LAND WEST OF ROUND HOUSE WAY, CRINGLEFORD, NORFOLK:

REPORT ON FURTHER ANALYSIS OF THE LATE SAXON CHARCOAL PITS

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PRE-CONSTRUCT ARCHAEOLOGY

Land West of Round House Way, Cringleford, Norfolk: Report on Further Analysis of the Late Saxon Charcoal Pits

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ABSTRACT

This report contains the results of further analysis arising from an archaeological trial trench evaluation carried out by Pre-Construct Archaeology on land west of Round House Way, Cringleford, Norfolk (NGR TG 1863 0578), between the 11th and 15th February 2019. The archaeological work was commissioned by CgMs Consulting on behalf of Kier Homes. The aim of the analysis was to ascertain, as far as possible, the date and function of a number of small, charcoal-rich, pits found during the evaluation. Similar, but often undated, pits are frequently found in archaeological work around the Norwich outskirts, as well as elsewhere in Norfolk, Suffolk and the wider region.

Radiocarbon dating has confirmed, as expected, that the 'charcoal pits' at the site are of Anglo-Saxon, specifically late Saxon, date (9th- to 10th-/early-11th-century AD). Analysis indicates that the charcoal in the pits is predominantly oak heartwood from the trunks and large branches of mature trees. As such, it is likely to derive from systematic burning of wood for charcoal manufacture, probably consisting of waste fragments that were considered too small to be useful or economical to transport. The products of this charcoal-burning industry are perhaps most likely to have supplied demand in the growing late Saxon town at Norwich, not least the ironworking industry that flourished in the Coslany area during the 10th to 12th centuries.

A short article detailing the results of the evaluation and this analysis has been prepared for inclusion in Norfolk Archaeology.

1 INTRODUCTION

1.1 A programme of archaeological trial trench evaluation was undertaken by Pre-Construct Archaeology Ltd. (PCA) on land west of Round House Way, Cringleford, Norfolk, NR4 6UD (centred on Ordnance Survey National Grid Reference (NGR) TG 1863 0578) between 11th and 15th February 2019 (Figure 1; Plate 1).

1.2 The archaeological work was commissioned by CgMs Consulting Ltd. on behalf of Kier Homes prior to development of up to 210 residential dwellings and other associated works. The site forms part of a larger site granted outline planning permission in 2016 (South Norfolk District Council Planning Reference: 2013/1494; Planning Appeal Ref. APP/L2630/A/14/2227526).

1.3 The evaluation was carried out in accordance with a Written Scheme of Investigation (WSI) prepared by Myk Flitcroft of CgMs Consulting Ltd. (2018) in response to a Brief issued by Norfolk County Council Historic Environment Team (NCC HET 2018).

1.4 The aim of the evaluation was to determine the location, date, extent, character, condition and quality of any archaeological remains on the site, to assess the significance of any such remains in a local, regional, or national context, as appropriate, and to assess the potential impact of the development proposals on the site's archaeology.

1.5 A total of 28 trenches, totalling 1100m, were excavated and recorded. Of these, 27 trenches were 40m long x 2m wide, and one was 20m x 2m (Figure 2).

1.6 The evaluation recorded undated ditches across the site. These were generally narrow and shallow, with sterile fills. They were morphologically similar to the Middle to Late Bronze Age field boundaries which are found quite widely on light-soil sites across East Anglia; however, this dating is highly tentative. Based on ditch alignments, at least two phases of land division may be represented. Sparsely distributed across the site were eight small, undated, pits containing charcoal-rich fills. These were similar to the 'burnt pits'/

'charcoal pits' recorded widely on sites around Norwich and on sand and gravel geology elsewhere in Norfolk and Suffolk. Although these burnt pits rarely contain datable artefacts, where radiocarbon dates have been attained, they frequently, though not always, date the features to the Anglo-Saxon period. Nevertheless, the precise dating and function of these widely occurring features remains poorly understood. A post-medieval field boundary ditch and a quarry pit, the latter probably dug to extract gravel for maintenance of the former turnpike road to the south of the site, were also recorded.

1.7 These remains were not deemed significant enough to warrant further archaeological excavation and recording at the site prior to development. However, it was agreed between the planning authority's archaeological advisor, Dr James Albone, and the developer's archaeological consultant, Myk Flitcroft, that a programme of analysis would be carried out on the charcoal pits in order to attempt to ascertain their date and function. This analysis would comprise assessment and, where considered worthwhile, full quantification and analysis of the charcoal from a selection of the pits, together with a programme of radiocarbon dating.

1.8 This report contains the results of this programme of analysis. It should be read in conjunction with/ as an addendum to the evaluation report (Jones and Woolhouse 2019), which contains full details of the background to the project, excavation and sampling methodologies, complete descriptions of the archaeological features and deposits found, and full specialist reports and catalogues. Appendix 3 is a short article describing the results of the project for inclusion in the 'shorter contributions' section of *Norfolk Archaeology*.

1.9 The site archive will be deposited at Norwich Castle Museum under Accession No. NWHCM: 2019.78.

1.10 Both the evaluation report and this analysis report will be uploaded to the Archaeology Data Service website (http://archaeologydataservice.ac.uk) under OASIS IDs preconst1-345065 and preconst1-416589, respectively, to ensure that the project results are accessible for future research.

2 GEOLOGY AND TOPOGRAPHY

2.1 Geology

2.1.1 The underlying geology across the site is described by the British Geological Survey (BGS; Website 1) as belonging to the Lewes Nodular Chalk Formation, overlain by superficial deposits of glacial sand and gravel of the Sheringham Cliffs Formation.

2.1.2 The natural geology encountered across the site was a coarse, orangey-brown, slightly clayey sand with occasional flints, overlain by 0.40–0.50m of overburden, comprising plough-soil and, occasionally, a thin 'subsoil', actually just the disturbed/ rooted interface between the plough-zone and the geological horizon. The main exception to this was in the trenches beside Round House Way (1, 2, 11 and 18), where there was between 0.7m and up to 1.1m (in the north) of topsoil and compacted made ground overlying the natural. This edge was used for storage of building materials during the construction of the housing estate on the opposite side of Round House Way (see photo on Website 3).

2.2 Topography

2.2.1 The site comprises an area of land totalling 5.85ha, situated on the western edge of Cringleford (Figure 1). The site is located across a gently undulating plateau landscape; the ground level gradually rises from the River Yare valley to the east.

2.2.2 The main body of the site occupies a former agricultural field, with other parts of the site present within scrubland to the east of this field. The site is bounded to the east by Round House Way, to the south by Newmarket Road and to the west and north by agricultural fields.

2.2.3 The overall rise in elevation over the site is approximately 6m, with the south-western part of site lying at approximately 30m above Ordnance Datum (OD) and the north-eastern corner at approximately 24m OD.

3 ARCHAEOLOGICAL BACKGROUND

3.1 Introduction

3.1.1 This background is taken from the Written Scheme of Investigation (Flitcroft 2018) and Archaeological Desk-Based Assessment (NPS 2013) and Geophysical Survey (ASWYAS 2013) undertaken for the site.

3.2 Prehistoric (*c*. 800,000 BC–AD 42)

3.2.1 A palaeolithic handaxe was recovered from river valley gravels in the grounds of Oakland House, *c*. 900m east of the site (Norfolk Historic Environment Record (NHER) 9353).

3.2.2 Archaeological works at the A11 Cringleford Bypass and Colney Lane, *c*. 150m east of the site, revealed undated ditches, pits and linear features (NHER 40130, 40131, 40132, 40136 and 40137).

3.2.3 Prehistoric flint artefacts and undated ditches, pits and postholes were found during an evaluation on the site of a proposed new school *c*. 500m south-east of the site (NHER 40940). The flints included a later Neolithic/ Bronze Age polished flint axe. The archaeological features could also be prehistoric.

3.2.4 Excavation revealed a possible Iron Age ditch *c*. 650m north-east of the site (NHER 56760). An evaluation *c*. 550m to the north-east of the site recovered Middle Iron Age pottery from the subsoil; medieval and post-medieval pottery was also recovered (NHER 56763). During a nearby evaluation in 2011, a number of prehistoric struck flints were recovered, including flakes of later prehistoric date, a core or tool of Late Neolithic or Early Bronze Age date, and blade-like pieces of possible Early Neolithic date (NHER 56764).

3.2.5 Fieldwalking by the Norfolk Archaeological and Historical Research Group, *c.* 350m north-east of the site, recovered prehistoric flint artefacts as well as sherds of medieval and post-medieval pottery. The prehistoric flints included a scraper, borers, a core and flakes (NHER 36243).

3.2.6 Possible prehistoric field boundaries are visible as cropmarks on aerial photographs of land to the east of the Thickthorn interchange, Cringleford, *c*.

350m to the west of the site (NHER 54404).

3.3 Roman (*c.* AD 43–410)

3.3.1 In 1930, a Roman cremation urn was recovered from the garden of Kent House, *c*. 750m south-east of the current site (NHER 9364). This consisted of a greyware jar, which was placed inverted in the burial, associated with cremated bone, oyster shell and other pottery sherds.

3.3.2 A Roman coin, a dupondius of Antonius Pius, was found *c*. 500m south-east of the site during building works on Cantley Lane (NHER 9366). Two further Roman brass coins (again of Antonius Pius) were found at the junction of Newfound Lane and Harts Lane, *c*. 800m north-east of the site (NHER 9368).

3.4 Anglo-Saxon, Medieval and Post-Medieval (*c*. AD 411–present)

3.4.1 Fieldwalking by the Norfolk Archaeological and Historical Research Group, *c*. 325m to the north-east of the site, recovered sherds of medieval and post-medieval pottery, post-medieval tiles, a post-medieval wig curler and a post-medieval coin (NHER 37342).

