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Alverstone Marshes, Isle of Wight

Dendrochronological and Radiocarbon Analysis

Peter Marshall, Ian Tyers, Christopher Bronk Ramsey, Michael Dee, Elaine Dunbar and Paula Reimer

Scientific Dating

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Summary

Tree-ring analysis of sixteen samples from oak timbers excavated at Alverstone Marshes, Isle of Wight in 2005 clustered ten of these samples into three groups, which consisted of two, five and three timbers respectively. These sample, and the six unmatched timbers, however, are all currently undated by dendrochronology. Radiocarbon dating of Cluster 2 (five timbers) surprisingly determined that these timbers were felled during the early part of the first millenium cal BC. Twenty-one timbers from eight structures were radiocarbon dated with construction in Areas A and B taking place in the sixth century cal AD and in Area C from the ninth–twelfth centuries cal AD. The identification of several sweet chestnut (*Castanea sativa* Mill.) timbers dating to the sixth century cal AD raises the possibility that they were derived from trees that may have been a relict population introduced during the Roman period.

Providing robust chronologies for the monoliths taken for environmental analysis was hampered by lack of suitable samples for scientific dating and by the presence of residual/intrusive material within the sediments.

Contributors

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Acknowledgements

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Front cover image

Excavations at Alverstone, 18 October 2005 (© Island 2000 Trust).

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Isle of Wight County Archaeology and Historic Environment Service, Westridge Centre, Brading Road, Ryde, Isle of Wight, PO33 1QS

Date of Research

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Introduction

This document is a technical archive report on the tree-ring and radiocarbon analysis of samples from Alverstone. An accompanying publication (Blanks et al. forthcoming) and technical report (Goodburn et al. forthcoming) incorporate the results from this report into a wider discussion of the chronology of the Alverstone timbers and palaeo-environmental remains.

Excavation on Alverstone Marshes

Excavation on Alverstone Marshes in 2005 recovered a multi-phased, linear timber structure of both vertical and horizontal timbers and a cobbled surface of Anglo-Saxon and early medieval date crossing the marsh. The fieldwork was managed by Island 2000 Trust in response to the archaeological remains being uncovered during the excavation of a flood relief pond as part of the Environment Agency's Water Level Management Plan. English Heritage (now Historic England) assumed responsibility for funding post-excavation work in 2009 and commissioned Museum of London Archaeology (MOLA) to bring the work to publication.

The site, designated a Site of Special Scientific Interest (SSSI) in the 1980s by English Nature on account of the marsh ecology, is located on the east side of the Isle of Wight, south of Alverstone village, near Sandown (Fig. 1). It is bounded by Alverstone Road and Alverstone bridge to the east, by the Eastern Yar river to the north and by Youngwoods Way to the south (Fig. 2). The excavation covered 1887m^2 and was dug to a maximum depth of 4m.

The archaeological sequence represents an infilled estuary that was probably under tidal influence during at least the early historic to the post-medieval periods. During excavation the timbers were thought to be Late Iron Age or Roman in date, however, detailed assessment of the technological aspects of the timber and scientific dating of a selection of them identified three principal phases of activity of Saxon and Saxo-Norman date.

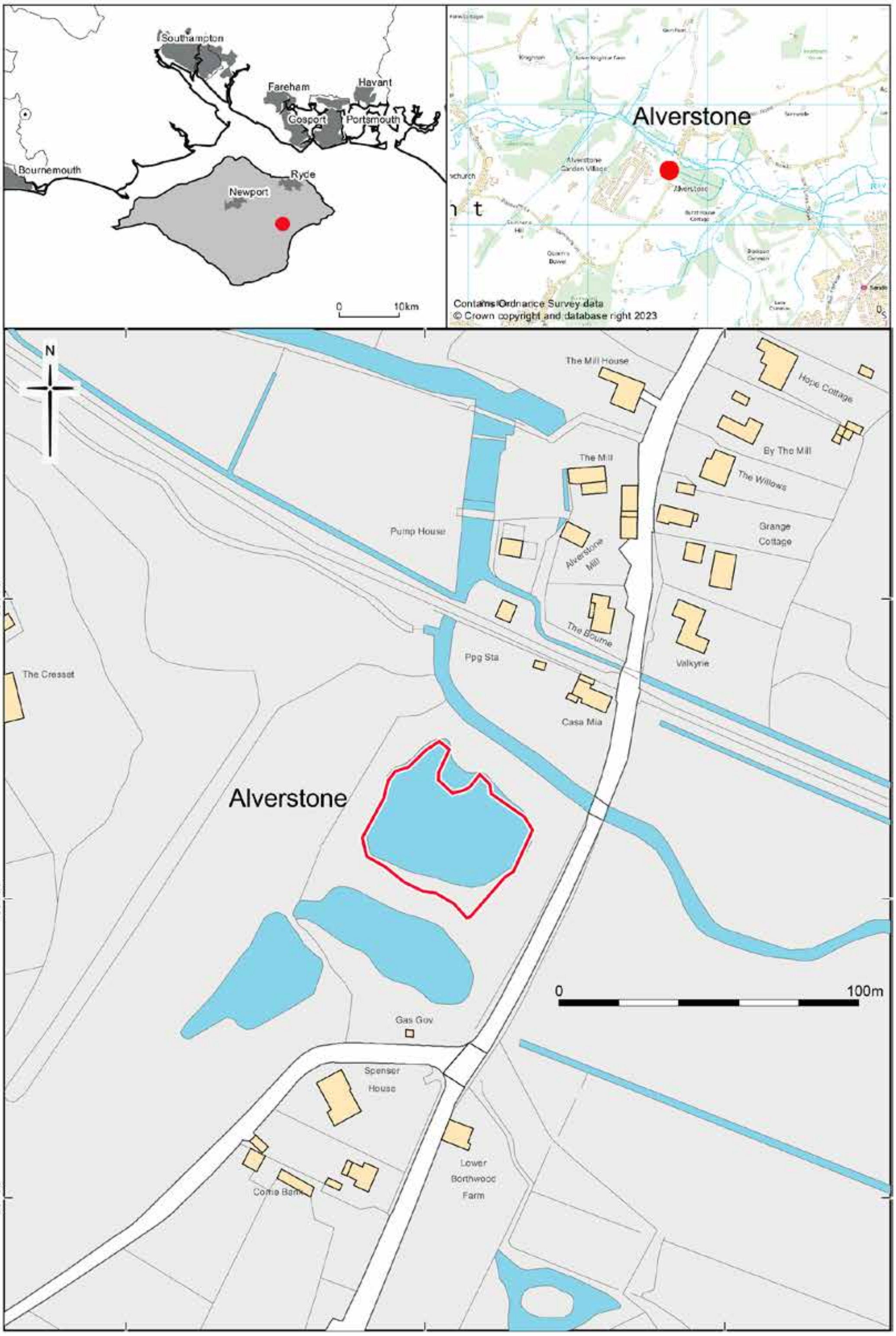

Figure 1: Location of the site on Alverstone Marshes, Isle of Wight. The red dot shows the location of the site. The red line shows the extent of the excavation. © MOLA

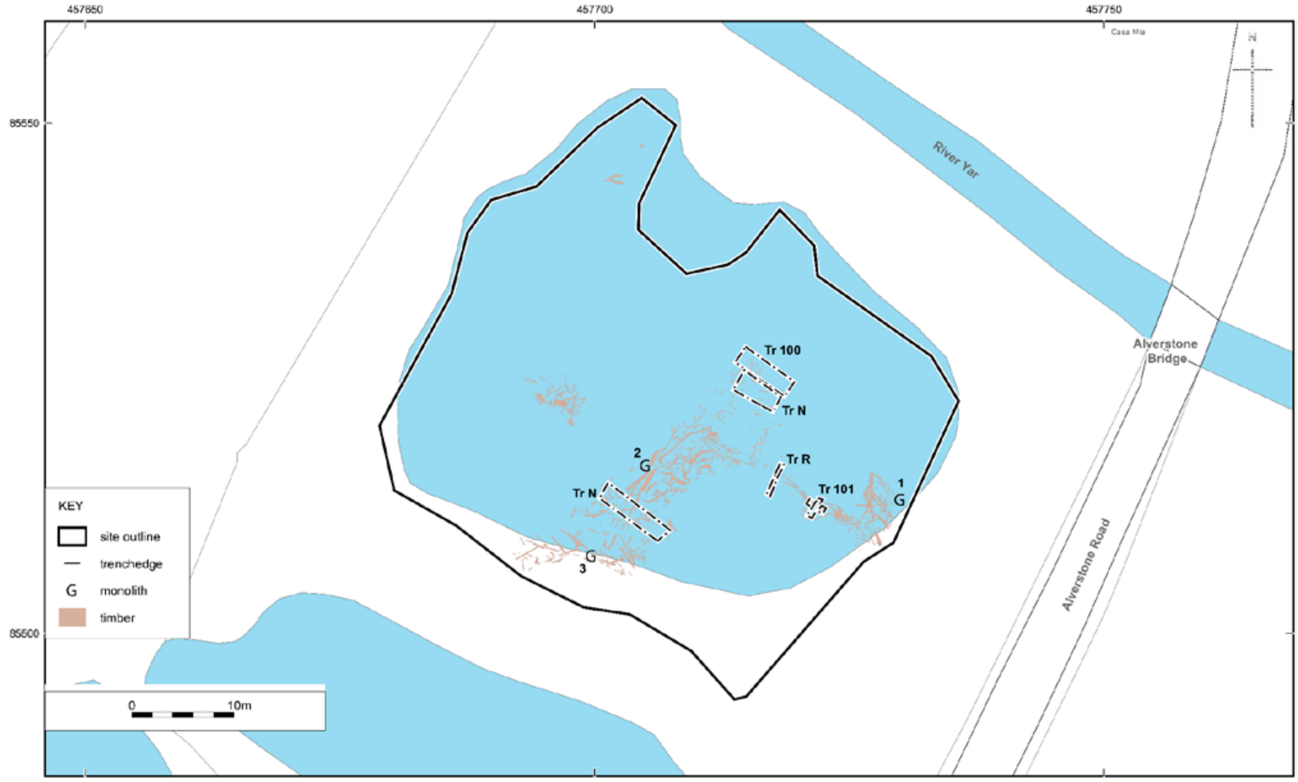

Figure 2: Site location specific: limits of the site showing the excavated timbers, monolith samples and trenches. © MOLA

The structures

A total of 18 structures were identified and numbered (Fig. 3). Apart from Structures 17 and 18, all of these were identified from vertical timbers (stakes and piles), and alignments. Horizontal timbers were not assigned to any structure number given the possibility that they had been displaced from their original position. Structure 17 is a brushwood platform to the north-west of the site and Structure 18 is a few outlying timbers to the north. Neither of these possessed vertical timbers.

Structure 1 (and 1a) - Area C

Double stake line in the south-east of the site (Area C), measuring 3.75m long by a maximum width of 1.45m. The two rows are aligned NW–SE and are *c.* 1.3m apart. Structure 1a refers to some outlying stakes further south-east.

Uprights: 436, 437, 438, 439, 440, 442, 448, 449, 457, 458, 461, 462, 463, 464, 469, 471, 474, 475, 477, 478, 479, 480, 501, 544, 548, 4000 (12 stakes).

Structure 1a denotes outlying stakes to the south-east of the south row of S1, which are potentially re-used.

Uprights: 483, 548, 895.

Structure 2 – Area C

Curvilinear feature in south-east of the site (Area C), measuring 4.65m SW–NE and 3.8m NW–SE (Fig 3). Two lines of stakes are connected with a curved corner. The NW-SE line is parallel with Structure 1.

Uprights: 424, 425, 427, 428, 430, 574, 575, 583, 595, 838, 839, 840, 841, 842, 843, 844, 845, 846, 858, 859, 860, 861, 862, 863, 889, 890, 891, 894.

