give a most likely felling date range for the group, all considered likely to have been felled at the same time, of AD 1427–59. Given the actual sapwood present however, this likely felling date range can be modified to AD 1438–59. This dating of the likely construction of the original two-storey jettied house on the site is of interest as the mid-fifteenth century date is considerably earlier than the sixteenth-century date attributed to it previously. The dating of the two common rafters also supports the view that the roof is indeed potentially largely composed of the original roof of the two-storey building reset after the insertion of the second softwood storey.

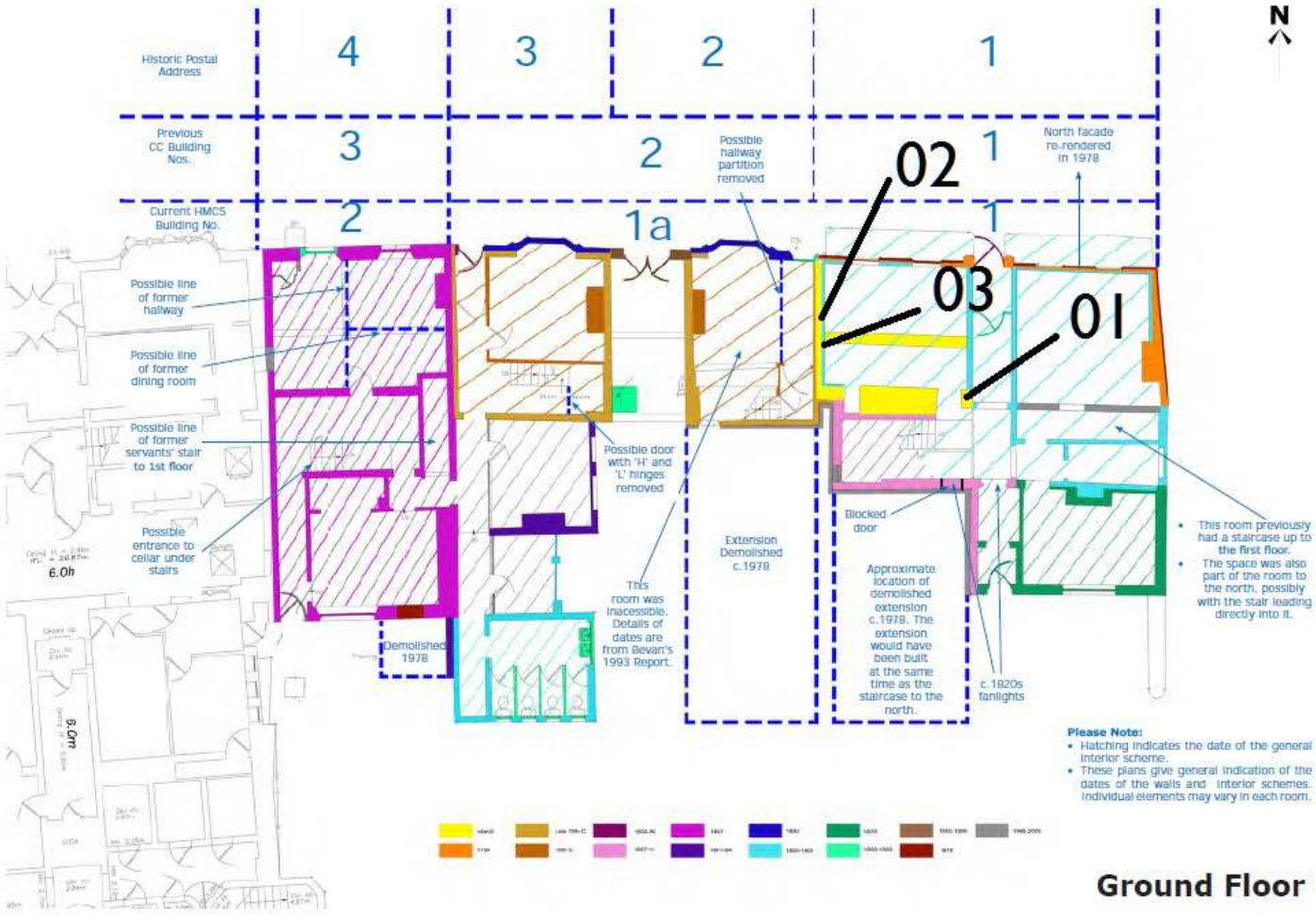

Figure 4: Plan of the ground floor of 1–4 St Paul's Square, Bedford, showing the approximate locations of samples taken for dendrochronology. Adapted from an original plan (Purcell Miller and Tritton LLP 2009)