3.4.2 Archaeological works at the A11 Cringleford bypass and Colney Lane, *c.* 150m east of the site, revealed undated ditches, pits and linear features along with medieval and post-medieval pottery and post-medieval metalwork (NHER 40130, 40131, 40132, 40136 and 40137).

3.4.3 Historic maps show an octagonal brick-built cottage, built in 1805 by Sir Roger Kerrison, just south-east of the site (NHER 11613).

3.5 Cartographic Sources

3.5.1 Former buildings are shown either in or just beyond the south-east corner of the site on the 1849 Cringleford Tithe Map and subsequent later-19th-century Ordnance Survey maps.

3.5.2 Historic maps do not show any features within the site boundaries.

3.6 Geophysical Survey (ASWYAS 2013)

3.6.1 No anomalies of archaeological significance were detected within the site.

4 SUMMARY OF ARCHAEOLOGICAL RESULTS

4.1 Late Saxon Charcoal Pits (Figure 3; Plates 2–4)

4.1.1 The principal result of the fieldwork was the identification of eight small charcoal-rich pits, some of which had scorched sides and bases. The 'charcoal pits' were all roughly circular in plan, with gradual to steeply sloping sides, concave bases, and main fills of dark silty sand containing abundant small charcoal pieces, sometimes above a basal 'fill' of reddish natural sand discoloured by heating. The pits ranged from 0.4m to about 1.4m across and were between 0.06m and 0.36m deep (mean 0.79m wide x 0.17m deep). In terms of size, the pits possibly appear to fall into two broad groups, some measuring about 0.4–0.8m wide and others around 1–1.4m wide. This variation does not appear to reflect any difference in function.

4.1.2 The degree of discolouration of the surrounding geology at the sides and bases of the pits was slight and may therefore reflect deposition of charcoal that was still hot rather than *in-situ* burning. An implication of this might be that, while whatever high-temperature process created the charcoal was taking place nearby, the pits may have had little to do with that process. This lack of evidence for direct exposure to sustained heat, together with their small size, would suggest that the pits were not themselves bases of charcoal clamps. Certainly, the features identified as Anglo-Saxon charcoal-burning pits at nearby Laurel Farm, Thorpe St Andrew (where there was a complex of features associated with iron ore extraction, processing and smelting) were considerably larger than the pits at Cringleford, ranging between 1.7 and 3.6m in diameter and from 0.09 to up to 1.26m deep (Bishop and Proctor 2011, 89–93; Riddler 2011, 97–98). Similarly, clear examples of charcoal-burning pits at a number of recently excavated sites in Ireland are rectangular in shape, 2–3m long, and filled with carbonised oak and alder (Carlin 2008, 89–91, 101 and fig. 58). In fact, the Cringleford pits are far closer in size to the features identified as 'iron ore-roasting pits' at Laurel Farm (0.25–1.3m wide and 0.06–0.39m deep), although with much less evidence for *in-situ* burning. However, the total absence of any other evidence for iron ore extraction or processing at Cringleford (e.g. quarry pits, ironstone fragments, smelting slag) renders such

an identification highly unlikely.

4.1.3 Overall, a definitive conclusion regarding the 'original' function of the charcoal pits at Cringleford, whether they were below-ground components of the charcoal clamps or were simply used to dispose of residues from charcoal burning, cannot be reached on the basis of the available evidence. The same minimally scorched appearance could arise from a process that was either relatively low-heat, one in which the majority of the heat generated was directed upwards, or one that was intentionally designed to maintain a reducing (i.e. low oxygen) environment, as would be expected in a charcoal stack.

4.1.4 Very little artefactual material was present in the charcoal pits, being limited to a clay pipe fragment, a sherd of 19th-century pottery and a shard of modern glass, none of them well stratified. These finds were almost certainly deposited during 18th-/19th-century agricultural land-use and have nothing to do with the date or function of the charcoal pits. Charcoal fragments of suitable size for radiocarbon dating were extracted manually during the excavation or were taken from bulk soil samples prior to/ after flotation. Charcoal samples from four of the pits were sent for dating; these consistently returned dates spanning the middle Anglo-Saxon to early medieval period, most likely in the 9th–10th/early 11th centuries AD. i.e. the late Saxon period (see Section 5.1).

4.1.5 The charcoal pits were scattered across the site, with the main concentration apparently in its central northern area (Trenches 4, 5, 10, 11 and 12), but at least one outlying pit was found in Trench 26, some distance to the south of the nearest identified pit in the main 'cluster'. Pits across the site were all of the same period (see Section 5.1), so their location does not appear to have any chronological significance.

4.2 Undated Field Boundary Ditches

4.2.1 Aside from the charcoal pits, a number of ditches were identified in the trenches. These appear to form parts of two main systems: the first made up of narrow and 'sinuous' ditches, with leached fills, orientated north-west to south-east by north-east to south-west, and a second system formed by a series of marginally more substantial ditches, aligned east-north-east to west-south-west by north-

north-west to south-south-east. The former ditch system may be of some antiquity, potentially as early as Bronze Age, based on the ditches' morphological similarity to the later prehistoric (*c*. 1500–800 BC) field systems that are widely found on light soils elsewhere in the Suffolk and Norfolk river valleys, coastal strip and Cambridgeshire fen edge. The alignments of the second system are also slightly at odds with the modern field layout and must therefore be earlier than the mid-19th century, by which time the extant field pattern was already more-or-less established and the site was, in any case, part of a single large field. They might be early post-medieval (*c*. 16th- to 18th-century?), but later Iron Age, Roman, Anglo-Saxon or medieval dates are also possible.

4.3 Post-Medieval Quarrying (Figure 2)

4.3.1 A post-medieval to modern field boundary ditch extended through Trench 18, in the east of the site. A 19th-century pit [113] was recorded in Trench 9 and a tree hollow of similar date in Trench 10. Pit [113] contained part of a rarely found 19th-century coiled-stemmed-type clay tobacco pipe. A large post-medieval pit exposed in Trenches 24 and 27, in the south of the site, is likely to have been a quarry pit dug to extract sand for the maintenance of the former turnpike road directly to the south (the now-bypassed Newmarket Road). The road from Norwich to Thetford was the first turnpike in Norfolk, being made under acts passed in 1694 and '5 (White's Directory 1845, 33; Virgoe 2017).

4.4 Blank Trenches (Figure 2)

4.4.1 Fourteen trenches contained archaeological features. Ten trenches (Trenches 1, 2, 3, 8, 13, 19, 20, 21, 25 and 28) were blank, containing no archaeologically significant features or deposits. Trenches 15, 16, 17 and 23 contained only features that turned out, upon excavation, to be natural in origin.

5 FINDS AND ENVIRONMENTAL ANALYSIS

5.1 Radiocarbon Dating

Bristol Radiocarbon Accelerator Mass Spectrometry (BRAMS)

Introduction

5.1.1 Four samples of organic material (charcoal), from selected burnt pits, were sent for radiocarbon analysis in an attempt to date these otherwise undated features.

Methodology

5.1.2 Where large pieces of charcoal were encountered during excavation of the charcoal pits, these were extracted by trowel and placed directly in sealed foil packets for potential radiocarbon dating. In other cases, charcoal was extracted from the flots/ residues of bulk soil samples that were taken from the pits principally for recovery of charred plant remains.

5.1.3 Charcoal from the environmental samples was selected by the project's charcoal specialist (Dana Challinor) to ensure its suitability for dating in terms of size, species and type. Charcoal that had been recovered specifically for potential dating purposes during the excavation was also reviewed and identified to species/ wood type by the specialist prior to being sent for dating, in order to avoid problems such as 'old wood effect'.

5.1.4 Charcoal from four burnt pits was selected for dating. Pits were selected to provide a representative sample of both the smaller and the slightly larger pits, and of pits in different areas of the site. This was to shed light on any potential temporal differences in pit size, location and, potentially, function. It was provisionally agreed with the planning authority's archaeological advisor that samples from five burnt pits ([152], [155], [158], [160] and [176]) would be submitted for dating. However, in the event, none of the charcoal recovered from Pits [155] or [158] was of suitable size/ type for radiocarbon dating, so charcoal from Pit [106], in a similar area of the site, was submitted instead.

5.1.5 The selected samples of material were sent to the Bristol Radiocarbon Accelerator Mass Spectrometry Facility (BRAMS) for dating. Pre-treatment

methods employed and their respective pre-treatment codes are described by Knowles, Monaghan and Evershed (2019), along with details regarding graphitization, AMS measurement and data reduction.

Results

5.1.6 The results of radiocarbon determination are presented in Appendix 2 and summarised below in Table 1. Results are given in uncalibrated radiocarbon years Before Present (BP). The data given are corrected for isotopic fractionation using the $^{13}C/^{12}C$ ratio measured on the AMS. The $\delta^{13}C$ value was measured on the AMS and may have been subject to additional isotopic fractionation. The error associated with this value is typically ±1‰. Calibration was performed using OxCal software v4.3.2 (Bronk Ramsey 2009; 2017) and the IntCal13 atmospheric calibration curve (Reimer *et al.* 2013).

5.1.7 All the charcoal pits have calibrated dates spanning the middle Anglo-Saxon to the early medieval period (9th to 12th centuries AD), most likely the 9th–10th/ early 11th centuries. This directly accords with the conjectured date of the features, and with the radiocarbon dates for many other charcoal pits excavated around Norwich. There is no difference in date between the smaller (e.g. [106], [160], [176]) and larger (e.g. [152]) pits.