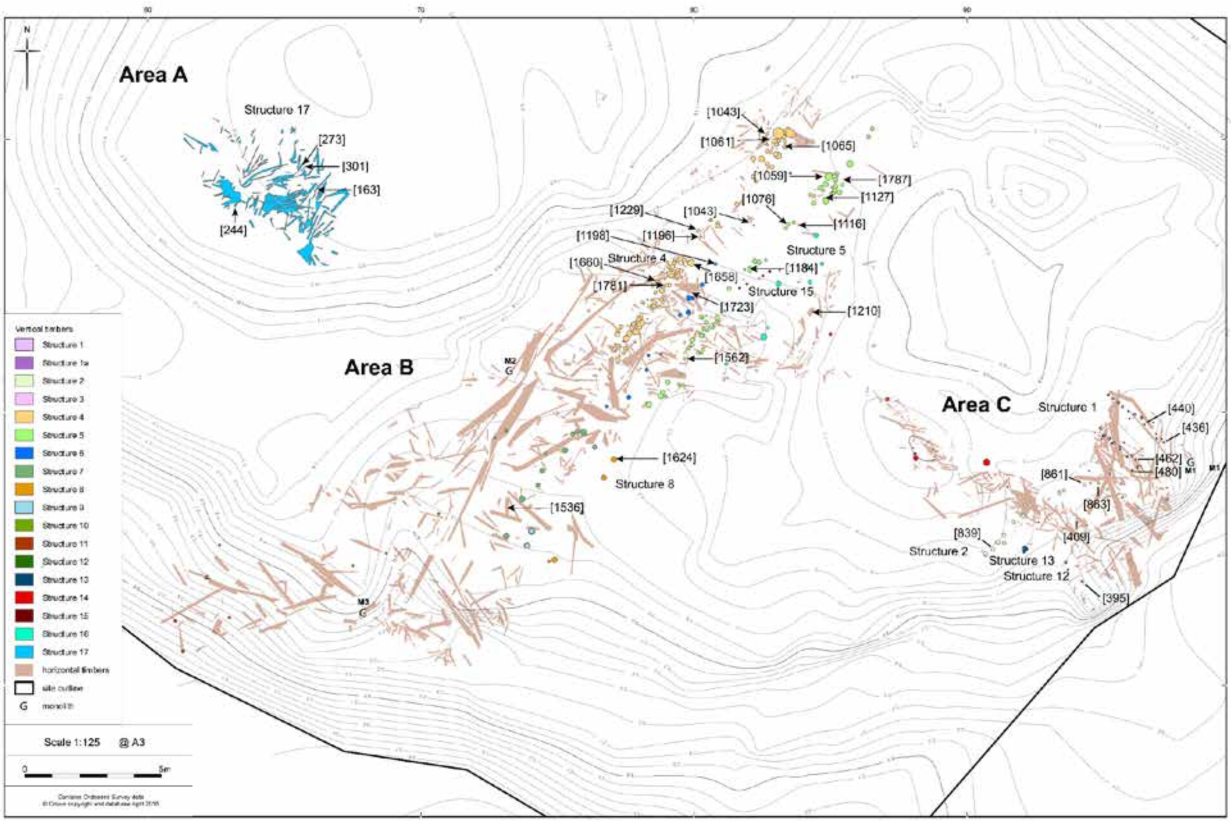

Figure 3: Contour plan of the base of excavation with timbers and sample locations. © MOLA

Structure 3 – Area C

Scatter of stakes between Structure 1 and Structure 2 (Area C), possibly related, measuring 1.45m long (Fig 3).

Uprights: 445, 446, 447, 466, 467, 505, 864.

Structure 4 – Area B

Northern line of uprights, running SW–NE, in the main causeway (see also Structure 5) (Area B). This measured 11.35m long and had a maximum width of 0.8m (Fig 3).

Uprights: 979, 1061, 1065, 1067, 1069, 1071, 1072, 1103, 1196, 1229, 1230, 1276, 1277, 1278, 1279, 1462, 1511, 1553, 1554, 1575, 1576, 1581, 1582, 1583, 1584, 1591, 1601, 1645, 1656, 1657, 1658, 1660, 1665, 1666, 1679, 1680, 1681, 1682, 1683, 1684, 1685, 1686, 1687, 1688, 1689, 1691, 1692, 1693, 1694, 1695, 1696, 1698, 1702, 1703, 1704, 1706, 1707, 1733, 1734, 1735, 1736, 1738, 1739, 1741, 1745, 1746, 1747, 1748, 1749, 1751, 1755, 1756, 1757, 1759, 1760, 1761, 1762, 1764, 1765, 1766, 1767, 1769, 1770, 1771, 1774, 1775, 1778, 1781, 1782, 1796, 1799, 1800, 1801, 1802, 1803, 1804, 1805, 1806, 1807, 1808, 1809, 1810, 1813, 1815, 1818, 1824, 1825.

Structure 5 – Area B

Southern line of uprights, running SW-NE, in the main causeway (Area B) measuring 13.10m long and with a maximum width of 0.8m (Fig 3). Structures 4 and 5 were *c.* 2m apart.

Uprights:1051, 1058, 1059, 1076, 1079, 1114, 1115, 1119, 1127, 1128, 1131, 1165, 1167, 1168, 1176, 1179, 1184, 1185, 1186, 1206, 1558, 1561, 1562, 1564, 1580, 1592, 1593, 1596, 1597, 1598, 1646, 1647, 1649, 1650, 1651, 1652, 1653, 1659, 1667, 1708, 1709, 1710, 1724, 1725, 1726, 1728, 1729, 1730, 1731, 1732, 1784, 1785, 1786, 1787, 1789, 1791, 1792, 1795, 1798, 1819, 1820, 1821, 1822, 1823, 1833, 1834, 1835, 1836, 1840.

Structure 6 – Area B

Central line of spaced-out stakes between Structures 4 and 5 (Area B), about 1m from each, running SW–NE (Fig 3). The stakes covered a line 12.35m long.

Uprights: 1111, 1198, 1200, 1412, 1523, 1589, 1599, 1654, 1655, 1662, 1677, 1720, 1790, 1815, 1827.

Structure 7 – Area B

Line of more spaced-out stakes which continue the line of Structure 4 to the south-west (Area B). They ran a length of 4.9m and were 2m away from Structure 4.

Uprights: 1540, 1615, 1616, 1618, 1626, 1637, 1638, 1642, 1669.

Structure 8 – Area B

Line of more spaced-out stakes which continue the line of Structure 5 to the south-west (Area B; Fig 3). The feature was 4.6m long and 2.1m away from Structure 5.

Uprights: 1533, 1539, 1624, 1625, 1639.

Structure 9 – Area B

Line of spaced-out stakes which continue the line of Structure 6 to the south-west Area B (Fig 3). The feature was 4.5m long and 1.4m away from Structure 6.

Uprights: 1534, 1535, 1623.

Structure 10 – Area B

Collection of uprights outside the main causeway lines to the north of Structure 7, 7.6m long (Area B; Fig 3).

Uprights: 742, 743, 991, 992, 1013, 1020, 1154, 1334.

Structure 11 – Area B

Small collection of uprights outside the main causeway lines to the south-west (Fig 3; Area B). Probably part of Structure 10 but separated. The feature was 4.2m long and a maximum of 2.2m wide. The upright timbers are more or less connected by horizontal timbers which run between them in a haphazard fashion.

Uprights:322, 323, 340, 725, 748.

Structure 12 – Area C

Ragged line of uprights running SE-NW for a length of 2.15m, to the south of Structure 2 (Fig 3; Area C). These are in alignment with Structure 14.

Uprights: 387, 388, 395, 925, 930, 932.

Structure 13 – Area C

Small group of uprights south of Structure 2, 2.5m long (Fig 3; Area C).

Uprights: 377, 378, 409, 410, 561, 573, 937.

Structure 14 – Area C

General alignment of uprights running SE–NW for 8.9m between Structure 2 and Structure 5 (Fig 3; Area C). These may relate to Structure 12.

Uprights: 348, 349, 409, 410, 561, 573, 937.

Structure 15 – Area B

A line of small stakes, 1.65m long, which are at odds with the main causeway alignment of Structure 5, being more WSW–ENE (Fig 3; Area B).

Uprights:1166, 1170, 1171, 1177, 1178, 1180.

Structure 16 – Area B

Group of uprights 5.9m long, do not form a clear line, south of Structure 5 (Fig 3; Area B).

Uprights:1118, 1158, 1159, 1160, 1161, 1163, 1172, 1173, 1181, 1332, 1557, 1643.

Structure 17 – Area A

So called ‘Brushwood platform’ to the north-west of the site (Area A), measuring 7.15m NW-SE and 3.8m SW-NE (Fig 3).

Horizontals: 1–3, 103–199, 228, 238, 240–244, 246–268 270, 271, 273–287, 289–299, 301–309, 311–314.

Structure 18

Group of seven random horizontal timbers 20m to the north of the main site area (Blanks et al. forthcoming, fig. 3).

Horizontals: 315–321.

Dendrochronology

Methodology

Twenty-three dendrochronological samples were delivered as complete or partial cross sections, wrapped in plastic (Table 1) to Dendrochronological Consultancy Ltd in 2010. It was assumed in the absence of other information that these sections were obtained from the optimum location for sapwood and bark survival from the timber. Each of these timbers was assessed for the wood type, the number of rings it contained, and whether the sequence of ring widths could be reliably resolved. For dendrochronological analysis samples usually need to be oak (*Quercus* spp.), to contain 50 or more annual rings, and the sequence needs to be free of aberrant anatomical features such as those caused by physical damage to the tree whilst it was still alive.

The apparently suitable samples (i.e. those that were oak and contained 50 or more annual rings) were then placed in a deep-freeze for at least 48 hours in order to consolidate the timber. A surface equivalent to the original horizontal plane of the parent tree was then prepared with a variety of bladed tools. This preparation revealed the width of each successive annual tree ring. Each prepared sample could then be accurately assessed for the number of rings it contained, and at this stage it was also possible to determine whether the sequence of ring widths within it could be reliably resolved.

Tree-ring dating employs the patterns of tree-growth to determine the calendar dates for the period during which the sampled trees were alive. The amount of wood laid down in any one year by most trees is determined by the climate and other environmental factors. Trees over relatively wide geographical areas can exhibit similar patterns of growth, and this enables dendrochronologists to assign dates to some samples by matching the growth pattern with other ring-sequences that have already been linked together to form reference chronologies.

Standard dendrochronological analysis methods (*see* e.g. English Heritage 1998) were applied to each suitable sample from the site. Complete or partial sequences of the annual growth rings were measured to an accuracy of 0.01mm using a micro-computer based travelling stage. Cross-correlation algorithms (e.g. Baillie and Pilcher 1973) were employed to search for positions where the ring sequences were highly correlated. The ring sequences with highly correlated positions were, in addition, plotted on the computer screen, or onto semi-log graph paper, to allow visual comparisons to be made, this providing a measure of quality control identifying any potential errors in the measurements. Where such matching positions were satisfactory, new composite sequences were constructed from the synchronised sequences. Any *t*-values reported below were 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 need to have been obtained from a range of independent sequences, and that these positions were supported by satisfactory visual matching.

Table 1: Samples submitted for dendrochronological assessment/analysis

Structure number	Wood Number	Species ID	Type	Reuse	Conversion
5	1115	*Quercus* spp.	Pile	N	Tangential
-	1211	*Quercus* spp.	Pile	N	Whole
-	1435	*Quercus* spp.	Pile	N	Whole
-	1542	*Quercus* spp.	Offcut	N	Radial
8	1639	*Quercus* spp.	Pile	N	Whole
4	1645	*Quercus* spp.	Pile	N	Whole
-	496	*Alnus* spp.	Log end	N	Whole
S17	5	*Quercus* spp.	Horizontal	Y	Radial
Horizontal, NE end S4	1043	*Quercus* spp.	Horizontal	N	Tangential
4	1065	*Quercus* spp.	Pile	Y	Box half
5	1076	*Quercus* spp.	Horizontal	N	Radial
5	1116	*Quercus* spp.	Stake	N	Radial
5	1127	*Quercus* spp.	Debris	N	Radial
5	1184	*Quercus* spp.	Pile	N	Radial
6	1198	*Quercus* spp.	Pile	N	Radial
Horizontal, no structure	1210	*Quercus* spp.	Offcut	N	Radial
4	1229	*Quercus* spp.	Pile	N	Radial
Horizontal, S end S7	1536	*Quercus* spp.	Pile	N	Radial
8	1624	*Quercus* spp.	Pile	N	Radial
4	1660	*Quercus* spp.	Stake	N	Radial
Horizontal, 4 or 6	1723	*Quercus* spp.	Pile	N	Radial
Horizontal, no structure	1852	*Quercus* spp.	Pile	N	Radial
Horizontal, no structure	5001	-	-	-	-

Not every tree can be correlated by the statistical tools or the visual examination of the graphs. There are thought to be a number of reasons for this: genetic variations, site-specific issues (for example a tree growing in a stream bed will be less responsive to rainfall), or some traumatic experience in the tree’s lifetime, such as injury by pollarding, defoliation events by caterpillars, or similar. These could each produce a sequence dominated by a non-climatic signal. Experimental work with modern trees shows that 5–20% of all oak trees, even when enough rings are obtained, cannot be reliably cross-matched.