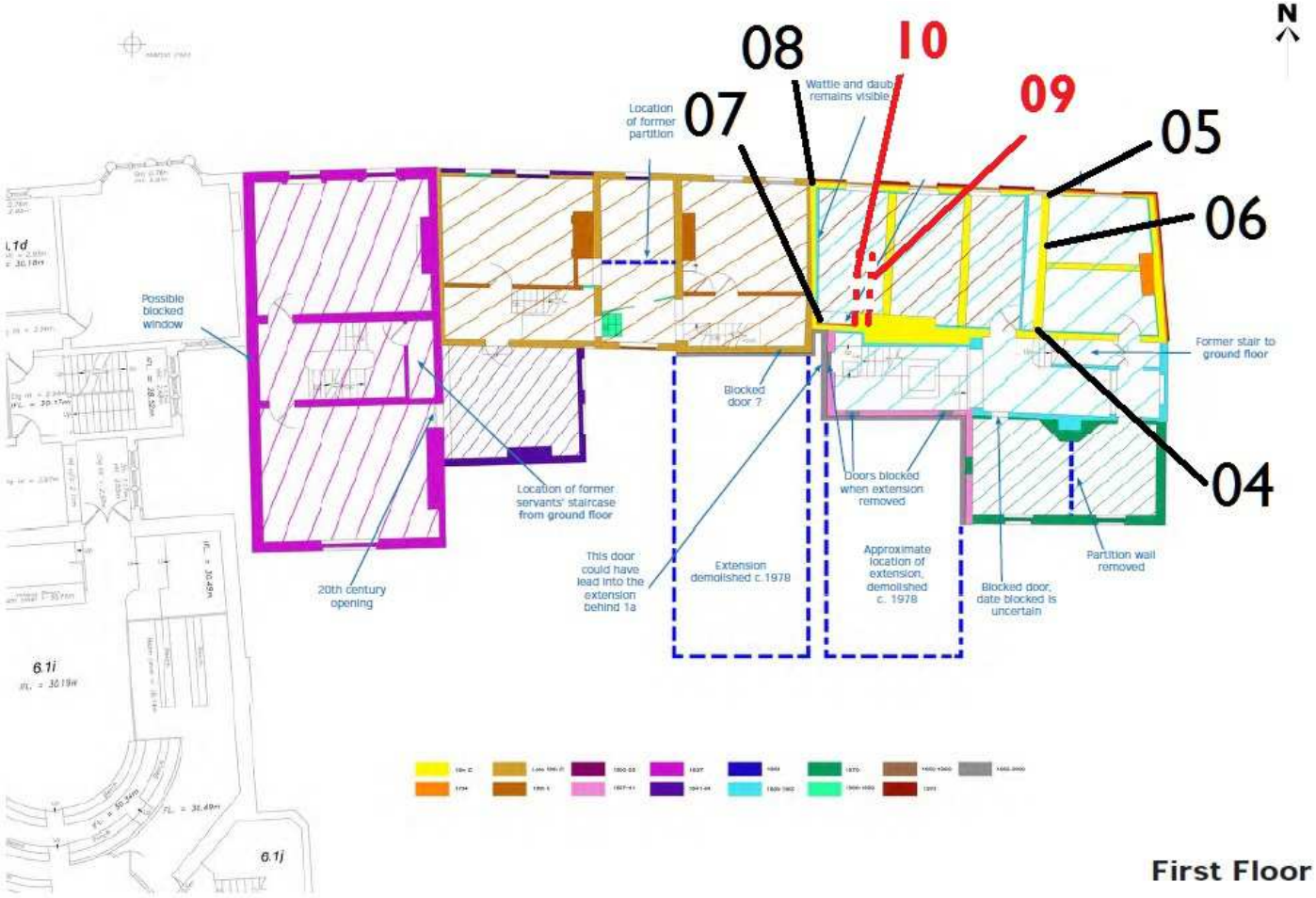

Figure 5: Plan of the first floor of 1–4 St Paul's Square, Bedford, showing the approximate locations of samples taken for dendrochronology. Samples 09 and 10 in red are common rafters in the roof above. Adapted from an original plan (Purcell Miller and Tritton LLP 2009

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Table 1: Details of the samples taken from No 1 St Paul's Square, Bedford