Context	Cut	Lab Code	Material	Radiocarbon age BP (before AD 1950)	Calibrated Date (95.4% probability)	Period
(151)	[152]	BRAMS-3551	Charcoal (*Clematis Vitalba* roundwood)	1129±25	778–790 (1.9%), 828–840 (1.3%) or 865–988 (92.2%) cal. AD	Middle to **late Anglo-Saxon**
(105)	[106]	BRAMS-3552	Charcoal (*Quercus* roundwood)	1009±25	982–1045 (89%), 1095–1120 (5.6%) or 1142–1147 (0.8%) cal. AD	**Late Anglo-Saxon** to early medieval
(159)	[160]	BRAMS-3553	Charcoal (*Corylus Avellana* roundwood)	1115±25	883–990 cal. AD	**Late Anglo-Saxon**
(175)	[176]	BRAMS-3554	Charcoal (*Quercus* roundwood)	1132±25	778–790 (2.5%), 810–815 (0.6%), 826–841 (1.9%) or 863–986 (90.5%) cal. AD	Middle to **late Anglo-Saxon**

Table 1: Radiocarbon Dating

5.2 Wood Charcoal

By Dana Challinor

Introduction

5.2.1 Eleven samples, taken from seven burnt pits, were submitted for analysis of the charcoal and selection of suitable material for radiocarbon dating. These types of burnt pits are frequently found on sandy sites around Norwich and Ipswich and are often found to date to the Anglo-Saxon or early medieval period. The samples came from three of the slightly larger pits ([155], [158] and [152]) and four of the smaller ones ([106], [141], [160] and [176]). Radiocarbon dating places the pits in the late Anglo-Saxon period; Pits [152], [160] and [176] date to the 9th–10th century AD, and Pit [106] to the 10th–11th century AD.

Methodology

5.2.2 Standard identification procedures were followed, using identification keys (Hather 2000; Schweingruber 1990) and modern reference material. The charcoal was fractured and examined at low magnification (up to x45), with representative fragments examined in longitudinal sections at high magnification (up to x400). All of the samples were scanned in the first instance for suitable dating material and the full results recorded in the site archive. A sub-sample from each feature was then analysed, with 30 fragments recorded. Observations on maturity and other features were made where appropriate. Classification and nomenclature follow Stace (2019).

	Feature	106	141	152	155	158	160	176
	Context no.	105	139	151	153	157	159	175
	Sample no.	8	7	2	3	5	9	10
Clematis vitalba L. traveller's joy	roundwood			1				
Quercus sp. oak	heartwood	13	19	18	22	20	13	11
	sapwood			(2)			2	(1)
	roundwood	2					1	1
	indeterminate maturity	15	11	9	8	10	13	17
Corylus avellana L. hazel	roundwood						1	
Bark				++				+

Table 2: Charcoal from the burnt pits (showing fragment counts)

Brackets denotes cf. identification; +=present; ++=frequent

Results

5.2.3 Preservation of the charcoal was generally good, with mid- or large-sized fragments (up to 8mm). High levels of vitrification were occasionally noted in some fragments. All of the samples were dominated by *Quercus* sp. (oak), with single roundwood fragments of *Clematis vitalba* (traveller's joy) in Pit [152] and *Corylus avellana* (hazel) in Pit [160] (Table 2). Scanning of additional samples from the pits did not yield any additional species identifications. The majority of the oak charcoal exhibited tyloses, indicating the presence of heartwood, although high levels of fragmentation inhibited some determination of maturity. Positive identifications of sapwood and roundwood were rare. A number of fragments exhibited slow growth, with little or no latewood pores visible.

Discussion

5.2.4 The function of the burnt pits is uncertain. They were not directly associated with a settlement area(s), nor did they produce occupation debris; therefore, they presumably represent an activity occurring in the countryside. Possible interpretations include charcoal burning or campfires relating to pastoral farming. The absence of charred cereal remains rules out arable activities such as crop-processing or -drying. The charcoal from the Cringleford pits was predominantly oak heartwood, which has a high calorific value, especially if pre-seasoned. The use of heartwood signifies that trees of some maturity were utilised, since heartwood does not usually form in oak until around 15–25 years of age (Paradis-Grenouillet and Dufraisse 2017). Although no individual fragments exhibited more than 18 years' growth, the absence of ring curvature suggests that the wood came from the trunkwood or large roundwood of trees significantly older than this. This indicates an investment of wood procurement, requiring felling and chopping, which is incompatible with the gathering of fallen branches and deadwood for use on a campfire. The charcoal assemblages from small, temporary cooking fires used, for instance, by shepherds tending their flocks, would typically derive from roundwood of small diameter, representing easily accessible and harvestable wood from a variety of local trees/shrubs. If heathland were available, gorse or heather would make excellent fuel and could be easily harvested.

5.2.5 Consequently, the charcoal evidence from these pits suggests that charcoal making is a more likely function. At the nearby site of Laurel Farm, Thorpe St Andrew, a series of 21 Anglo-Saxon/ early medieval charcoal-making pits were found (Bishop and Proctor 2011, 97). These pits were clearly burnt *in situ*¸ producing copious amounts of charcoal, and were found in association with ironworking activities, including a series of ore-roasting pits. All of the charcoal assemblages were dominated by oak, including a large component of heartwood, although the authors point out that heartwood tends to survive better through the burning process than the outer wood (Austin and Gray 2011, 102). They also concluded that the common presence of detached charred bark fragments indicated that the wood was burnt in the form of roundwood/stem wood, rather than converted. This is possible, and consistent with medieval documentary evidence and traditional practices, in which charcoal clamps were composed of roundwood of 6cm to 25cm diameter, sawn into lengths of about 1m, which were then seasoned prior to burning in a domed stack covered over with turf (Bond 2007, 280–290). However, the presence of charred detached bark on its own merely signifies that bark was not removed prior to burning and could have come from halved or quartered lengths rather than whole roundwood. Certainly, in the Cringleford charcoal, there was insufficient evidence to suggest the burning of whole roundwood.

5.2.6 Additionally, despite a traditional use of diverse taxa (usually sourced from coppiced stems of mixed deciduous woodland), there was a clear preference for oak at both Cringleford and Laurel Farm. This picture is replicated in two presumed charcoal-making pits (one Anglo-Saxon and one early medieval) excavated at Easton, a few miles north-west of Cringleford, which also produced charcoal assemblages dominated by oak heartwood, with rare fragments of holly (*Ilex aquifolium*) (Challinor 2019). This suggests a localised practice, using larger, mature oak wood, perhaps utilising a variation on the round mounded wood stack. One possible approach to this is a type of low, rectangular mound used in modern-day Tanzania, which is more appropriate for larger lengths or widths of logs (TFCG 2012). Some of these large rectangular-type stacks are built over shallow pits (Kelley 1996, 4).

5.2.7 There was no clear evidence for *in-situ* burning in the Cringleford pits. Areas of light scorching around the pits' sides and bases are perhaps more in keeping with dumps of still-hot charcoal from a process taking place somewhere nearby. However, the evidence is not conclusive and it remains possible that the pits were themselves parts of the charcoal clamps, with the low level of scorching reflecting the fact that the heat generated mainly radiated upwards into the stack rather than outwards. Whatever the 'original' function of the pits, their contents are likely to represent burial of sweepings/waste from the charcoal-burning process. Historical documents record that, after a charcoal burn, charcoal was graded for different purposes; in the 17th century AD, for instance, wood colliers from the Weald reserved the larger portions of charcoal for ironworks, while medium-sized and smaller charcoal was taken into London for domestic and other uses (Bond 2007, 292). Many of the historic – and current – uses for small charcoal did not exist in the Anglo-Saxon period (e.g. gunpowder) and it is likely that this smaller material was considered waste (and/or was deemed too difficult or uneconomical to transport). The charcoal at Cringleford was highly fragmented and did not include particularly large pieces.

5.2.8 Why waste remains from a charcoal burn were dumped into pits rather than left on the surface to degrade is a matter for conjecture. One possibility is to prevent unintentional fires, although native woodlands are not prone to forest fires (Rackham 1989, 24–25). It is likely that charcoal manufacture would have occurred within the woodland from which the wood was sourced, since the finished product is easier to transport than the wood. The narrow growth rings seen in the Cringleford charcoal, similar to growth signatures seen at Laurel Farm (Austin and Gray 2011,102), indicate periods of slow growth caused by less than optimum conditions, such as growing in dense woodland. This would suggest that there were local pockets of closed woodland around late Saxon to medieval Norwich, alongside more open and heathland areas, which were exploited for charcoal making and industry. The evidence from both Cringleford and the site at Easton appears to represent small-scale activity, presumably for local consumption in the city, perhaps particularly to supply the considerable

needs of the ironworking industry which flourished there in the late Saxon period (Woolhouse and Cowgill 2009).

6 DISCUSSION AND CONCLUSIONS

6.1 Radiocarbon dating has shown the charcoal pits to be of late Anglo-Saxon (9th- to 10th-/early-11th-century AD) date. This is in line with what was expected and accords well with the Anglo-Saxon to early medieval radiocarbon dates for many other similar 'burnt pits'/ 'charcoal pits' found in excavations around Norwich (e.g. Laurel Farm, Thorpe St Andrew (Bishop and Proctor 2011); Mayton Wood, Buxton with Lammas (NHER 39833)), as well as at other sites in Norfolk, Suffolk and further afield.

6.2 Analysis indicates that the charcoal in the Cringleford pits is predominantly oak heartwood. This would almost certainly not have been used in *ad hoc* shepherds' fireplaces, as was considered a possibility in the evaluation report (Jones and Woolhouse 2019, 30). Instead, it reflects the systematic burning of good-quality timber from the trunks and larger branches of mature oak trees, a valuable resource which would have required a considerable investment of time and labour to fell and prepare. The charcoal in the pits is likely to be the waste from a charcoal-burning industry operating in this area during the later Anglo-Saxon period, comprising material that was considered too small to be useful or economical to transport.