Converting the date obtained for a tree-ring sequence into a useful date requires a record of the nature of the outermost rings of the sample. If bark or bark-edge survives, a felling date precise to the year or season can be obtained. If no sapwood survives, the date obtained from the sample gives a *terminus post quem* for its use. If some sapwood survives, an estimate for the number of missing rings can be applied to the end-date of the heartwood. This estimate is quite broad and varies by region. This report uses a range of 10–46 rings for the local English material from Alverstone (English Heritage 1998, 11; Arnold et al. 2019, fig 9). The BC scale used by dendrochronologists, and as used in this report, has no year zero, the year 1 BC immediately precedes the year AD 1

Results

The material comprised 22 oak (*Quercus* spp.) samples and one alder (*Alnus* spp.) sample. After their preparation it was determined that 16 of the oak samples contained measurable sequences, the remaining six oaks (samples 1115, 1211, 1435, 1542, 1639 and 1645) either contained too few rings or aberrant bands of narrow growth, and the alder (sample 496) is of a type of wood which is generally unsuitable for reliable tree-ring analysis. The details of the 16 suitable oak samples are provided in Table 2. Compared with most archaeological assemblages the material was slow growing and many samples contained sections with aberrantly narrow growth, several contained repeated series of narrow growth bands. The 16 suitable samples were each measured successfully, yielding 16 separate tree-ring series (Table 2; Appendix 1). Three groups of material were identified that cross-matched each other, randomly labelled Clusters 1–3 (see Tables 3–5 and Figs 4–6 inclusive). None of the clusters, nor the remaining six samples have produced tree-ring sequences that match to reference data, and all the samples are currently undated by dendrochronology.

Table 2: Details of the 16 measurable oak (*Quercus* spp.) dendrochronological samples

Structure number	**Wood Number**	**Rings**	**Sapwood**	**AGR (mm)**	**Date of measured sequence**	**Cross-matching results**
S17	5	171	-	0.94	undated	1–171[3]
Horizontal, NE end S4	1043	69	-	1.26	undated	-
S4	1065	79	-	1.35	undated	-
S5	1076	58	-	2.19	undated	11–68[2]
S5	1116	86	15+Bs	0.76	undated	-
S5	1127	108	-	0.70	undated	−6–101[1]
S5	1184	92	-	1.28	undated	6–97[2]
S6	1198	157	-	1.03	undated	71–227[3]
Horizontal, no structure	1210	124	-	1.46	undated	72–195[3]
S4	1229	114	-	1.38	undated	-
Horizontal, S end S7	1536	94	-	1.51	undated	1–94[2]
S8	1624	107	14	1.28	undated	2–108[2]
S4	1660	106	-	0.79	undated	-
Horizontal, S4 or S6	1723	50	-	1.46	undated	-
Horizontal, no structure	1852	81	H/S?	1.52	undated	13–93[2]
Horizontal, no structure	5001	112	-	0.69	undated	1–112[1]

Key: AGR average growth rate; +Bs incomplete outermost ring, early spring felled; H/S? possible heartwood/sapwood boundary. The cross-matching results are relative years within the undated Cluster to which the sample belongs (indicated by the superscript numbers [1 2 3]).

Table 3: The *t*-value (Baillie and Pilcher 1973) between the two matched samples forming Cluster 1

	5001
1127	6.72

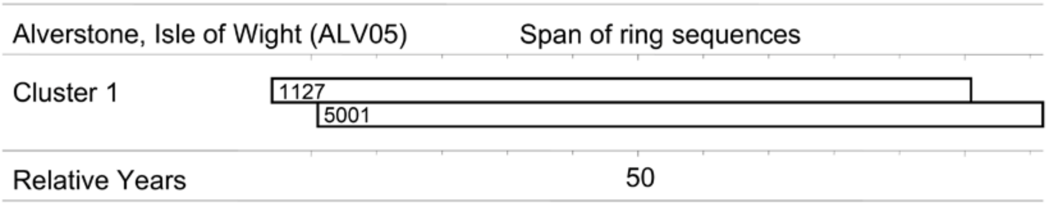

Figure 4: Bar diagram showing the relative positions of the two matched tree-ring samples forming Cluster 1. Scale is relative years and the datum year is arbitrary and unrelated to those of Figures 5 and 6. KEY; oak heartwood (white bars).

Table 4: The *t*-values (Baillie and Pilcher 1973) between the four matched samples forming Cluster 2. Value in bold indicates the same tree.

	1184	**1536**	**1624**	**1852**
1076	3.84	6.25	3.95	5.48
1184	-	8.65	9.46	7.09
1536	-	-	8.87	**13.62**
1624	-	-	-	7.91

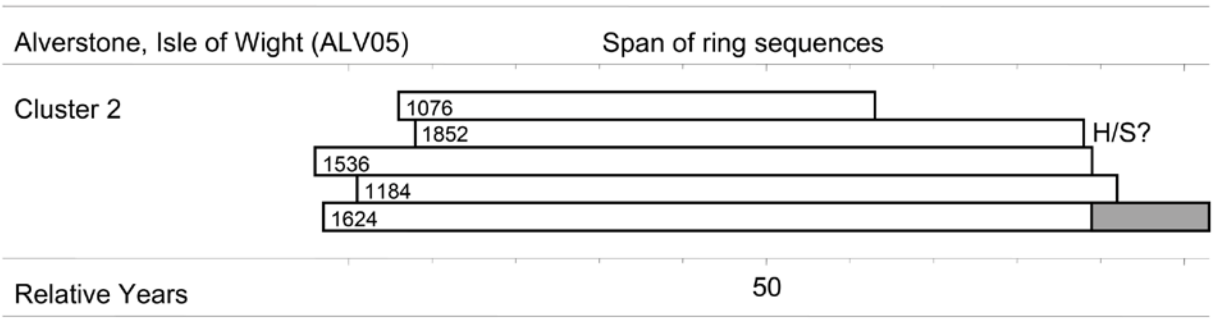

Figure 5: Bar diagram showing the relative positions of the five matched tree-ring samples forming Cluster 2. Scale is relative years and the datum year is arbitrary and unrelated to those of Figures 4 and 7. KEY; oak heartwood (white bars).

Table 5: The *t*-values (Baillie and Pilcher 1973) between the three matched samples forming Cluster 3

	1198	**1210**
5	6.82	4.83
1198		6.11

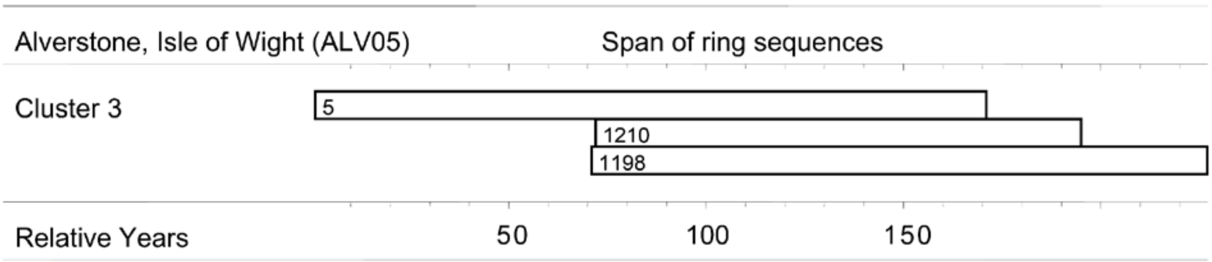

Figure 6: Bar diagram showing the relative positions of the three matched tree-ring samples forming Cluster 3. Scale is relative years and the datum year is arbitrary and unrelated to those of Figures 1 and 2. KEY; oak heartwood (white bars).

Radiocarbon Dating

Thirty-five radiocarbon measurements have been undertaken on samples from Alverstone, 29 measurements on samples from 22 timbers, and six measurements on samples of waterlogged plant material from three of the monolith tins.

Laboratory Methods

Eleven samples of waterlogged wood were dated at the Scottish Universities Environmental Research Centre (SUERC-) in 2010, and two more samples of waterlogged wood and a waterlogged plant macrofossil were dated there in 2013. These samples were pretreated as described by Stenhouse and Baxter (1983) with the CO_2 obtained from the pre-treated samples combusted in pre-cleaned sealed quartz tubes (Vandeputte et al. 1996) and then converted to graphite (Slota et al. 1987). The samples were dated by Accelerator Mass Spectrometry (AMS) as described by Freeman et al. (2010).

Two samples of waterlogged wood and two samples of bulked waterlogged plant macrofossils were dating at the ^{14}CHRONO Centre, the Queen's University Belfast (UBA-), in 2013. These were processed using an acid-alkali-acid pre-treatment as first outlined in Vries and Barendsen (1952). The pretreated and dried samples were placed in quartz tubes with a strip of silver ribbon to remove nitrates, chlorides, and CuO. The samples were then sealed under vacuum and combusted to CO_2 overnight at 850°C. The CO_2 was converted to graphite on an iron catalyst using the zinc reduction method (Vogel et al. 1984). The graphite samples were analysed with a 0.5MeV NEC pelletron compact accelerator (Reimer et al. 2015).

Ten samples of waterlogged wood were dated at the Oxford Radiocarbon Accelerator Unit (OxA-) in 2010. These were pre-treated using a standard acid/base/acid method followed by an additional bleaching step (Brock et al. 2010) and measured by AMS as described by Bronk Ramsey et al. (2004).

Eight samples of waterlogged wood were dated at the Centre for Isotope Research, University of Groningen, the Netherlands (GrM-) in 2023–4. Each single tree-ring was converted to α-cellulose using an intensified aqueous pretreatment (Dee et al. 2020) and combusted in an elemental analyser (IsotopeCube NCS), coupled to an Isotope Ratio Mass Spectrometer (Isoprime 100). The resultant CO_2 was graphitised by hydrogen reduction in the presence of an iron catalyst (Wijma et al. 1996; Aerts-Bijma et al. 1997). The graphite was then pressed into aluminium cathodes and dated by AMS (Synal et al. 2007; Salehpour et al. 2016). Data reduction was undertaken as described by Wacker et al. (2010).

All four radiocarbon laboratories maintain continual programme of quality assurance procedures (e.g. Aerts-Bijma et al. 2021), in addition to participation in international inter-comparisons (Scott et al. 2010; Scott et al. 2017; Wacker et al. 2020). These tests indicate no laboratory offsets and demonstrate the reproducibility and accuracy of these measurements.

Radiocarbon and Stable Isotope Results

The results are conventional radiocarbon ages, corrected for fractionation (Stuiver and Polach 1977; Tables 6–14 and 19–20). Age calculation has been undertaken using $\delta^{13}C$ values measured by AMS, except at SUERC where the values obtained by Isotope Ratio Mass Spectrometry (IRMS) were used. The quoted $\delta^{13}C$ values are those measured by IRMS as these more accurately reflect the natural isotopic composition of the sampled plant material.

Radiocarbon Calibration

Radiocarbon calibration has been undertaken using the IntCal20 calibration curve (Reimer et al. 2020) and the probability method (Stuiver and Reimer 1993). These are the probability distributions shown in outline in Figures 7–14 and 17–18, and in black in Figures 15–16 and 25–26.

Chronological Modelling

The chronological modelling described below has been undertaken using OxCal 4.4 (Bronk Ramsey 1995; 2009; Bronk Ramsey et al. 2001). The models are defined by the OxCal CQL2 keywords and by the brackets on the left-hand side of Figures 7–14 and 18–19. In these diagrams, calibrated radiocarbon dates (Stuiver and Reimer 1993) are shown in outline and the posterior density estimates produced by the chronological modelling are shown in solid black. The Highest Posterior Density intervals which describe the posterior distributions are given in italics and have been rounded as outlined in Bayliss and Marshall (2022, §1.5).

The CQL2 code for the models presented in provided in Appendix 2.

Structure 1

Four timbers [436], [440], [462], and [480] were dated from Structure 1 (Table 6). The four radiocarbon determinations from this group (OxA-23587, OxA-23668, SUERC-32338 and

SUERC-32342) are not statistically consistent at the 5% significance level (T'=193.5; v=3; T'(5%)=7.8; Ward and Wilson 1978).

Table 6: Radiocarbon and associated stable isotope measurements from Structure 1 (Area C)

Laboratory number	Sample identifier & timber description	Material	d^{13}C$_{IRMS}$ (‰)	Radiocarbon age (BP)
OxA-23587	Timber [436]: roundwood stake end (160mm length × 35mm diameter)	Waterlogged wood: alder sapwood, last 2–3 rings to bark-edge	−26.8±0.2	1592±30
SUERC-32338	Timber [440]: roundwood stake, chisel end (160mm length × 31mm diameter)	Waterlogged wood, alder sapwood, outer rings	−28.5±0.2	1135±30
OxA-23668	Timber [462]: roundwood stake with chisel end (320mm length × 40mm diameter)	Waterlogged wood: sweet chestnut, sapwood, outer 2 rings	−27.4±0.2	1133±22
SUERC-32342	Timber [480]: roundwood stake, tapering branch, chisel end (362mm length × 35mm diameter)	Waterlogged wood: sweet chestnut sapwood, outer 2–3 rings	−25.8±0.2	1125±30

The result from Timber [436] (OxA-23587) dates to the middle of the first millennium cal AD, while the remaining three results date to nearer the end of that millennium. This suggests that either [436] was a timber re-used from an earlier structure, or that there are multiple phases of construction and repair to Structure 1 that span, or are separated by, nearly half a millennium. Given it seems unlikely that a structure would be maintained for almost 500 years in such a dynamic environment, we have decided to exclude the measurement (OxA-23587) on Timber [436] from model shown in Figure 7.

The model for Structure 1 shown in Figure 7 provides an estimate for its construction of *cal AD 890–995* (*95% probability*; *BuildStructure1*; Fig. 7) probably *cal AD 925–980* (*68% probability*).