Sample number	Timber and position	No of rings	Mean HW ring width (mm)	Dates spanning (AD)	h/s boundary (AD)	Sapwood rings	Mean sensitivity	Felling date range (AD)
stpb01	Post in south-east corner of west ground-floor room	72	1.95	1349–1420	1420	h/s (+17NM)	0.28	1437–61
stpb02*	3rd stud from north in west wall of west ground-floor room	<20	NM	-	-	-	-	-
stpb03*	4th stud from north in west wall of west ground-floor room	82	NM	-	-	-	-	-
stpb04	Storey post, south-west corner of first-floor east room	51	3.25	1368–1418	1417	1 (+10NM)	0.24	1428-58
stpb05	North post in first-floor east room	62	2.79	1371–1432	1415	17	0.34	1432–56
stpb06*	Axial ceiling beam joining posts 04 and 05	58	NM	-	-	-	-	-
stpb07a	South-west corner post in first-floor west room	37	2.55	1389–1425	1420	5	0.41	-
stpb07b	*ditto*	75	2.54	1362–1436	1420	16	0.35	-
stpb07	Mean of 07a and 07b	75	2.56	1362–1436	1420	16	0.36	1436–61
stpb08	North-west corner post in first-floor west room	66	1.89	1363–1428	1417	11	0.38	1428–58
stpb09	South common rafter 3rd from east wall above west room	43	3.35	1396–1438	1418	20	0.26	1438–59
stpb10	South common rafter 4th from east wall above west room	35	2.47	1404–38	1419	19	0.29	1438–60

Key: * = timbers found to be of elm (*Ulmus* spp), all others are oak (*Quercus* spp); NM = not measured; HW = heartwood; h/s = heartwood-sapwood boundary

Table 2: Cross-matching between the dated samples from No 1 St Paul's Square, Bedford. t-values above 3.5 are considered significant

	t-values					
Sample	stpb04	stpb05	stpb07	stpb08	stpb09	stpb10
stpb01	3.1	4.1	6.8	5.5	*	*
stpb04		5.4	5.4	5.9	*	*
stpb05			7.2	6.4	6.6	*
stpb07				6.7	10.2	7.7
stpb08					4.1	*
stpb09						7.8

* = overlap less than 30 rings, no *t*-value calculated

Table 3: Dating evidence for the site master STPBEDFD, AD 1349–1438

Source region:	Chronology name:	Publication reference:	File name:	Span of chronology (AD)	Overlap (years)	*t*-value
Bedfordshire	Chicksands Priory	(Howard *et al* 1998)	CHKSPQ01	1200–1541	90	11.7
Bedfordshire	Bellframe, Cranfield	(Bridge 1998)	CRANFLD	1342–1469	90	10.2
Bedfordshire	2–3 Old Way, Bletsoe	(Miles *et al* 2007)	BLETSOE1	1355–1459	84	7.6
London	White Tower, Tower of London	(Miles 2007)	WHTOWR5	1260–1489	90	7.6
Essex	Bentfield Bury barn	(Bridge 2002)	BENTFLD	1380–1452	59	6.6
Oxfordshire	High Street, Oxford	(Fletcher 1980)	HIGH	1367–1477	72	6.6
Bedfordshire	Willington Dovecote	(Miles and Worthington 1998)	WILNGTN1	1394–1542	45	6.4
Buckinghamshire	Newton Longville	(Alcock and Miles 2013)	NWL-B	1294–1454	90	6.3
Hertfordshire	The Retreat, Chorleywood	(Miles *et al* 2005)	CHRLYWD	1365–1443	74	6.3
London	Sutton House, Hackney	(Tyers and Hibberd 1993)	SUT91	1319–1534	90	6.1