6.3 The reason why the waste charcoal was deliberately buried rather than just being left on the ground surface is unclear. It could perhaps have been a measure to mitigate against forest fires, though native broadleaf woodlands are not that susceptible to conflagration (Rackham 1989, 24–25). This raises the possibility that, despite the apparently minimal evidence for *in-situ* burning, the pits were themselves parts of the charcoal clamps, with their contents consisting of material that was discarded during the process of sorting/ grading charcoal after a burn. This waste material was either deliberately discarded into the pits, which would have been exposed once the stacks were opened, or else it was casually deposited on the ground surface and some of it became incidentally incorporated into them. However, as discussed above, their small size compared to the charcoal-burning pits at Laurel Farm and other sites does not sit easily with identification as integral components of the charcoal stacks

themselves, and the question of the pits' 'original' function remains open.

6.4 The destination of the end products of the charcoal burning is not certain, but is perhaps most likely to have been the developing city at Norwich, which experienced significant growth during the 10th and 11th centuries AD. In particular, it is known that there was a major ironworking industry operating in the Coslany area, in the north of the city, at this time, which must have required considerable inputs of raw materials including charcoal (Woolhouse and Cowgill 2009). At Laurel Farm, Thorpe St Andrew, on the east side of Norwich and a similar distance from the historic city centre as Cringleford, there were a combination of charcoal-burning pits to supply fuel and ore-roasting pits for heating iron ore obtained from the natural gravels to remove any impurities (Bishop and Proctor 2011, 79–104 and 122–24). Charcoal-burning pits have frequently been found in association with ironworking features elsewhere, for example, at Cross Leys Quarry, Wittering, Cambridgeshire, where several clusters of charcoal-rich pits were radiocarbon dated to about cal. AD 520–660 (Peterborough HER 51192, 51311; Abrams 2002; Abrams and Wilson 2004), and Bestwall Quarry, Wareham, Dorset, where nearly 1000 oak charcoal-filled pits were found over a wide area and returned radiocarbon dates mostly in the range cal. AD 700–850 (Ladle 2006). Charcoal is less likely to have been used in domestic fires, as its manufacture required significant investment of labour and raw materials, usually from carefully managed woods (the conversion rate of wood to charcoal is around 7:1 or, at best, 5:1; Dana Challinor, pers.comm.).

6.5 It is perhaps unsurprising that other low-density scatters of similar small, charcoal-rich pits, of Anglo-Saxon to early medieval date, and probably similar in function, are frequently encountered in excavation in the hinterlands of other Anglo-Saxon towns, most notably around the *emporia* at Ipswich (e.g. Suffolk HER IPS 719 (Clover 2013); IPS 725 (Woolhouse 2014); IPS 756 (Jones 2015); MRM 157 (Woolhouse 2016)), but also close to monastic settlements such as Peterborough (*Medeshamstede*) (Webley 2007). The apparent concentration of such features on sites in the hinterlands of Ipswich and Norwich is likely to be linked to the development of those settlements into major centres of population and industry in the middle and late Anglo-Saxon periods,

respectively. While ironworking may have been a particular stimulus to charcoal production in the Norwich environs, the presence of the Ipswich Ware pottery industry might have provided a similar impetus for charcoal burning in the countryside around Ipswich from the late 7th/ early 8th century onwards.

6.6 Craft and industrial production during the Anglo-Saxon period, and the interrelationships between rural 'producer' and urban 'consumer' sites have been identified in the East Anglian regional archaeological research agendas as topics requiring further research (Medlycott 2011, 56–58).

6.7 Use of the site for charcoal burning in the late Saxon period, utilising mature oak trees, poses some interesting questions for wider issues of local landscape history. If, as conjectured, the first phase of undated field boundary ditches at the site dates from the Middle to Late Bronze Age, then there must have been woodland growth here at some point between the later Bronze Age and the Anglo-Saxon period. Evidence for later prehistoric field systems and Anglo-Saxon to medieval charcoal burning frequently occur together on sand and gravel sites across Norfolk and Suffolk, sometimes in areas of known/ documented former common heathland, and usually with a distinct absence of any archaeological evidence for activity during other periods of prehistory or history. There has been speculation that these elements might together amount to a distinct heathland 'archaeological signature', that could perhaps then be extrapolated to identify other, undocumented, areas of former common land (Albone 2019). Certainly, there is no historical record of the Cringleford site being within a former heath or common. Although its archaeological record of prehistoric(?) fields, Anglo-Saxon charcoal burning and otherwise low-intensity land use would fit this suggested heathland signature, the environmental evidence here (narrow growth rings observable in the heartwood) indicates a landscape of closed-canopy woodland rather than open heath, in Anglo-Saxon times at least.

7 ACKNOWLEDGEMENTS

7.1 Pre-Construct Archaeology Ltd would like to thank Myk Flitcroft of CgMs Consulting Ltd for commissioning the work on behalf of Kier. PCA are also grateful to James Albone of Norfolk County Council Historic Environment Team for monitoring the work on behalf of the Local Planning Authority. The project was managed for PCA by Tom Woolhouse and the fieldwork was supervised by Matt Jones. The author would like to thank Iza Anderle, Petra Ivanova, Tibi Nica, Gareth Morgan and Roz Hall for their hard work on site. Figures accompanying this report were prepared by Rosie Scales of PCA's CAD Department. Finds analysis was coordinated by Sîan O'Neill.

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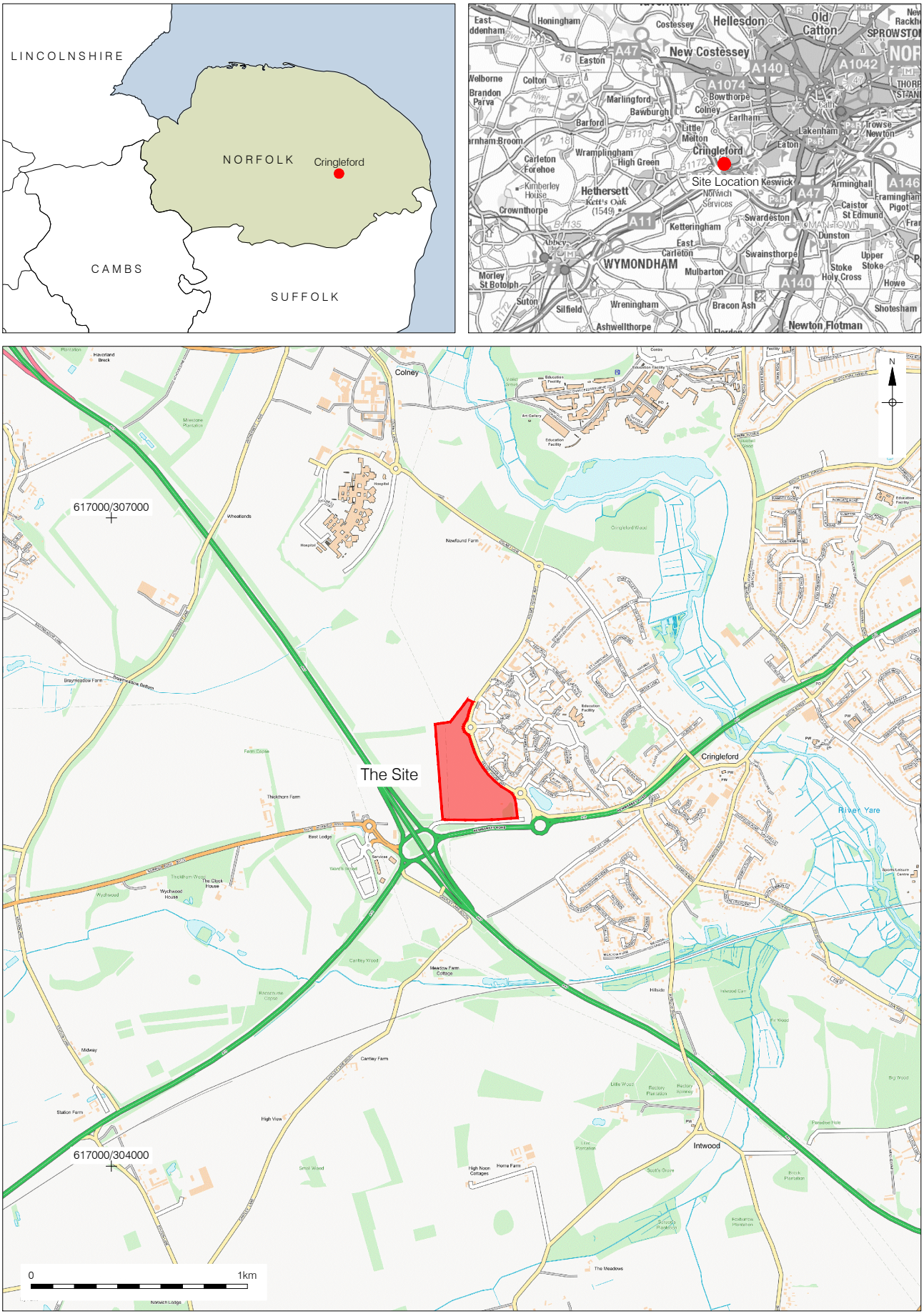
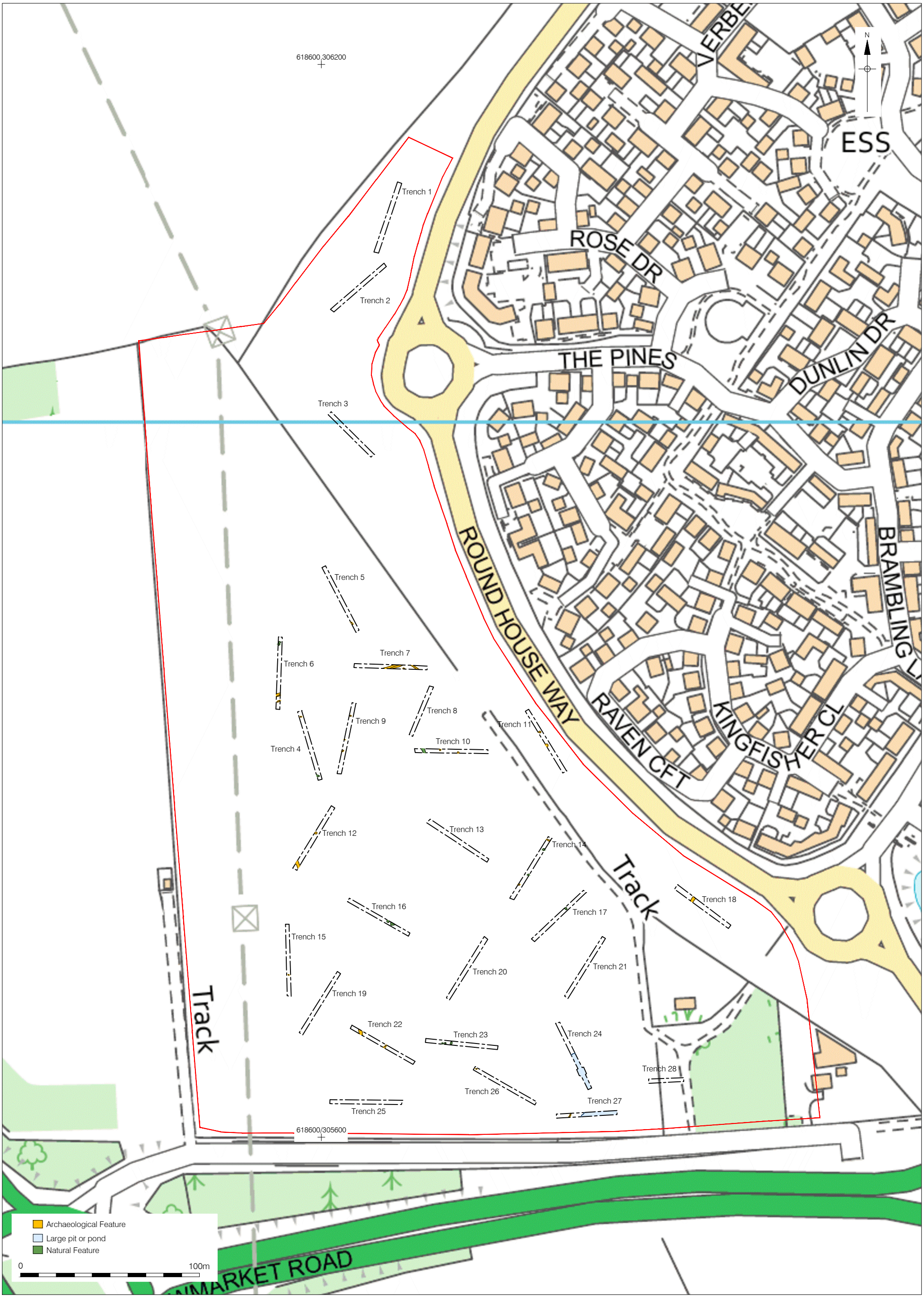
9 FIGURES