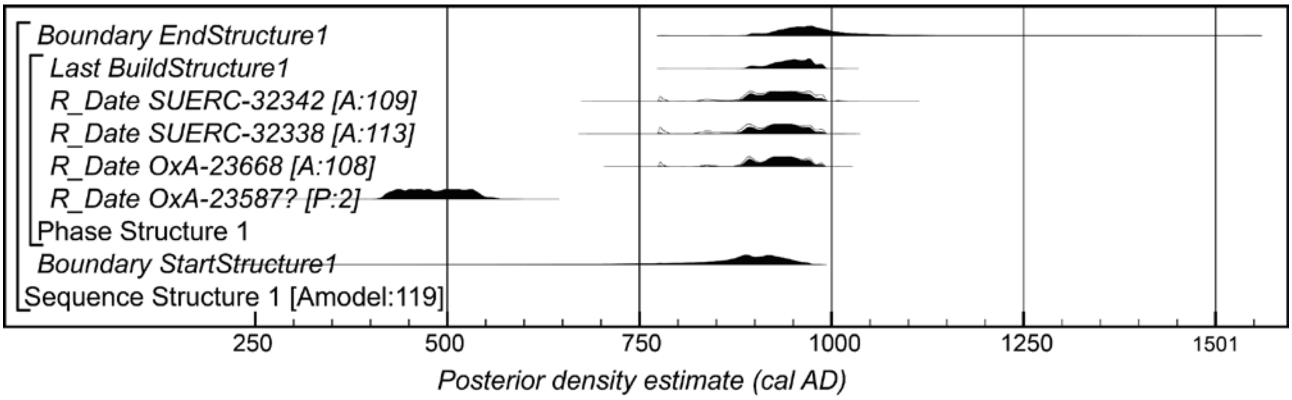

Figure 7: Probability distributions of dates from Structure 1. Each distribution represents the relative probability that an event occurs at a particular time. For each of the dates two distributions have been plotted: one in outline, which is the result of simple radiocarbon calibration, and a solid one, based on the chronological model used. Distributions other than those relating to particular samples correspond to aspects of the model. For example, the distribution 'BuildStructure1' is the estimated date when Structure 1 was built. The large square brackets down the left-hand side along with the OxCal keywords define the overall model exactly.

Structure 2

Three timbers [839], [861], and [863] were sampled from Structure 2. The three radiocarbon measurements from this structural group (OxA-23669–70 and SUERC-32343; Table 7) are statistically consistent at the 5% significance level (T'=3.8; v=2; T'(5%)=6.0; Ward and Wilson 1978) and could therefore be of the same actual age.

Table 7: Radiocarbon and associated stable isotope measurements from Structure 2 (Area C)

Laboratory number	**Sample identifier & timber description**	**Material**	**$d^{13}C_{IRMS}$ (‰)**	**Radiocarbon age (BP)**
OxA-23669	Timber [839]: roundwood stake, side branches trimmed, cut to point (290mm length × 60mm diameter)	Waterlogged wood: alder sapwood, outer 5–7 rings to bark-edge	−27.5±0.2	1143±23
SUERC-32343	Timber [861]: roundwood stake axe-cut to point (280mm length × 50mm diameter)	Waterlogged wood: alder, sapwood, outer 5–10 rings to bark-edge	−27.9±0.2	1195±30
OxA-23670	Timber [863]: roundwood stake, axe-cut to point (290mm length × 60mm diameter)	Waterlogged wood, alder sapwood, outer 2 rings to bark-edge	−26.4±0.2	1203±23

The model for Structure 2 shown in Figure 8 provides an estimate for its construction of *cal AD 780–795* (*2% probability*; *BuildStructure2*; Fig. 8) or *cal AD 820–980* (*93% probability*) probably *cal AD 835–905* (*49% probability*) or *cal AD 920–950 (19% probability)*.

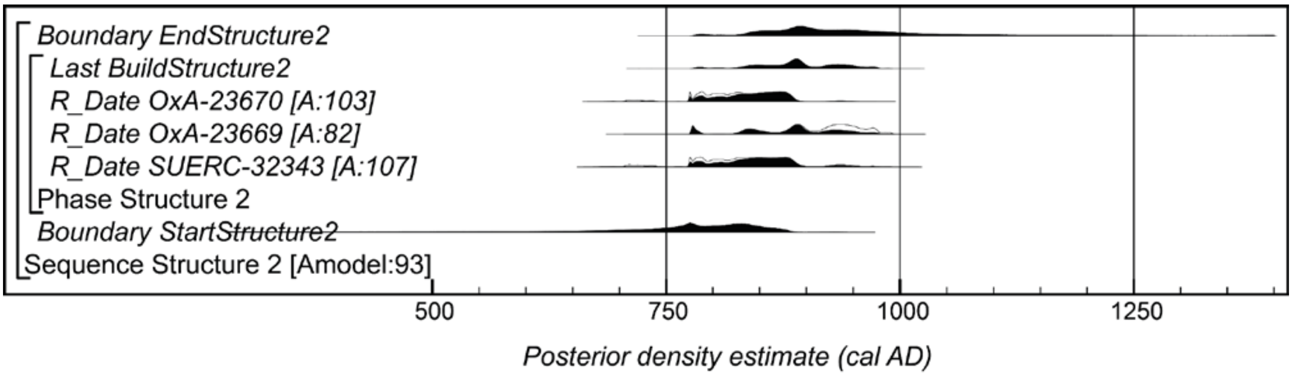

Figure 8: Probability distributions of dates from Structure 2. The overall format is identical to Figure 7. The large square brackets down the left-hand side along with the OxCal keywords define the overall model exactly.

Structure 4

Four timbers [1061], [1196], [1658], and [1781] were sampled from Structure 4 in 2010. The four results (OxA-23671, OxA-23673 and SUERC-32345–6; Table 8) from this group are statistically consistent at the 5% significance level (T'=4.3; v=3; T'(5%)=7.8) and could therefore all be of the same actual age. Given the importance of providing a more precise date for the sweet chestnut timbers from the site a series of samples from timber [1781] were submitted for radiocarbon wiggle-matching in 2023.

Table 8: Radiocarbon and associated stable isotope measurements from Structure 4 (Area B)

Laboratory number	Sample identifier & timber description	Material	$d^{13}C_{IRMS}$ (‰)	Radiocarbon age (BP)
SUERC-32346	Timber [1658]: roundwood pile, cut to point, tool marks (1.2m length × 130mm diameter)	Waterlogged wood: sweet chestnut sapwood, outer 3–4 rings to bark-edge	−26.0±0.2	1550±30
OxA-23673	Timber [1781]: pile, cut to point, knotty (1.1m length × 160mm diameter)	Waterlogged wood: sweet chestnut towards the outer edge of the timber	−26.2±0.2	1513±24
GrM-33107	As OxA-23673	Waterlogged wood: sweet chestnut heartwood, ring 1	−24.2±0.15	1520±19
GrM-33108	As OxA-23673	Waterlogged wood: sweet chestnut heartwood, ring 5	−25.8±0.15	1531±20
GrM-33109	As OxA-23673	Waterlogged wood: sweet chestnut heartwood, ring 9	−27.3±0.15	1552±20
GrM-33110	As OxA-23673	Waterlogged wood: sweet chestnut sapwood, ring 12	−26.9±0.15	1519±19
OxA-23671	Timber [1061]: roundwood stake, end cut to point, top crotch end Y shaped (1.17m length × 85mm diameter)	Waterlogged wood: sweet chestnut, sapwood	−25.5±0.2	1477±24
SUERC-32345	Timber [1196]: pile, axe-trimmed end, side branches cut (1.2m length × 120mm diameter)	Waterlogged wood: oak sapwood, outer 2 rings	−27.6±0.2	1535±30

Figure 9 illustrates the radiocarbon wiggle-match model for timber [1781]. This model incorporates the gaps between each dated annual ring known from tree-ring counting (e.g. that the carbon in ring 1 of the measured tree-ring series (GrM-33107) was laid down 4 years before the carbon in ring 5 of the tree ring series (GrM-33108) with the radiocarbon measurements (Table 8).

The model has good overall agreement (Acomb: 141.1; An: 35.4, n: 4; Fig. 9), with all four radiocarbon dates having good individual agreement (A > 60; Fig. 9). It suggests that the final ring of timber [1781] formed in *cal AD 550–580* (*95% probability*; *GrM-33110*; Fig. 9), probably in *cal AD 555–570* (*68% probability*).

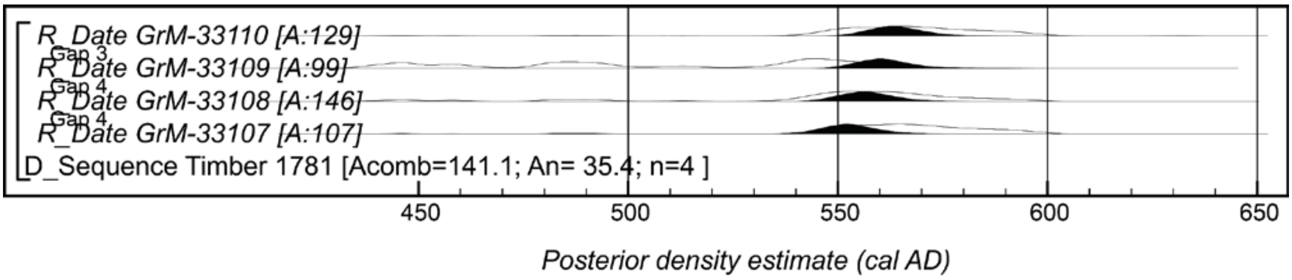

Figure 9: Probability distributions of dates from timber [1781]. Each distribution represents the relative probability that an event occurs at a particular time. For each of the dates two distributions have been plotted: one in outline, which is the simple radiocarbon calibration, and a solid one, based on the wiggle-match sequence. The large square brackets down the left-hand side along with the OxCal keywords defines the overall model exactly.

Although we do not know exactly which ring(s) from timber [1781] were dated in 2010 (Table 8) they must be older than the outer ring of the timber dated in 2023 (GrM-33110). The model shown in Figure 10 that includes this information has good overall agreement (Amodel: 87) although it does not further refine the estimate for the formation of the last ring of the timber.

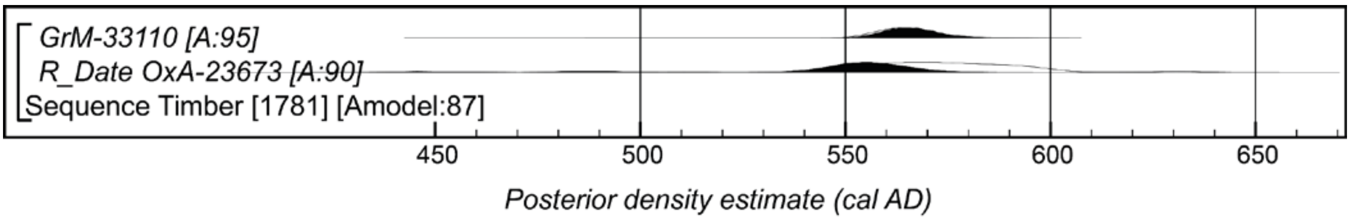

Figure 10: Probability distributions of dates from timber [1781]. The overall format is identical to Figure 7. The large square brackets down the left-hand side along with the OxCal keywords define the overall model exactly.

The model for Structure 4 is shown in Figure 11. This includes the posterior distribution for the formation of the final ring of timber [1781] derived from the model illustrated in Figure 9 and suggests that Structure 4 was constructed in *cal AD 550–595* (*95% probability*; *BuildStructure4*; Fig. 11), probably in *cal AD 555–575* (*68% probability*).

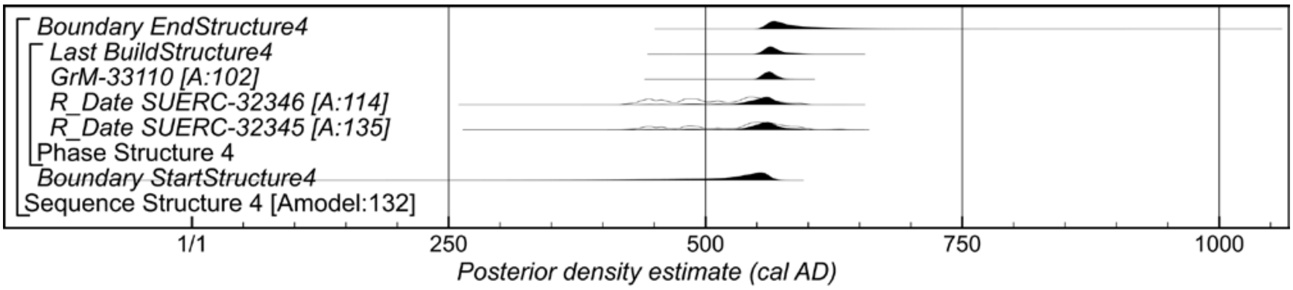

Figure 11: Probability distributions of dates from Structure 4. The overall format is identical to Figure 7. The large square brackets down the left-hand side along with the OxCal keywords define the overall model exactly.