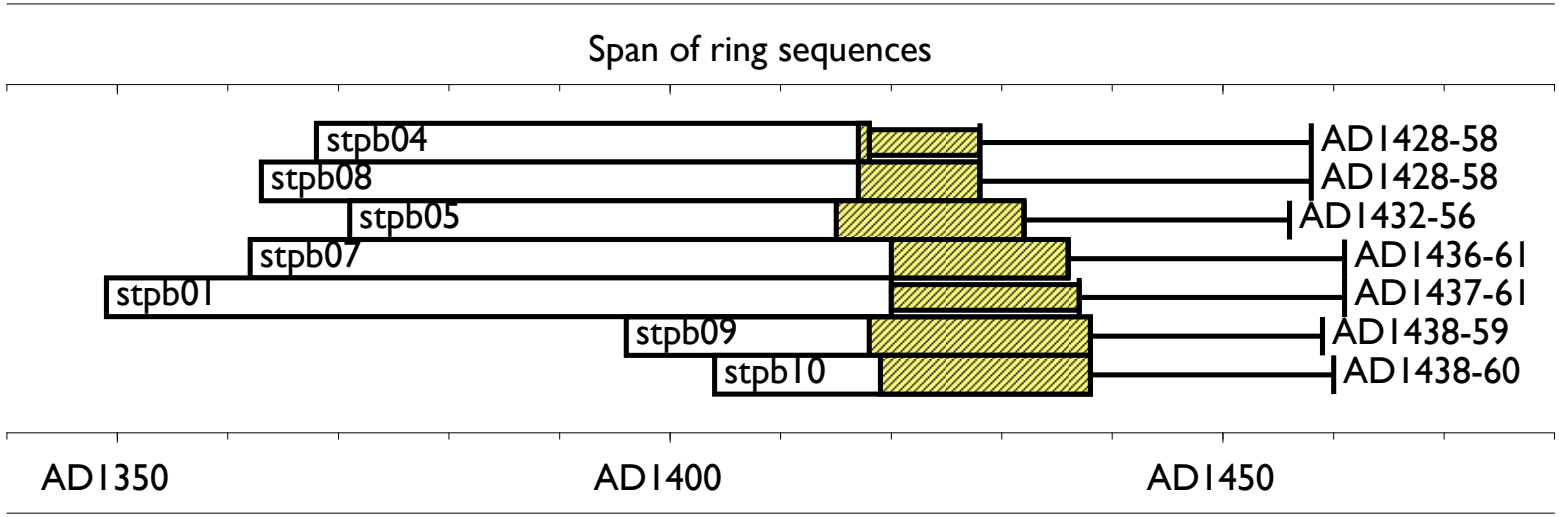

Figure 6: Bar diagram showing the relative positions of overlap and likely felling date ranges for the individual dated samples from the 1 St Paul's Square, Bedford. White bar – heartwood; yellow hatched bar – sapwood; narrow section of bar – additional unmeasured rings

APPENDIX

Ring width values (0.01mm) for the sequences measured

stpb01

178	179	235	184	259	132	160	144	232	124
130	156	104	195	287	270	151	125	266	322
241	254	186	176	105	130	145	122	113	185
96	91	146	144	149	77	178	202	217	230
164	221	510	241	258	259	223	337	214	269
283	259	325	258	270	254	203	333	359	338
296	129	143	138	142	79	123	80	66	89
73	108								

stpb04

502	507	449	288	359	336	370	236	334	298
259	250	204	221	339	198	95	169	229	376
304	270	403	328	311	515	437	359	298	344
415	529	464	504	319	267	342	276	440	321
347	365	220	262	364	353	207	245	215	188
236									

stpb05

144	115	118	226	258	466	366	358	133	94
120	212	155	99	157	198	261	288	272	508
480	221	434	455	392	240	280	392	226	307
324	393	325	276	208	336	243	409	464	189
268	352	331	212	245	239	238	232	112	284
156	210	273	148	71	55	234	228	188	157
107	213								

stpb07a

399	484	807	407	933	325	202	265	274	394
429	351	325	166	214	160	141	271	146	162
178	74	111	161	136	50	125	105	90	80
62	119	52	81	164	154	52			

stpb07b

390	505	431	192	173	337	446	247	284	192
311	157	201	182	202	174	290	204	100	122
236	191	142	229	368	368	476	475	560	763
347	732	286	209	255	263	354	366	327	277
204	220	137	125	210	149	168	179	79	113
159	150	57	135	114	102	85	64	144	68
101	173	153	59	53	108	105	95	84	55
245	187	146	107	143					

stpb08

169	314	227	148	340	337	470	408	189	198
140	374	355	294	187	188	123	144	153	261
128	100	177	244	249	220	129	269	162	96
237	158	118	148	166	181	180	153	163	154
135	101	58	151	122	163	227	70	95	178
151	77	227	117	77	177	80	174	87	112
142	99	71	62	98	116				

stpb09

310	299	371	346	316	360	381	627	427	326
445	413	408	395	211	295	425	341	171	254
246	195	132	141	183	147	207	208	218	85
86	209	268	272	178	139	299	240	211	207
124	195	252							

stpb10

245	211	431	440	441	383	159	206	307	165
85	197	192	185	168	130	180	137	208	150
138	81	85	171	145	155	127	70	164	155
128	105	108	140	139					

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