Figure 1 Site Location



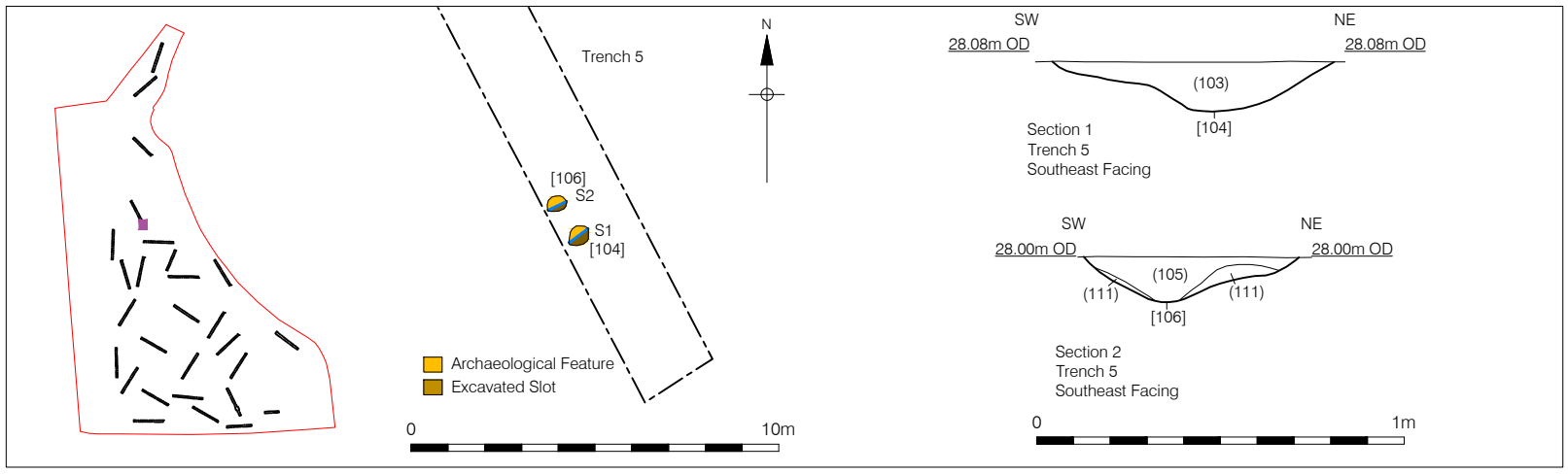
26/02/19 RS

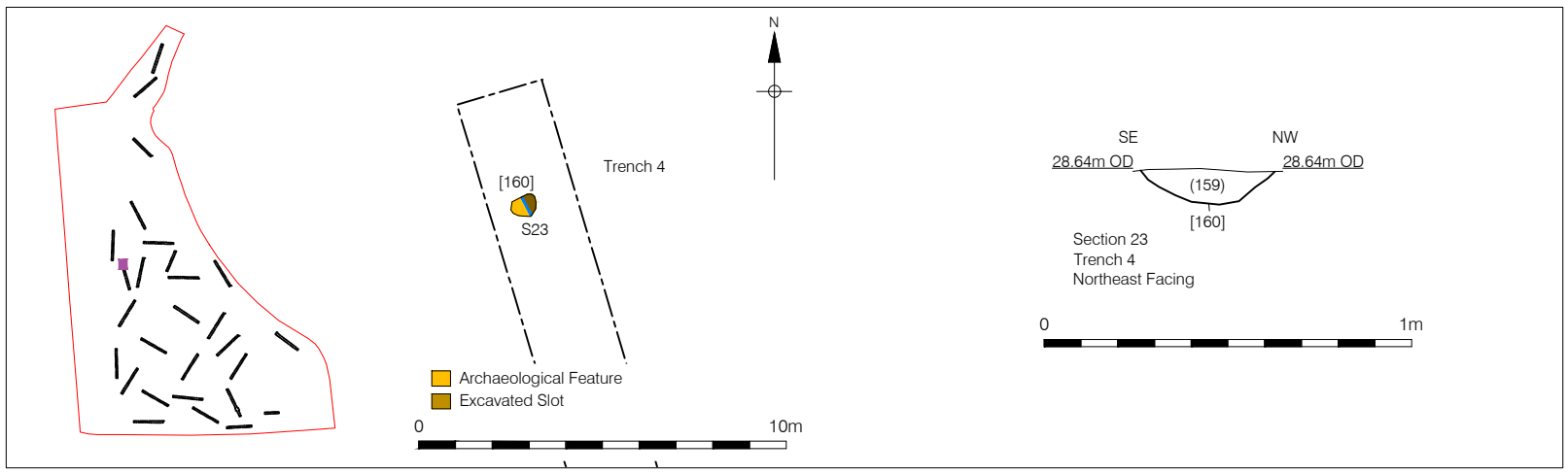
Figure 1
Site Location
1:2,000,000, 1:250,000, 1:25,000 at A4