Structure 5

Three timbers [1562], [1059], [1787] were sampled from Structure 5 in 2010 (Table 9). The three results (OxA-23672, SUERC-32344 and SUERC-32347) from this group are statistically consistent at the 5% significance level (T'=0.0; v=2; T'(5%)=6.0) and could therefore all be of the same actual age.

Table 9: Radiocarbon and associated stable isotope measurements from Structure 5 (Area B)

Laboratory number	Sample identifier & timber description	Material	$d^{13}C_{IRMS}$ (‰)	Radiocarbon age (BP)
OxA-23672	Timber [1562]: pile, reused structural timber, 2 augered holes are fixings for previous use, cut to point (1.3m length × 110mm diameter)	Waterlogged wood: sweet chestnut sapwood, outer 2-3 rings to bark-edge	−26.7±0.2	1480±23
SUERC-32344	Timber [1059]: pile, top end battered (hammered), cut to point but broken, 2 side branches cut off (1.13m length × 140mm diameter)	Waterlogged wood: sweet chestnut sapwood, outer 2–4 rings to bark-edge	−25.8±0.2	1495±30
SUERC-32347	Timber [1787]: roundwood stake, tapering, cut to point, cut facets along entire length (590mm length × 27mm diameter)	Waterlogged wood: sweet chestnut sapwood, 2 rings probably whole growth	−26.9±0.2	1490±30

The model for Structure 5 shown in Figure 12 provides an estimate for its construction of *cal AD 565–645* (*95% probability*; *BuildStructure5*; Fig. 12) probably of *cal AD 575–610* (*68% probability*).

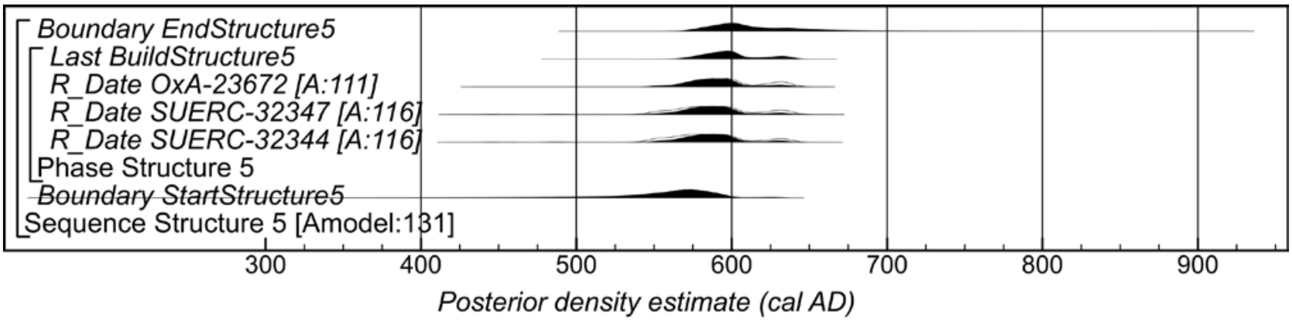

Figure 12: Probability distributions of dates from Structure 5. The overall format is identical to Figure 7. The large square brackets down the left-hand side along with the OxCal keywords define the overall model exactly.

Structure 8

A single sample was dated in 2010 from timber [1624], which forms part of Structure 8 (Table 10). This timbers forms part of Cluster 2, the five-timber undated tree-ring chronology (see above Fig. 5). Figure 13 illustrates the chronological model for timber [1624] that provides an estimate for formation of the last ring of timber [1624] of *965–950 cal BC* (*1% probability*; *Timber1624Ring107*; Fig. 13) or *925–805 cal BC* (*94% probability*) probably of *900–825 cal BC* (*68% probability*).

Table 10: Radiocarbon and associated stable isotope measurements from Structure 8 (Area B).

Laboratory number	**Sample identifier & timber description**	**Material**	**d^{13}C (‰)**	**Radiocarbon age (BP)**
SUERC-32929	Timber [1624]: pile, radially cleft conversion, slow grown, cut to point (1.2m length × 110mm diameter)	Waterlogged wood: oak, sapwood, rings 98–107 of relative chronology	−22.6±0.2	2735±30

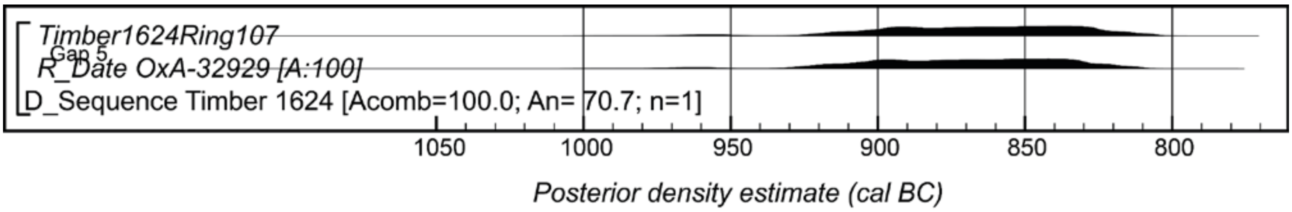

Figure 13: Probability distributions of dates from timbers [1624]. The overall format is identical to Figure 9. The large square brackets down the left-hand side along with the OxCal keywords defines the overall model exactly.

Although timber [1624] does not have complete sapwood (Table 2), it does retain 14 sapwood rings. We can estimate the felling date of this timber by adding the probability distribution of the expected number of sapwood rings in ancient oak timbers from England (Arnold et al. 2019, fig 9) to the estimated date of the last ring of this timber. For timber [1624] we apply this probability distribution truncated to allow for the surviving sapwood rings (Bayliss and Tyers 2004, 960–1). This analysis suggests the timber was felled in *960–940 cal BC* (*1% probability*; *Timber1624Felling*; Fig. 14) or *925–790 cal BC* (*94% probability*), probably in *890–815 cal BC* (*68% probability*).

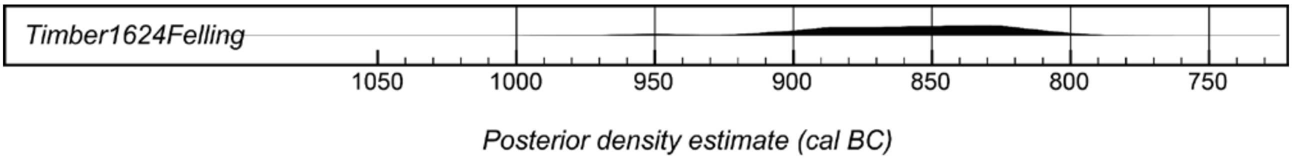

Figure 14: Probability distribution estimating the felling date of timber [1624].

Timber [1624] and the others that formed Cluster 2 ([1184], [1536], [1852] and [1076] were all thought stylistically to be Saxo-Norman in date, and it therefore seems probable that they simply represent reused material especially given they form part of more than one structure (Table 2; Fig. 3).

Structure 12

A single timber, [395], has been dated from Structure 12 (Table 11). This provides an estimate for its construction of cal AD 995–1150 (95% probability; Fig. 15).

Table 11: Radiocarbon and associated stable isotope measurements from Structure 12 (Area B)

Laboratory number	Sample identifier & timber description	Material	d13C (‰)	Radiocarbon age (BP)
OxA-23667	Timber [395]: roundwood stake, end trimmed to point (420mm length × 32mm diameter)	Waterlogged wood: sweet chestnut, sapwood, outer 4–5 rings to bark-edge	−25.5±0.2	996±24

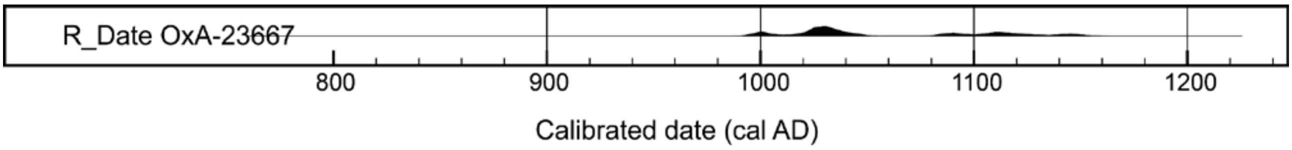

Figure 15: Probability distribution of the date of timber [395]. The distribution is the result of simple radiocarbon calibration (Stuiver and Reimer 1993).

Structure 13

A single timber, [409], has been dated from Structure 13 (Table 12). This provides an estimate for its date of construction of cal AD 775–980 (95% probability; Fig. 16).

Table 12: Structure 13 radiocarbon and associated stable isotope measurements

Laboratory number	Sample identifier & timber description	Material	d13C (‰)	Radiocarbon age (BP)
SUERC-32337	Timber [409]: roundwood with bark (105mm length × 34mm diameter)	Waterlogged wood: willow/poplar, sapwood, last 2 rings to bark-edge	−30.6±0.2	1155±30

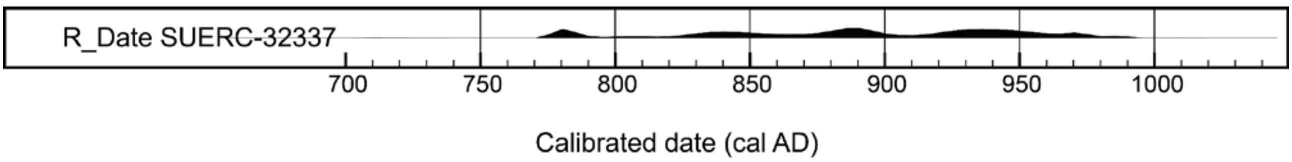

Figure 16: Probability distribution of the date of timber [409]. The distribution is the result of simple radiocarbon calibration (Stuiver and Reimer 1993).

Structure 15

Given the importance of providing a more precise date for the sweet chestnut timbers from the site, a series of samples from timber [1178] that formed part of Structure 15 were submitted for radiocarbon wiggle-matching (Table 13).

Table 13: Radiocarbon and associated stable isotope measurements from Structure 15 (Area B)

Laboratory number	Sample identifier & timber description	Material	$d^{13}C_{IRMS}$ (‰)	Radiocarbon age (BP)
GrM-34752	Timber [1178] pile, whole, side branches cut, end tapered to pencil point (1.2m length × 115mm diameter)	Waterlogged wood: chestnut heartwood, ring 1	−23.7±0.15	1536±17
GrM-33103	As GrM-34752	Waterlogged wood: chestnut heartwood, ring 5	−23.9±0.15	1492±19
GrM-33105	As GrM-34752	Waterlogged wood: chestnut heartwood, ring 9	−25.3±0.15	1571±19
GrM-33106	As GrM-34752	Waterlogged wood: chestnut sapwood, ring 12	−24.6±0.15	1546±19

Figure 17 illustrates the chronological model for timber [1178]. This model incorporates the gaps between each dated annual ring known from tree-ring counting (e.g. that the carbon in ring 1 in measured tree-ring series (GrM-34752) was laid down 4 years before the carbon in ring 5 of the tree ring series (GrM-33103) with the radiocarbon measurements (Table 9). Two further sapwood rings were present on this timber beyond the sapwood ring dated by GrM-33106.

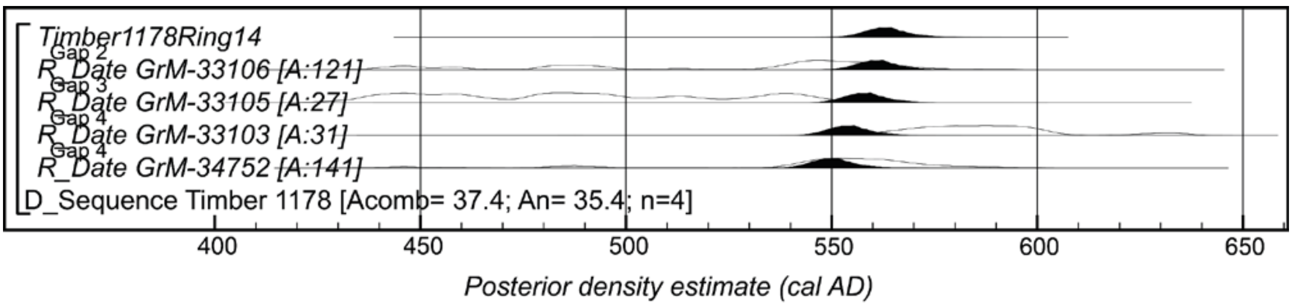

Figure 17: Probability distributions of dates from timber [1178]. The overall format is identical to Figure 9. The large square brackets down the left-hand side along with the OxCal keywords define the overall model exactly.

The model has good overall agreement (Acomb: 37.4; An: 35.4, n: 4; Fig. 17), although two of the radiocarbon dates have poor individual agreement (A < 60; GrM-33103 (A:31) and GrM-33105 (A:27); Fig. 17). It suggests that the final ring of timber [1178] formed in *cal AD 550–580* (*95% probability*; *Timber1178Ring14*; Fig. 17), probably in *cal AD 555–570* (*68% probability*).

Structure 17

Fours timbers from Structure 17 were submitted for radiocarbon dating ([163], [244], [273], and [301]). The results (OxA-23665–23666 and SUERC-32335–32336; Table 13) are statistically consistent at the 5% significance level (T'=6.2; v=3; T'(5%)=7.8) and could be the same actual age. This suggests that they could have been cut down at the same time or within a very short period.

The model for Structure 17 shown in Figure 18 provides an estimate for its construction of *cal AD 535–610* (*95% probability*; *BuildStructure17*; Fig. 18) probably of *cal AD 550–590* (*68% probability*).

Table 14: Structure 17 radiocarbon and associated stable isotope measurements

Laboratory number	**Sample identifier & timber description**	**Material**	**d^{13}C$_{IRMS}$ (‰)**	**Radiocarbon age (BP)**
OxA-23665	Timber [163]: roundwood stake with chisel end and Y-crotch top, L. 995mm Diam. 45mm	Waterlogged wood: alder, sapwood, outer 3–5 rings to bark-edge	−27.7±0.2	1506±24
SUERC-32335	Timber [244]: roundwood stake with chisel end and Y-crotch top, L. 995mm Diam. 45mm	Waterlogged wood, alder, sapwood, outer 3–5 rings to bark-edge	−30.0±0.2	1540±30
OxA-23666	Timber [273]: roundwood, frequent side branches, L. 220mm, Diam. 46mm	Waterlogged wood, alder, sapwood, outer 2–3 rings to bark-edge	−27.5±0.2	1588±23
SUERC-32336	Timber [301]: roundwood, side branch torn from main stem, L. 165mm, Diam.19mm	Waterlogged wood: alder, sapwood, outer 2–3 rings to bark-edge	−27.9±0.2	1540±30

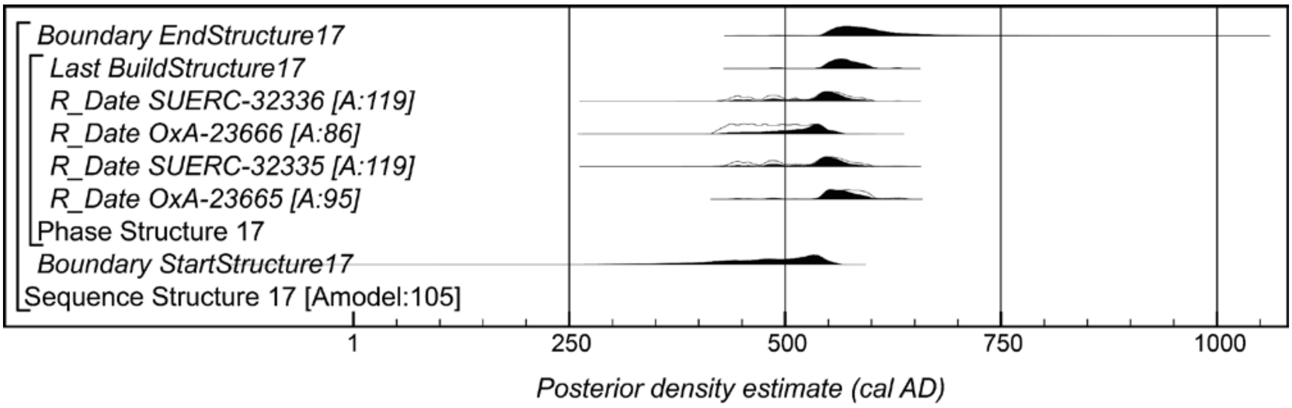

Figure 18: Probability distributions of dates from Structure 17. The overall format is identical to Figure 7. The large square brackets down the left-hand side along with the OxCal keywords define the overall model exactly.

Discussion

The chronology of the wooden structures

The main causeway/weir structure in Area B aligned south-west to north-east across the site is estimated to have been constructed in *cal AD 550–570* (*95% probability*; *FirstAreaB*; Fig. 19) probably in *cal AD 555–560* (*68% probability*). The main causeway/weir structure is likely (*67.9% probability*; Table 16) to pre-date the brushwood platform, Structure 17 in Area A (Fig. 3), that was constructed in *cal AD 535–610* (*95% probability*; *BuildStructure17*; Fig. 19) probably *cal AD 550–590* (*68% probability*).

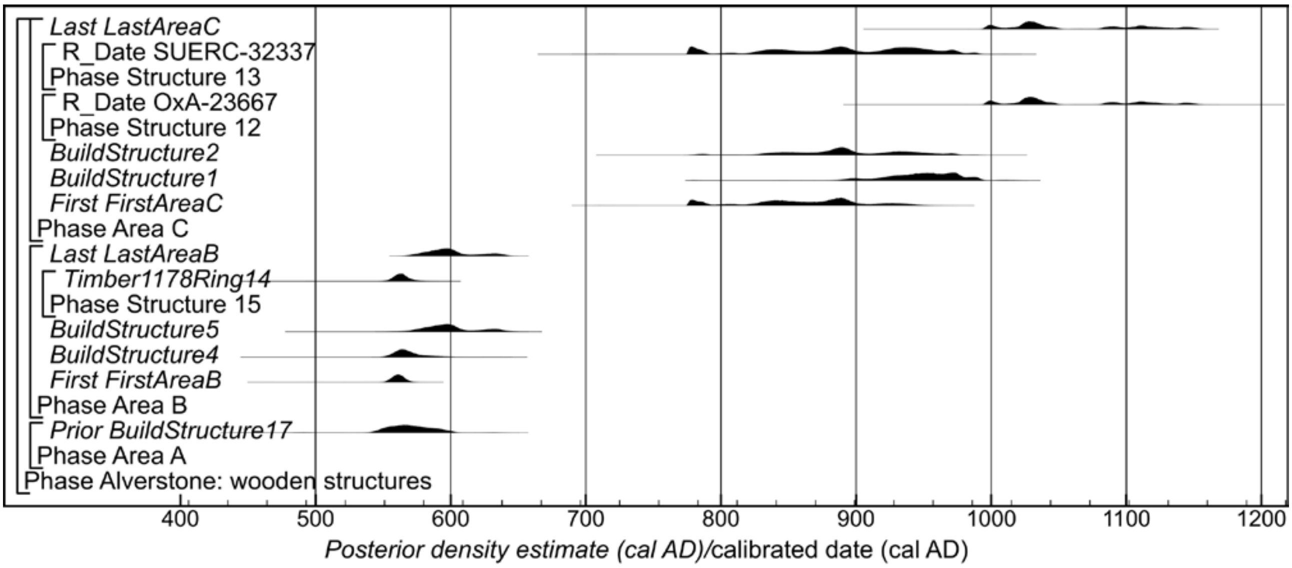

Figure 19: Probability distributions for the dates of wooden structures from Areas A–C. The distributions are derived from the models shown in Figures 7 (Structure 1); 8 (Structure 2); 11 (Structure 4); 12 (Structure 5); 17 (Structure 15) and 18 (Structure 17).

The first dated structure to be built in Area C is estimated to have been built *170–360 years* (*95% probability*; distribution not shown) probably *190–315 years* (*68% probability*) after the last dated structure in Area B. Structures 2 and 13 were probably built about the same time in the late eight–late tenth centuries cal AD, although Structure 13 is only dated by a single timber (SUERC-32337). Structure 1 was built in *cal AD 890–995* (*95% probability*; *BuildStructure1*; Fig. 19) probably in *cal AD 925–980* (*68% probability*) after Structure's 2 and 13 but before Structure 12 (*71.2% probable;* Table 15), but again Structure 12 is only dated by a single timber.

Table 15: Percentage probabilities of the relative order construction of wooden structures in Areas A and B, from the models defined in Figures 11 (Structure 4), 12 (Structure 5), 17 (Structure 15) and 18 (Structure 17). The cells show the probability of the distribution on the left-hand column being earlier than the distribution on the top row. For example, the probability that *BuildStructure17* is earlier than *BuildStructure5* is 88.8%

	BuildStructure17	***BuildStructure4***	***BuildStructure5***	***Timber1178Ring14***	***FirstAreaB***
BuildStructure17		46.3	88.8	37.2	32.2
BuildStructure4	53.7		95.1	36.4	0.0
BuildStructure5	11.2	4.9		1.3	0.0
Timber1178Ring14	62.8	63.7	98.7		0.0
FirstAreaB	67.9	100.0	100.0	100.0	

Table 16: Percentage probabilities of the relative order construction of wooden structures in Area C, from the models defined in Figure 7 (Structure 1) and Figure 8 (Structure 2).The cells show the probability of the distribution on the left-hand column being earlier than the distribution on the top row. For example, the probability that *BuildStructure2* is earlier than *BuildStructure1* is 87.0%.

	BuildStructure1	***BuildStructure2***	**OxA-23667**	**SUERC-32337**
BuildStructure1		13.0	99.9	18.1
BuildStructure2	87.0		100.0	50.4
OxA-23667	0.1	0.0		0.0
SUERC-32337	81.9	49.6	100.0	

The identification of five timbers that were felled in the early first millennium cal BC and incorporated into later structures was unexpected and hints at a much longer use of the landscape.

Sweet chestnut (*Castanea sativa* Mill.)

The identification of several sweet chestnut timbers dating to the sixth century cal AD and later (Fig. 20) raises the possibility that they were derived from trees growing in a local woodland. This appears to be a more plausible explanation than them being imported timbers given that the material was “low value, often crooked roundwood rather than converted ‘timber’ that might be likely to be traded over long distances” (Goodburn et al. forthcoming).

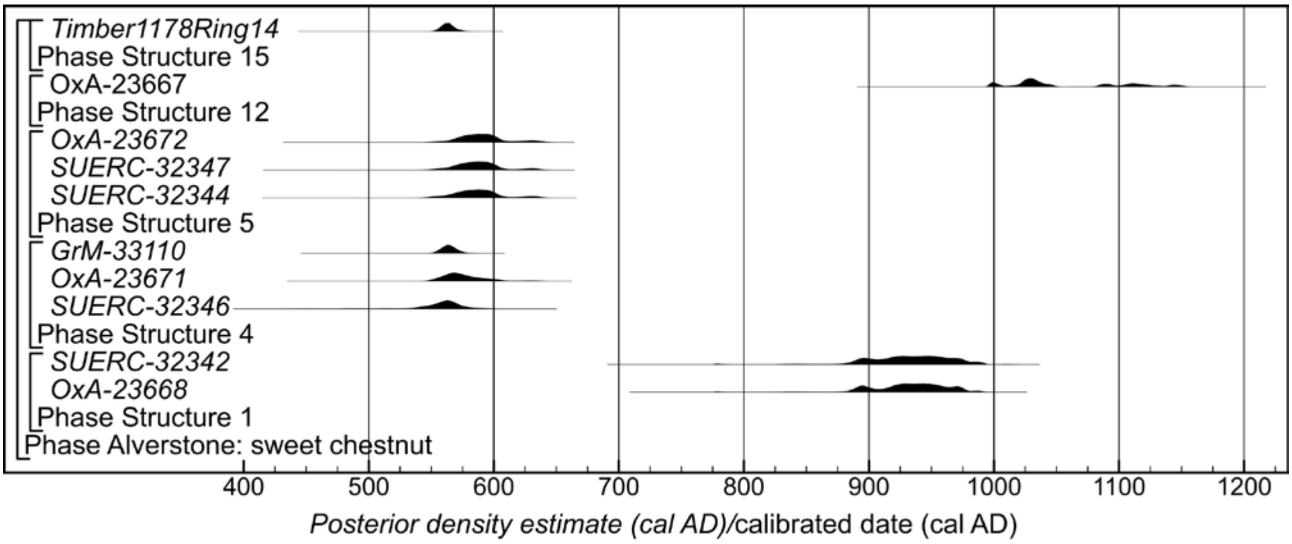

Figure 20: Probability distributions for the dates of sweet chestnut timbers. The distributions are derived from the models shown in Figures 7 (Structure 1); 11 (Structure 4), 13 (Structure 5) and 17 (Structure 15).

Dendrochronology

The Alverstone material is from a low lying site on the eastern edge of the Isle of Wight. In tree-ring terms there is a distinct lack of geographically adjacent site reference data with which to compare the sequences. No adjacent oak data is of course available from south, south-west and south-east of the Isle of Wight.

The five timbers from Cluster 2 (Fig 5) form an undated short sequence, with fairly low replication, that radiocarbon dating suggests falls near the the beginning of the first millennium BC, with the last ring of timber [1624] estimated to have formed in *965–950 cal BC* (*1% probability*; *Timber1624Ring107*; *Fig. 15*) or *925–805 cal BC* (*94% probability*). Cluster 2 is therefore of a very similar date to the Must Farm ash (*Fraxinus*) master sequence (the last ring of which is estimated to have formed in *865–840 cal BC* (*95%*

probability; ash_ring_0; Tyers et al. 2020, fig 22) and the probably slightly later Shinewater Platform (Tyers et al. 2020, appendix 4).