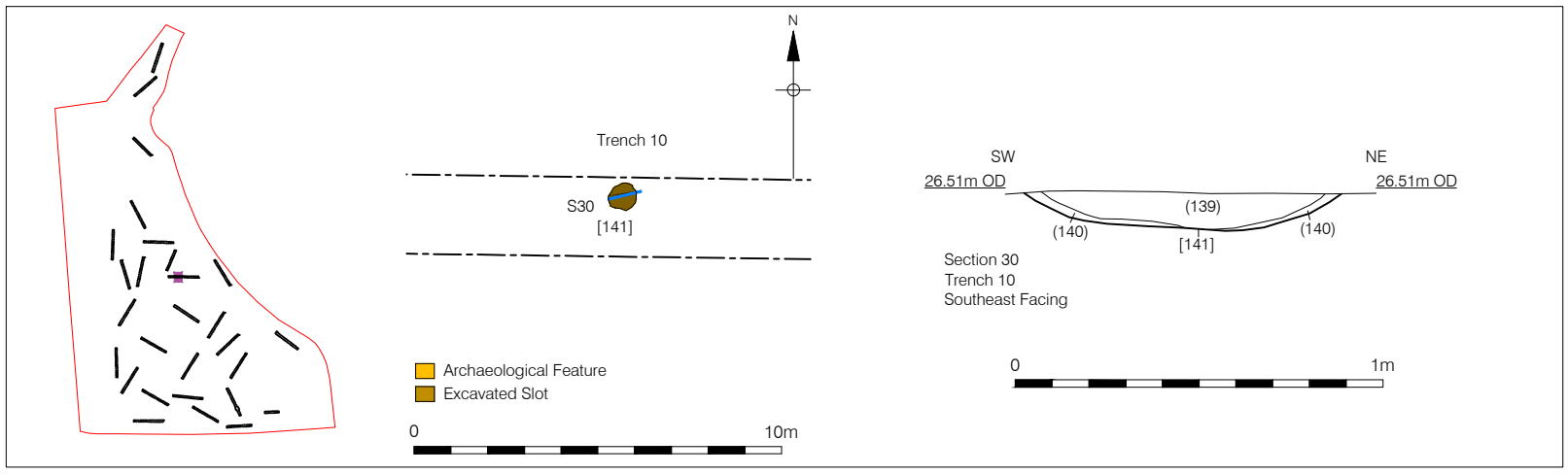


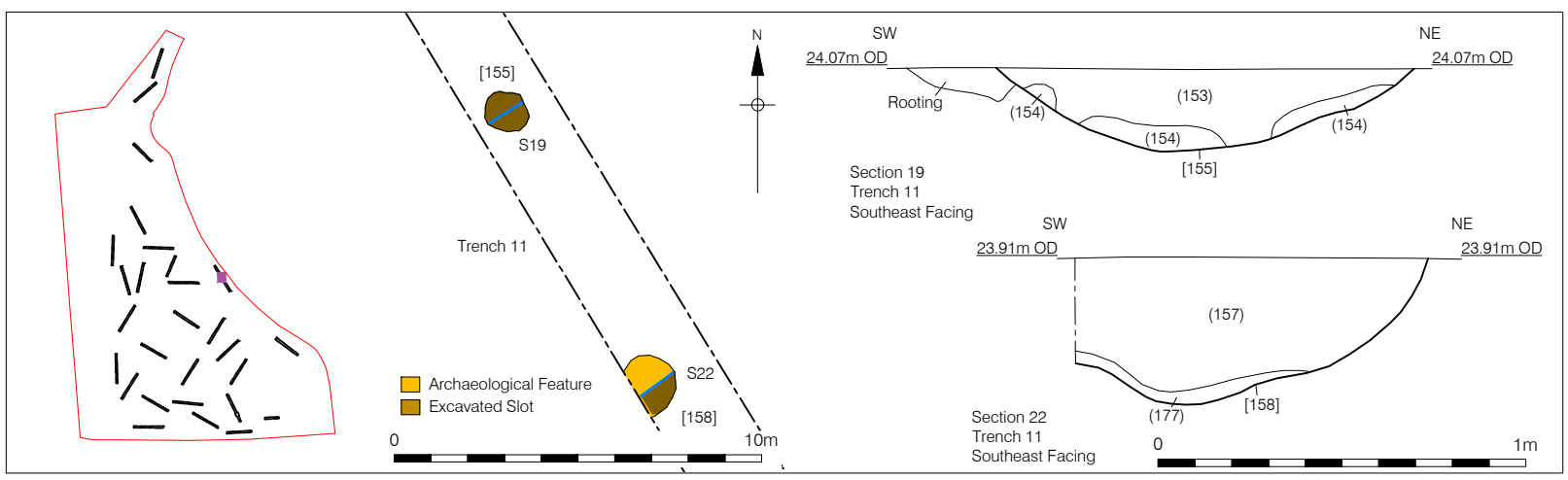
26/02/19 RS

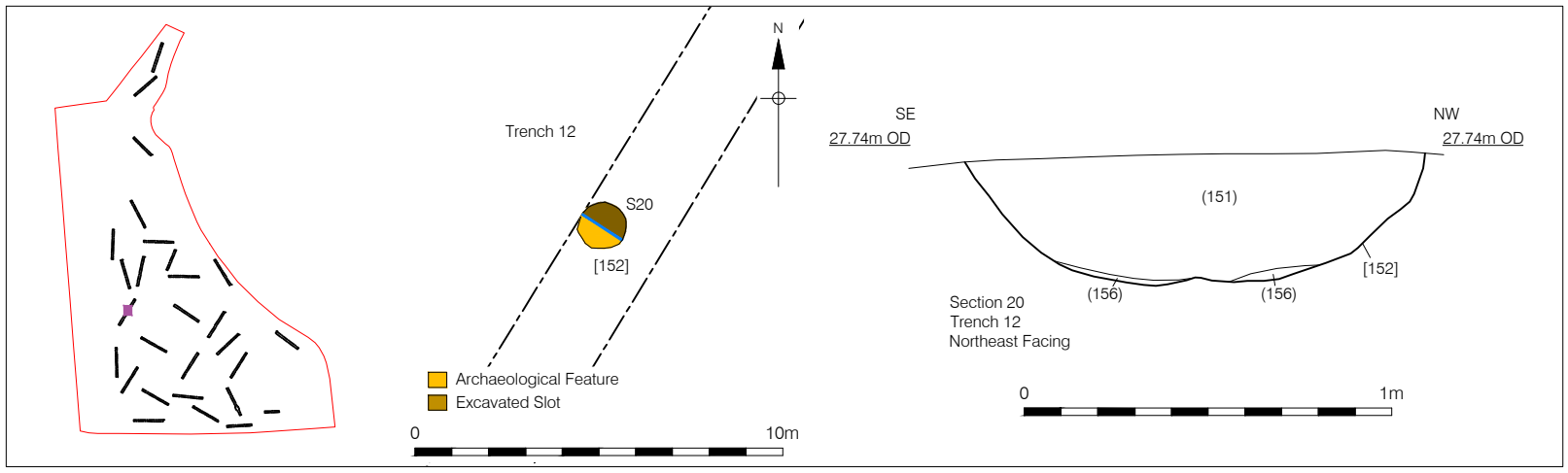
Figure 2
Detailed Trench Location
1:2000 at A3

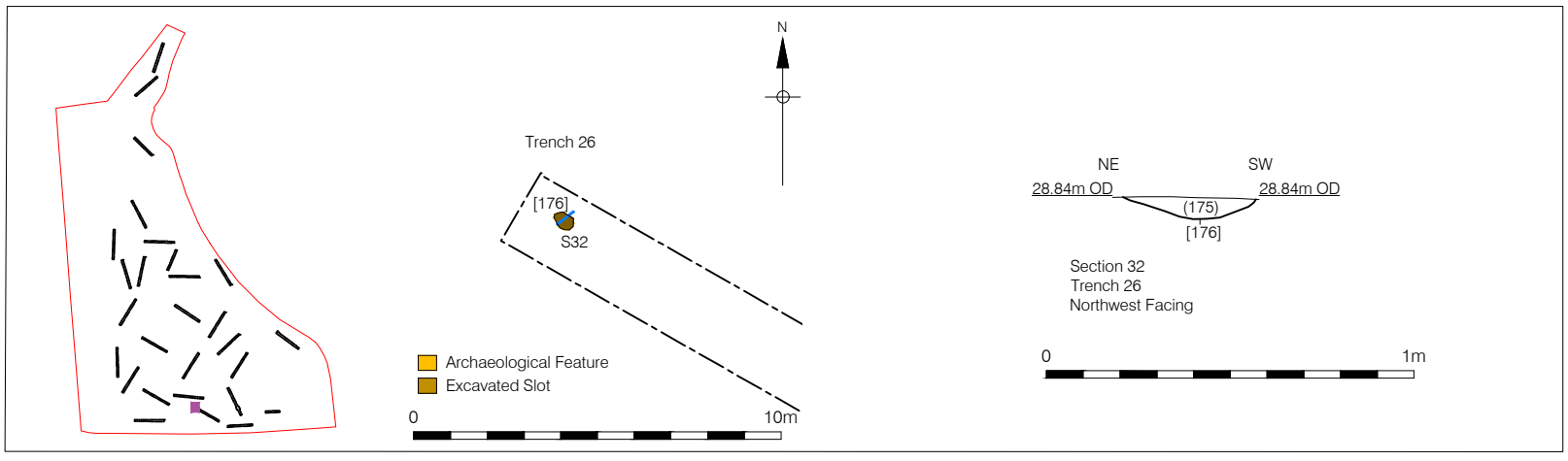












26/02/19 RS

Figure 3
Plans and Sections of all Charcoal Pits
Inset 1:10 000, Plans 1:200, Sections 1:20 at A3