The chronological and geographical disposition of contemporaneous reference datasets is the key determinant for the likelihood of dating these sequences, with at present there being just three tree-ring series from the British Isles that give complete or almost complete overlaps across the period. One of these is the Newington Quarry, Nottinghamshire material (Tyers 2003; Tyers 2017), running to 835 BC, and a further English group is Swan Carr from County Durham, 1155–381 BC, (Baillie and Brown pers. comm.). Swan Carr has approximately ten timbers and Newington has approximately five that cover some of the period covered by these sequences. Both these sites are almost certainly too distant to be any help with dating the timbers from Alverstone Cluster 2, the Must Farm pile-dwelling or Shinewater Platform. The third site is Ballymacombs More, Northern Ireland, running from 947–633 BC, which as well as being even further away only includes one timber that covers the period of interest to us (Baillie and Brown pers. comm.). Currently this is the entire British Isles data set for the first quarter of the first millennium BC, the weakest point in the 7000-year continuous tree-ring sequence.

Radiocarbon dating has demonstrated that the bulk of the timber from Alverstone material is Saxon or Saxo-Norman and thus there are some fifth–seventh-century AD data sets from London, Berkshire and Hampshire, and slightly more widespread data from the later Saxo-Norman period including some material from Winchester and Southampton which are at least reasonably close.

The Alverstone data, both the individual series and the clustered groups, have been fully cross-checked against prehistoric and historic datasets from the British Isles and western Europe as well as with a number of other undated prehistoric and historic assemblages from England, but at present none of it can be conclusively dated.

Cores

Introduction

As there has been a notable absence of palaeoenvironmental work covering the early historic period on the Isle of Wight and understanding of land use remains poor, three profiles were sampled during the excavation by monolith tin allowing an intact column of sediment to be obtained (Fig. 21).

Sampling

The tins were hammered into the open section with an overlap of *c.* 0.1m removed with a trowel, wrapped in clingfilm and stored. The columns were numbered 1, 2 (one tin each) and 3 (three tins A, B and C). The Monolith 1 column sample is presumed lost, as is not stored with the M2 and M3 columns.

Monolith 2

Sediment descriptions and interpretations from Monolith 2 (Fig. 21) are given in Table 17.

Figure 21: Alverstone ALV05 Monolith 2 (wooden platform and deposits directly below). © MOLA

Table 17: Alverstone ALV05 Monolith 2 sediment descriptions and interpretations

Unit	From (m BGL)	OD height (m BGL)	From (mOD)	To (mOD)	Description	Provisional interpretation
3.11	0	0.22	**0.00**	**-0.22**	Moderate friable dark greyish brown **sandy humic silt** with some clay, abundant black humic patches and organic inclusions	Alluvial / wetland matrix with detrital organic remains. Context of ?Saxo-Norman platform / trackway / causeway
sharp / clear diagonal sloping boundary						
3.9	0.22	0.6	**-0.22**	**-0.60**	Moderate very friable damp dark orange and greenish grey **slightly silty clay** with occasional black manganese patches/ mottles and rare small white patches - possibly calcareous inclusions or degraded stone (flint?)	Weathered and desiccated upper bedrock horizon (Atherfield Clay Formation)

Monolith 3

Sediment descriptions and interpretations from monolith 3 (Figs 22–24) are given in Table 17.

Figure 22: Alverstone ALV05 Monolith 3A. © MOLA

Figure 23: Alverstone ALV05 Monolith 3B. © MOLA

Figure 24: Alverstone ALV05 Monolith 3C. © MOLA

Table 18: Alverstone ALV05 Monolith 3 sediment descriptions and interpretations

		OD height			**Description**	**Provisional interpretation**	**Tin**
		Mono 3A	**Mono 3B**	**Mono 3C**			
		0.000	0.000	0.000			
unit	from (m BGL)	to (m BGL)	from (mOD)	to (mOD)			
3.11	0	0.12	**0.00**	**-0.12**	Moderate very friable dark orange brown mottled black gritty **sandy clay silt**. Sand is coarse.	weathered and friable sandy soil (?post Saxo-Norman)	
gradational boundary over 200mm							
3.10	0.12	0.3	**-0.12**	**-0.30**	Moderate-soft wet/damp friable dark greyish brown very **humic silt** with some clay and common- frequent woody inclusions (twigs)		
diffuse/imperceptible boundary							**3A**
3.9	0.3	0.6	**-0.30**	**-0.60**	Moderate-soft wet/damp friable dark greyish brown very **humic silt** with some clay and sand content. Sand is orange brown and coarse. Abundant woody inclusions i.e. twigs, branches (between 0.35-0.50) and detrital organic matter.	Alluvial / wetland matrix with detrital organic remains, context of Saxo-Norman platform / trackway / causeway	
3.8	0	0.2	**0.00**	**-0.20**	**Humic silt** as above		
clear boundary							
3.7	0.2	0.22	**-0.20**	**-0.22**	Band of moderate - loose dark orange brown coarse sand grit and fine gravel in **humic silt** matrix (sand/gravel clast-supported)	Possible sand bar or consolidation layers for trackway / causeway construction. Transition from sand bar to wetland development	**3B**
clear boundary							
3.6	0.22	0.25	**-0.22**	**-0.25**	Band of moderate-soft wet/damp friable dark brown humic silt with abundant twigs - as in unit 3.8		
clear boundary							

		OD height			**Description**	**Provisional interpretation**	**Tin**
		Mono 3A	**Mono 3B**	**Mono 3C**			
3.5	0.25	0.35	**-0.25**	**-0.35**	Moderate-loose wet/damp friable dark brownish orange with dark brown and grey patches **humic silt sand.** Sand is medium coarse in humic silt matrix. Occasional to common organic / woody inclusions		**3B**
sharp / clear horizontal boundary							
3.4	0.35	0.6	**-0.35**	**-0.60**	Moderate-loose wet/damp greenish grey (salt and pepper appearance) and dark orange fine to coarse **sand**	Weathered sand horizon dating to earlier prehistoric. Possible sand bar derived from redeposited bedrock (Cretaceous Ferruginous Sand Formation). Mottling / colouration likely from partial oxidation of deposit.	
3.3	0	0.2	**0.00**	**-0.20**	Moderate dark greyish orange **slightly humic silt sand** and dark degraded organic patches		**3C**
very diffuse / gradational boundary over e.g. 500mm							
3.2	0.2	0.35	**-0.20**	**-0.35**	Moderate friable dark greyish orange **sandy silt clay** with occasional - common medium and large black woody and organic inclusions. Sand is coarse. Clay-rich matrix appears blocky		
3.1	0.35	0.6	**-0.35**	**-0.60**	Moderate friable dark brown / grey orange **silt clay**. Blocky structure and some fine sand content. No visible inclusions	Weathered Atherfield Clay Formation (with dessication cracks)	

Radiocarbon dating

Given that the sampled sediments had the potential to provide a definition of the landscape within which the timber structures were located and to contribute to the interpretation of the archaeology through *inter alia* their association with late Holocene sea-level rise, a programme of radiocarbon dating was undertaken. It was hoped that if robust chronologies for these monoliths could be obtained then the proxy data they contained (pollen, diatoms, ostracods and plant macrofossils) could provide information on Saxon fields and the landscape in the vicinity of the site.

Monolith 2

Four samples of short-life material were dated from Monolith 2 in 2014 (Table 19). A plot of their calibrated dates against depth (Fig. 25) shows no chronological coherence and it is clear that material that is either residual or intrusive has become incorporated into the sediments. As a result of the first set of results no further samples were submitted for radiocarbon dating.

Table 19: Monolith 2 radiocarbon and associated stable isotope measurements

Laboratory number	**Sample**	**Material**	**$\delta^{13}C_{IRMS}$ (‰)**	**Radiocarbon Age (BP)**
UBA-24898	ALV05 M2 – 0.04m	Plant macrofossil (waterlogged): *Alnus glutinosa* seeds	−27.1±0.2	1113±31
SUERC-50132	ALV05 M2 – 0.1m	Plant macrofossil (waterlogged): hazelnut	−25.0*	1527±42
SUERC-50133	ALV05 M2 – 0.16m	Wood (waterlogged): *Alnus* sp.	−26.0±0.2	1268±42
UBA-24897	ALV05 M2 – 0.26m	Plant macrofossil (waterlogged): *Alnus glutinosa* seeds	−27.0±0.2	1164±30

* assumed value

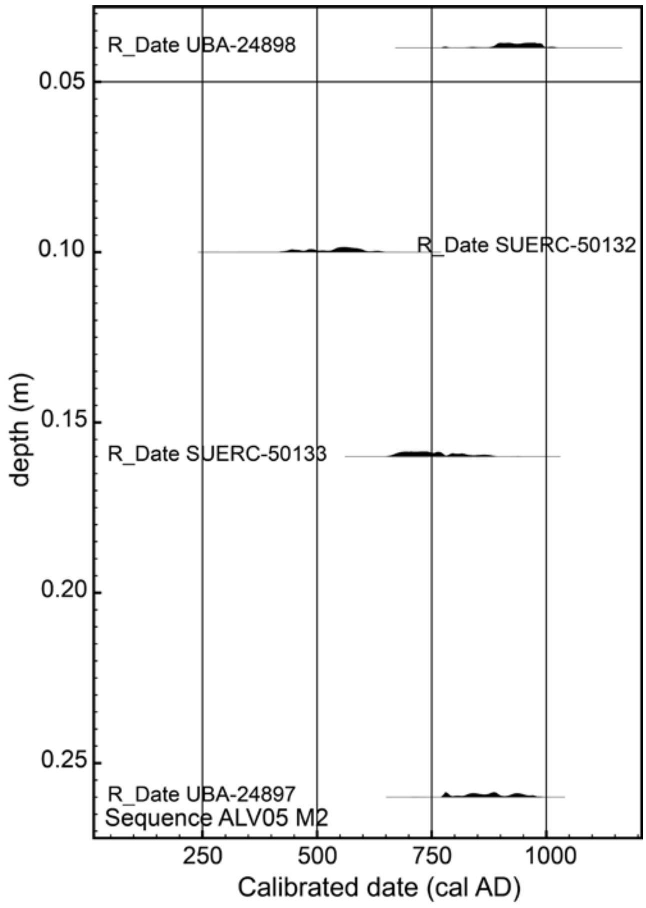

Figure 25: Probability distribution of the dates from Monolith 2. The distributions are the result of simple radiocarbon calibration (Stuiver and Reimer 1993).

Monolith 3

Three samples of short-life material were dated from Monolith 3 in 2014 (Table 20). A plot of their calibrated dates against depth (Fig. 26) shows them to be in a chronological sequence. No further samples were submitted for radiocarbon dating due to the lack of suitable material.

Table 20: Monolith 3 radiocarbon and associated stable isotope measurements

Laboratory number	Sample	Material	$\delta^{13}C_{IRMS}$ (‰)	Radiocarbon Age (BP)
UBA-24899	ALV05 M3A – 0.4m	Bark, unidentified	−29.3±0.2	1114±29
SUERC-50131	ALV05 M3A – 0.45m	Wood (waterlogged): alder/birch	−26.3±0.2	1124±42
UBA-24900	ALV05 M3B – 0.33m	Bark, unidentified	−27.5±0.2	1349±26

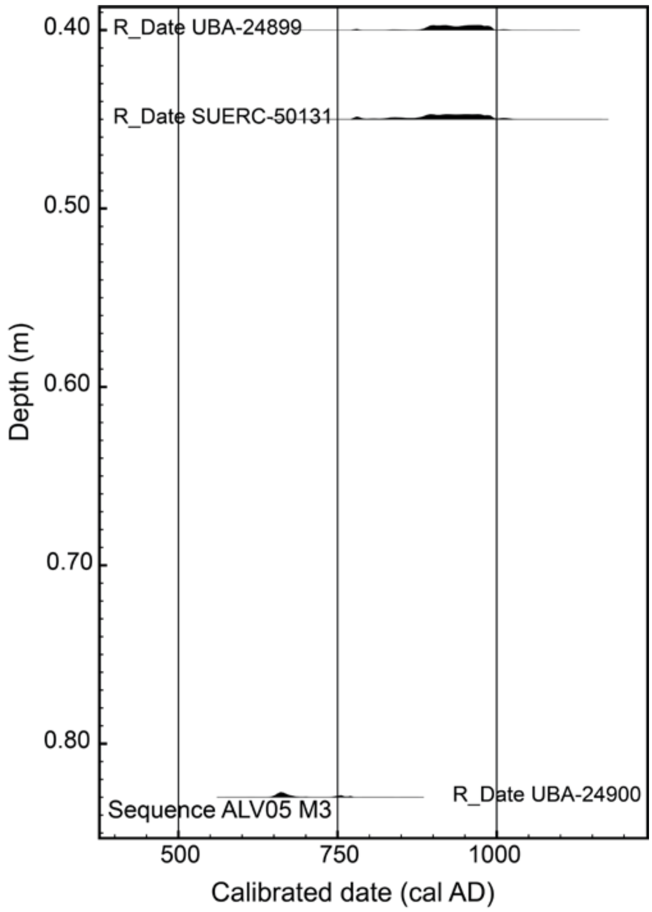

Figure 26: Probability distribution of the dates from Monolith 3. The distributions are the result of simple radiocarbon calibration (Stuiver and Reimer 1993).

Conclusion

Despite the challenging nature of its excavation, together with a long and at times tortuous programme of recording and analysis, the timbers from Alverstone provide an important glimpse of how people interacted with their landscape. Scientific dating of the waterlogged timbers has shown the longevity of activity in a dynamic environment.

The accompanying publication (Blanks et al. forthcoming) and technical report (Goodburn et al. forthcoming) should be consulted for further discussion of the results from the analysis programme.

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Appendix 1: Data of measured samples

alv0005

153	148	108	108	118	133	170	107	195	162
64	118	113	147	132	139	152	93	79	78
103	92	173	176	83	68	113	121	133	84
60	86	132	145	106	74	50	58	116	107
113	99	101	121	106	107	90	90	93	121
127	120	109	89	97	74	88	143	135	194
125	113	127	116	91	69	83	97	145	155
151	123	156	85	120	99	87	99	70	77
68	97	76	72	42	37	32	26	40	30
36	35	47	46	58	75	80	75	56	67
86	68	83	79	69	92	90	103	68	55
69	131	72	87	80	71	114	74	70	72
97	104	85	95	104	76	94	89	92	89
84	78	72	103	84	94	100	96	103	91
75	57	72	99	99	99	98	76	79	67
56	82	94	118	116	115	114	109	103	81
68	57	110	81	65	57	55	43	49	
47									

alv1043

114	106	150	132	114	113	152	169	114	114
72	53	79	132	98	147	141	198	170	157
139	142	97	104	62	147	190	111	108	62
61	81	98	88	138	201	237	150	119	169
121	156	119	119	147	171	120	90	65	94
130	149	110	175	232	142	148	88	147	100
160	85	117	109	127	144	100	103	85	

alv1065

276	238	187	132	202	254	204	165	258	192
179	186	160	192	168	177	185	135	138	103
83	97	136	124	112	123	108	111	75	87
61	96	131	107	104	117	137	174	112	134
116	132	98	174	169	161	142	106	81	67
82	57	55	88	96	103	78	81	74	80
90	86	109	94	90	151	172	208	198	238
143	123	167	157	187	127	109	128	107	

alv1076

260	243	454	270	207	196	223	286	427	293
254	321	366	283	195	162	241	254	228	188
222	258	233	162	234	203	150	152	105	119
146	115	88	172	214	227	243	170	125	153
140	130	140	136	228	271	243	178	248	293
238	269	169	161	208	231	260	323		

alv1116

43	32	62	71	62	39	54	78	42	53

60	32	43	38	38	39	50	54	39	36
39	50	28	23	29	43	37	45	34	30
64	65	54	69	39	31	49	48	43	42
49	44	69	58	60	37	49	53	44	44
41	54	67	89	67	41	53	36	66	100
153	100	91	108	114	206	201	192	205	148
149	122	125	136	146	124	92	94	113	105
133	86	148	158	126	190				

alv1127

111	106	102	82	63	58	61	62	73	53
72	87	88	106	102	82	103	109	97	87
68	70	64	55	68	69	54	54	62	54
65	63	78	67	52	55	75	80	65	70
51	60	65	60	75	62	70	61	58	60
58	54	56	58	145	97	77	65	81	77
75	69	67	54	59	57	62	83	107	117
120	96	90	62	71	71	82	58	52	64
68	68	60	71	56	57	82	46	54	62
48	59	58	48	46	46	50	50	62	60
66	62	68	67	69	66	71	58		

alv1184

283	323	221	336	266	166	164	191	116	123
121	157	180	205	176	130	132	212	217	188
191	229	165	123	186	171	178	201	203	214
185	184	106	85	90	125	129	68	140	152
116	80	53	73	67	70	66	88	136	144
134	102	99	97	153	125	79	71	62	103
158	135	155	78	68	63	73	76	68	85
74	81	68	55	39	70	105	78	91	88
72	90	85	91	88	56	82	110	107	132
110	105								

alv1198

112	107	122	107	171	163	114	126	119	108
77	125	137	131	117	103	90	83	80	99
90	73	83	99	127	135	158	112	98	87
99	97	74	82	102	118	107	98	55	47
68	93	80	96	84	96	113	73	72	66
91	72	80	117	129	117	108	105	110	116
109	109	80	95	89	93	104	104	100	92
77	34	53	76	86	134	135	103	87	73
67	73	85	93	96	91	81	87	92	67
50	62	86	83	79	69	89	64	67	69
73	97	95	84	110	117	91	61	61	69
104	129	127	108	93	114	76	58	78	103
107	128	133	106	121	65	84	123	149	121
110	113	101	90	80	81	78	94	93	142
112	135	106	170	120	141	132	134	169	115
258	153	169	184	238	160	167			

alv1210

142	146	121	93	112	101	100	82	64	59
92	99	95	133	101	104	80	127	158	236
151	155	134	152	164	189	172	170	167	215
137	111	121	163	228	172	171	139	95	150
218	181	166	146	156	191	179	163	158	211
182	180	319	260	207	153	130	172	168	168
137	112	102	112	117	149	144	131	139	80
127	140	166	185	236	172	174	146	92	90
124	127	127	148	193	166	156	130	128	88
102	133	174	125	121	192	227	135	160	113
177	166	164	141	143	114	88	90	135	143
141	145	135	152	132	117	109	153	141	119
176	191	136	125						

alv1229

392	436	351	350	367	394	366	331	387	263
338	310	380	318	363	209	305	279	189	265
154	290	341	238	269	194	171	168	177	169
155	96	85	74	98	101	121	99	107	79
59	72	91	96	99	135	112	144	172	142
125	63	66	40	42	38	44	54	49	71
67	57	52	45	48	46	48	46	78	73
99	93	94	88	77	92	97	72	77	78
108	154	89	58	59	44	64	70	87	87
108	78	66	46	42	51	68	69	63	57
57	58	57	65	67	61	59	54	81	95
118	154	179	226						

alv1536

353	298	277	135	153	257	306	216	266	271
172	233	245	149	118	134	183	155	203	195
100	146	216	126	73	88	178	164	127	129
117	122	124	100	105	109	108	87	57	80
115	114	58	183	205	197	184	111	108	97
107	65	82	139	206	179	75	138	149	240
167	118	108	108	228	200	150	200	128	97
112	139	212	141	170	166	146	128	50	80
103	148	135	101	201	150	170	156	109	167
86	83	145	171						

alv1624

216	265	193	236	300	379	306	400	265	173
219	201	149	144	199	222	180	212	151	132
153	182	157	104	137	141	153	69	121	60
92	115	95	93	100	95	68	46	71	91
71	39	258	219	168	157	112	73	94	61
49	109	151	114	139	65	85	129	217	113
48	56	43	141	128	98	131	56	68	67
62	111	85	106	83	82	45	40	47	64
133	86	87	62	59	62	83	81	69	44
83	170	150	133	80	90	74	106	136	237
257	179	196	86	126	114	88			

alv1660

140	215	139	161	144	171	134	176	102	82
126	140	127	147	120	143	102	133	100	118
122	172	115	86	61	56	74	80	118	96
71	77	59	83	71	59	79	57	70	51
52	72	54	70	67	71	51	68	81	63
65	67	52	66	45	48	70	42	65	50
73	74	49	57	58	54	47	68	68	75
70	67	45	57	70	73	64	67	62	40
43	42	48	56	44	63	79	59	74	54
52	68	47	44	53	52	73	68	59	62
57	80	83	76	68	77				

alv1723

185	112	77	135	247	298	288	318	300	198
231	252	176	190	155	194	97	68	69	108
159	225	222	185	166	145	102	145	69	56
56	52	89	139	85	82	82	109	97	124
125	121	109	102	74	62	55	157	230	188

alv1852

362	302	138	287	337	274	315	289	172	239
324	242	171	159	196	241	186	154	197	222
200	151	132	121	118	86	67	112	124	101
58	160	179	136	160	122	99	121	102	90
84	141	169	165	66	118	110	173	134	103
96	112	177	144	142	186	122	80	82	125
175	134	155	126	112	105	83	61	90	142
127	116	163	137	149	146	115	137	74	63
124									

alv5001

55	74	51	79	100	89	93	91	74	90
99	87	77	64	73	58	48	64	56	58
52	61	63	69	64	85	72	69	63	74
83	81	65	70	64	70	70	72	76	70
64	65	73	63	61	61	55	63	57	55
40	62	63	63	68	54	49	51	48	59
66	67	73	106	99	85	65	59	68	80
65	54	54	78	74	66	68	57	62	77
61	66	66	56	49	60	50	40	56	46
57	84	60	75	71	79	79	79	71	73
83	74	99	164	83	83	79	52	58	78
84	98								

Appendix 2: CQL2 code for chronological models

Structure 1 (Fig. 7)

```
Options()
 {
  Resolution=1;
  kIterations=20000;
 };
 Plot()
 {
  Sequence("Structure 1")
  {
   Boundary("StartStructure1");
   Phase("Structure 1")
   {
    R_Date("OxA-23587", 1592, 30)
    {
     Outlier();
    };
    R_Date("OxA-23668", 1133, 22);
    R_Date("SUERC-32338", 1135, 30);
    R_Date("SUERC-32342", 1125, 30);
    Last("BuildStructure1");
   };
   Boundary("EndStructure1");
  };
 };
```

Structure 2 (Fig. 8)

```
Options()
 {
  Resolution=1;
  kIterations=20000;
 };
 Plot()
 {
  Sequence("Structure 2")
  {
   Boundary("StartStructure2");
   Phase("Structure 2")
```

```
   {
    R_Date("SUERC-32343", 1195, 30);
    R_Date("OxA-23669", 1143, 23);
    R_Date("OxA-23670", 1203, 23);
    Last("BuildStructure2");
   };
   Boundary("EndStructure2");
  };
 };
```

Timber 1781 (Fig. 9)

```
Options()
 {
  Resolution=1;
  kIterations=20000;
 };
 Plot()
 {
  D_Sequence("Timber 1781")
  {
   R_Date("GrM-33107",1520,19);
   Gap(4);
   R_Date("GrM-33108",1531,20);
   Gap(4);
   R_Date("GrM-33109",1552,20);
   Gap(3);
   R_Date("GrM-33110",1519,19);
  };
 };
```

Structure 4 (Fig. 11)

```
Options()
 {
  Resolution=1;
  kIterations=20000;
 };
 Plot()
 {
  Sequence("Structure 4")
  {
   Boundary("StartStructure4");
```

```
  Phase("Structure 4")
  {
   R_Date("SUERC-32345", 1535, 30);
   R_Date("SUERC-32346", 1550, 30);
   Prior("GrM_33110");
   Last("BuildStructure4");
  };
  Boundary("EndStructure4");
 };
};
```

Structure 5 (Fig. 12)

```
Options()
{
 Resolution=1;
 kIterations=20000;
};
Plot()
{
 Sequence("Structure 5")
 {
  Boundary("StartStructure5");
  Phase("Structure 5")
  {
   R_Date("SUERC-32344", 1495, 30);
   R_Date("SUERC-32347", 1490, 30);
   R_Date("OxA-23672", 1480, 23)
   Last("BuildStructure5");
  };
  Boundary("EndStructure5");
 };
};
```

Timber 1624 (Fig. 13)

```
Options()
{
 Resolution=1;
};
Plot()
{
 D_Sequence("Timber 1624")
```

```
 {
  R_Date("OxA-32929", 2735, 30);
  Gap(5);
  Date("Timber1624Ring107");
 };
};
```

Timber 1178 (Fig. 17)

```
Options()
{
 Resolution=1;
 kIterations=20000;
};
Plot()
{
 D_Sequence("Timber 1178")
 {
  R_Date("GrM-34752", 1536, 17);
  Gap(4);
  R_Date("GrM-33103",1492,19);
  Gap(4);
  R_Date("GrM-33105",1571,19);
  Gap(3);
  R_Date("GrM-33106",1546,19);
  Gap(2);
  Date("Timber1178Ring14");
 };
};
```

Structure 17 (Fig. 18)

```
Options()
{
 Resolution=1;
 kIterations=20000;
};
Plot()
{
 Sequence("Structure 17")
 {
  Boundary("StartStructure17");
  Phase("Structure 17")
```

```
  {
   R_Date("OxA-23665", 1506, 24);
   R_Date("SUERC-32335", 1540, 30);
   R_Date("OxA-23666", 1588, 23);
   R_Date("SUERC-32336", 1540, 30);
   Last("BuildStructure17");
  };
  Boundary("EndStructure17");
 };
};
```

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