10 APPENDIX 1: PLATES

Plate 1: The site, view south-west

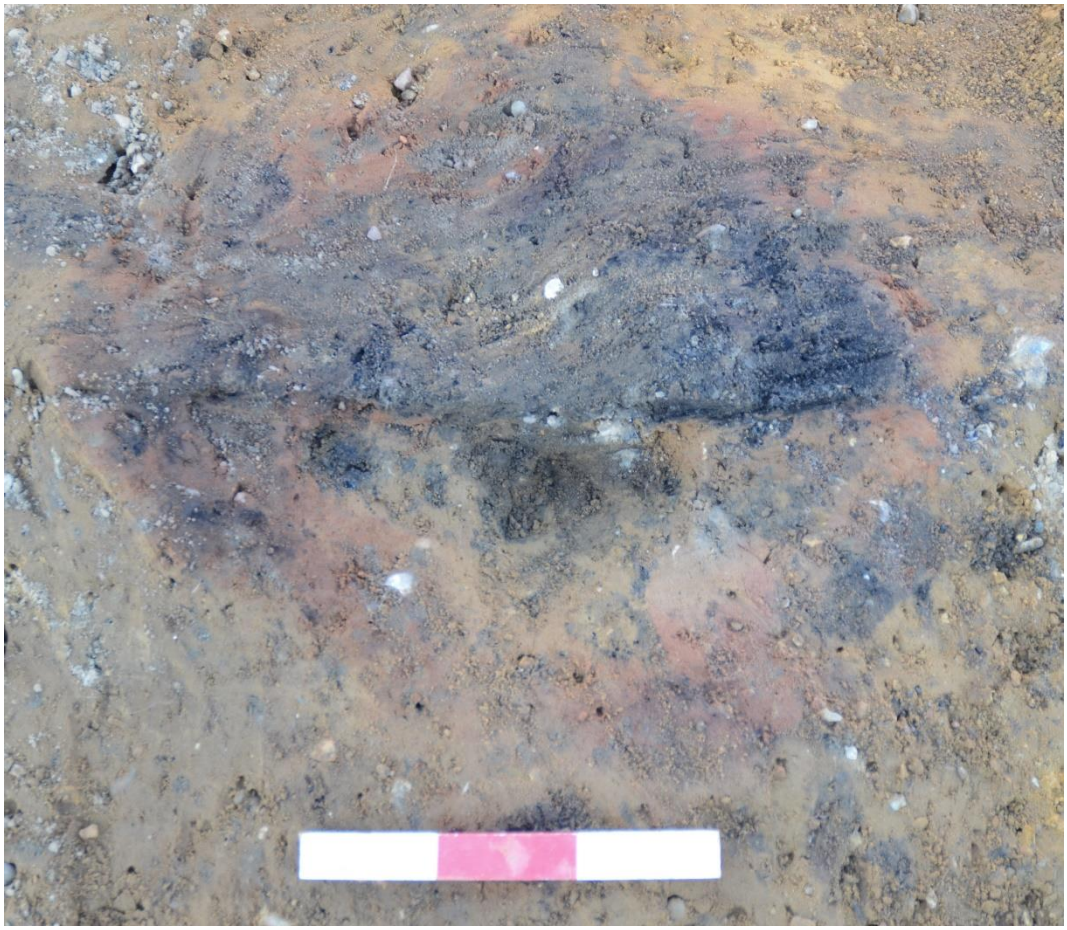


Plate 2: Charcoal Pit [141] (Trench 10), view north

Plate 3: Charcoal Pit [155] (Trench 11), view north

Plate 4: Charcoal Pit [158] (Trench 11), view north

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UK

Friday, 28th February 2020

Report on Radiocarbon Age Determination for BRAMS-3551

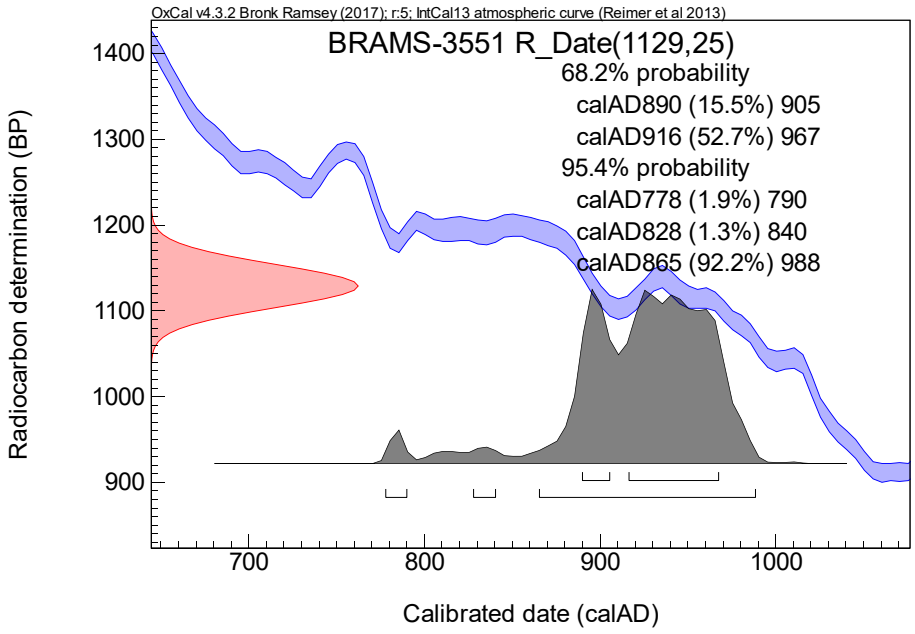
Submitter:	Sian O'Neill
Submitter's Code:	2 (Clematis Vitalba rw x1)
Project:	Roundhouse Way, Cringleford
Sample material:	Charcoal
Pretreatment Code:	ABA

$F^{14}C$	**0.8688± 0.27 %**
Result	**1129 ± 25 BP**
Indicative $\delta^{13}C$	**-29.4 ‰**

The result is given in uncalibrated radiocarbon years Before Present (BP). Data given are corrected for isotopic fractionation using the $^{13}C/^{12}C$ ratio measured on the AMS. The $\delta^{13}C$ value was measured on the AMS and may have been subject to additional isotopic fractionation. The error associated with this value is typically ±1‰.

Calibration Plot

Calibration was performed using OxCal software v4.3.2 and the IntCal13 atmosphric calibration curve



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Friday, 28th February 2020

Report on Radiocarbon Age Determination for BRAMS-3552

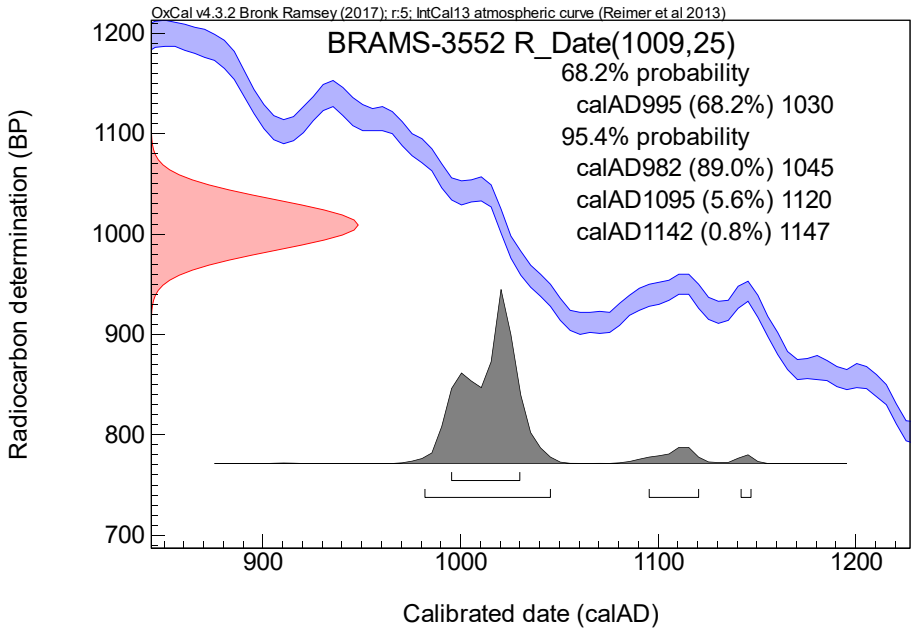
Submitter:	Sian O'Neill
Submitter's Code:	8 (Quercus rw x1)
Project:	Roundhouse Way, Cringleford
Sample material:	Charcoal
Pretreatment Code:	ABA

$F^{14}C$	**0.8820± 0.27 %**
Result	**1009 ± 25 BP**
Indicative $\delta^{13}C$	**-27.9 ‰**

The result is given in uncalibrated radiocarbon years Before Present (BP). Data given are corrected for isotopic fractionation using the $^{13}C/^{12}C$ ratio measured on the AMS. The $\delta^{13}C$ value was measured on the AMS and may have been subject to additional isotopic fractionation. The error associated with this value is typically ±1‰.

Calibration Plot

Calibration was performed using OxCal software v4.3.2 and the IntCal13 atmosphric calibration curve



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Friday, 28th February 2020

Report on Radiocarbon Age Determination for BRAMS-3553

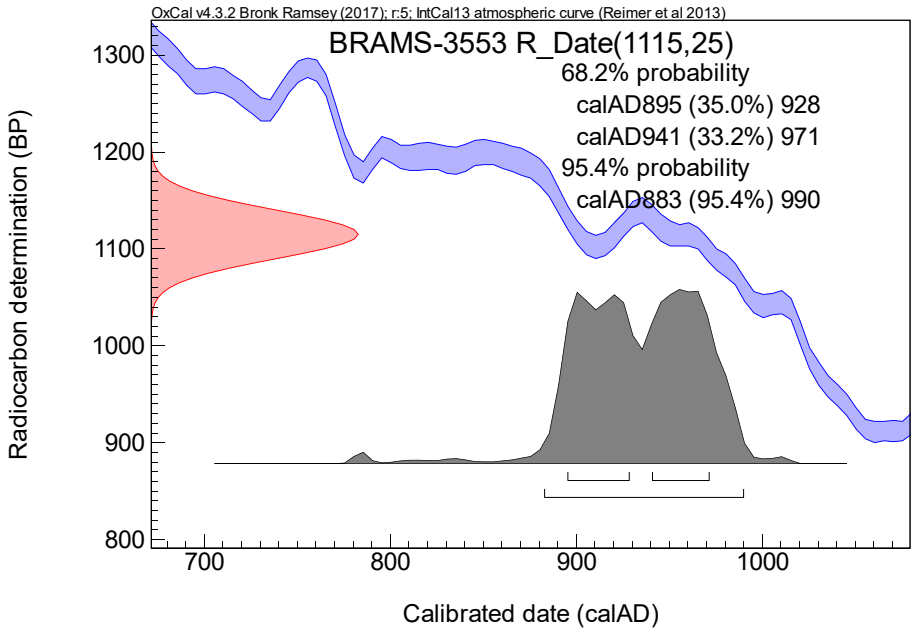
Submitter:	Sian O'Neill
Submitter's Code:	9 (Corylus Avellana rw x1)
Project:	Roundhouse Way, Cringleford
Sample material:	Charcoal
Pretreatment Code:	ABA

$F^{14}C$	**0.8704± 0.27 %**
Result	**1115 ± 25 BP**
Indicative $\delta^{13}C$	**-31.5 ‰**

The result is given in uncalibrated radiocarbon years Before Present (BP). Data given are corrected for isotopic fractionation using the $^{13}C/^{12}C$ ratio measured on the AMS. The $\delta^{13}C$ value was measured on the AMS and may have been subject to additional isotopic fractionation. The error associated with this value is typically ±1‰.

Calibration Plot

Calibration was performed using OxCal software v4.3.2 and the IntCal13 atmosphric calibration curve



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UK

Friday, 28th February 2020

Report on Radiocarbon Age Determination for BRAMS-3554

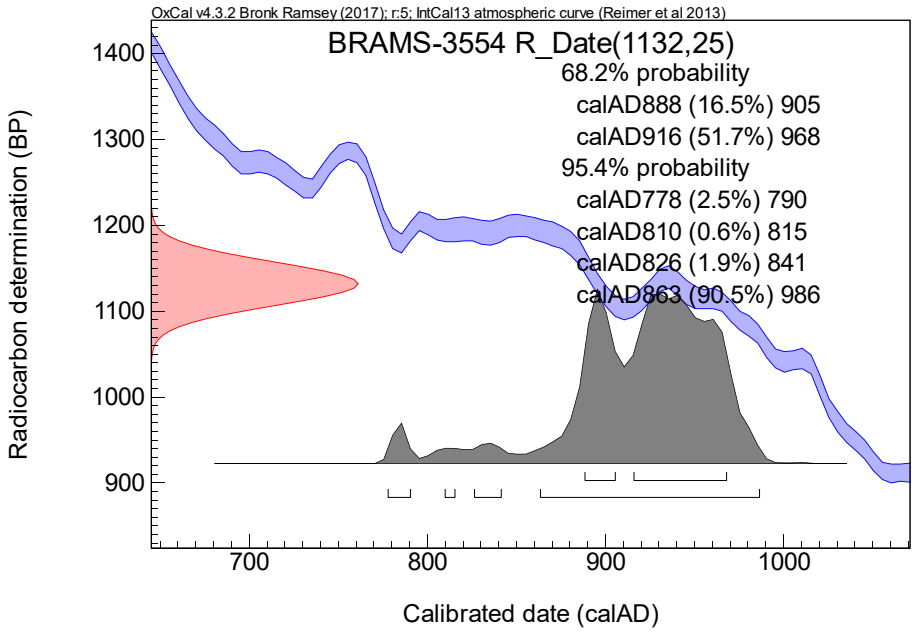
Submitter:	Sian O'Neill
Submitter's Code:	10 (Quercus rw x1)
Project:	Roundhouse Way, Cringleford
Sample material:	Charcoal
Pretreatment Code:	ABA

$F^{14}C$	**0.8686± 0.27 %**
Result	**1132 ± 25 BP**
Indicative $\delta^{13}C$	**-26.4 ‰**

The result is given in uncalibrated radiocarbon years Before Present (BP). Data given are corrected for isotopic fractionation using the $^{13}C/^{12}C$ ratio measured on the AMS. The $\delta^{13}C$ value was measured on the AMS and may have been subject to additional isotopic fractionation. The error associated with this value is typically ±1‰.

Calibration Plot

Calibration was performed using OxCal software v4.3.2 and the IntCal13 atmosphric calibration curve



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Dr. Timothy Knowles
BRAMS Manager

12 APPENDIX 3: DRAFT ARTICLE FOR *NORFOLK ARCHAEOLOGY*

LATE SAXON CHARCOAL BURNING AT ROUND HOUSE WAY, CRINGLEFORD

By Tom Woolhouse and Dana Challinor

ABSTRACT

A trial trench evaluation carried out by Pre-Construct Archaeology on land west of Round House Way, Cringleford, recorded eight small pits with charcoal-rich fills, which have been radiocarbon dated to the late Saxon period (9th- to 10th-/early-11th-century AD). Analysis indicates that the charcoal is predominantly oak heartwood from the trunks and large branches of mature trees. It is likely to derive from systematic burning of wood for charcoal manufacture, with the pits containing waste fragments that were considered too small to be useful or economical to transport. The products of this charcoal-burning industry are likely to have supplied demand in the growing town at Norwich, perhaps not least the ironworking industry that flourished in the Coslany area during the 10th to 12th centuries. Similar Anglo-Saxon 'charcoal pits' are frequently found in archaeological work around Norwich and Ipswich, as well as in the hinterlands of other large Anglo-Saxon settlements in the wider region.

INTRODUCTION AND BACKGROUND

An archaeological trial trench evaluation was undertaken by Pre-Construct Archaeology (PCA) on 5.85ha of land west of Round House Way, Cringleford (centred on Ordnance Survey National Grid Reference (NGR) TG 1863 0578) in February 2019 (Figure 1). The archaeological work was commissioned by CgMs (now RPS) Consulting Ltd, on behalf of Kier Homes, prior to residential development. The aim was to determine the location, date, extent, character, condition and significance of any archaeological remains on the site and to assess the potential impact of the development on any archaeological remains. Twenty-eight trial trenches, totalling 1100m in length, were excavated and recorded.

The evaluation trenches found undated ditches across the site. These were generally narrow and shallow, with leached and artefactually sterile fills, and were morphologically similar to the Middle to Late Bronze Age field boundaries which are found quite widely on light-soil sites across East Anglia. Based on ditch alignments, at least two phases of land division may be represented. Sparsely distributed across the site were eight small, undated pits containing abundant small charcoal fragments. These were similar to the 'burnt pits'/ 'charcoal pits' frequently recorded at sites around Norwich. Although these burnt pits rarely contain datable artefacts, where radiocarbon dates have been attained, they often place the features in the Anglo-Saxon period. Nevertheless, the precise dating and function of these widely occurring features remains poorly understood.

These remains were not deemed significant enough to warrant further archaeological excavation and recording at the site prior to development. However, it was agreed with the

planning authority's archaeological advisor that a programme of analysis would be carried out on the charcoal pits found during the evaluation to attempt to ascertain their date and function. This analysis would comprise assessment and, where considered worthwhile, full quantification and analysis of the charcoal from a selection of the pits, together with a suite of radiocarbon dates.

Full details of the background to the project, excavation and sampling methodologies, complete descriptions of the archaeological features and deposits found, and full specialist reports and catalogues can be found in the evaluation report (Jones and Woolhouse 2019), available from Norfolk Historic Environment Record (NHER) or online via the Archaeology Data Service website <http://archaeologydataservice.ac.uk>. The site archive will be deposited at Norwich Castle Museum under Accession No. NWHCM: 2019.78.

TOPOGRAPHY AND GEOLOGY

The majority of the site occupies a single former arable field within a gently undulating plateau landscape. The ground level gradually rises from the River Yare valley to the east, with an overall rise in elevation across the site of approximately 6m, from 24m above Ordnance Datum (AOD) in the north-east to 30m AOD in the south-west. The underlying geology is nodular chalk overlain by superficial deposits of glacial sand and gravel (British Geological Survey 2020). The natural geology encountered during the evaluation was generally a coarse, orangey-brown, slightly clayey sand with occasional flints, overlain by 0.40–0.50m of overburden consisting of ploughsoil and, occasionally, a thin 'subsoil', which was actually just the disturbed/ rooted interface between the plough zone and the geological horizon. The character of the archaeological remains encountered, the sterile appearance of the fills of most features, and the very low incidence of artefactual material both within cut features and in the overburden, suggest that the site had only ever seen low-intensity land use.

DESCRIPTION OF THE ARCHAEOLOGICAL FEATURES

Late Saxon charcoal pits

The principal result of the fieldwork was the identification of eight small, charcoal-rich pits, some of which had lightly scorched sides and bases (Figures 2 and 3). The pits were all roughly circular in plan with gradual to steep sides, concave bases and main fills of dark silty sand containing abundant small charcoal pieces, sometimes with a basal 'fill' of reddish natural sand discoloured by heating. The pits ranged from 0.4m to about 1.4m across and were between 0.06 and 0.36m deep (mean 0.79m wide and 0.17m deep).

The degree of discolouration of the surrounding geology at the sides and bases of the pits was only slight, possibly indicating deposition of charcoal that was still hot rather than *in-situ* burning. An implication of this might be that, while whatever high-temperature process created the charcoal was taking place nearby, the pits may have had little to do with that process. This lack of evidence for direct exposure to sustained heat, together with their small size, might

suggest that the pits were not themselves bases of charcoal clamps. Certainly, the features identified as Anglo-Saxon charcoal-burning pits at nearby Laurel Farm, Thorpe St Andrew (where there was a complex of features associated with iron ore extraction, processing and smelting) were considerably larger than the pits at Cringleford, ranging between 1.7 and 3.6m in diameter and from 0.09 to up to 1.26m deep (Bishop and Proctor 2011, 89–93; Riddler 2011, 97–98). Similarly, clear examples of charcoal-burning pits at a number of recently excavated sites in Ireland are rectangular in shape, 2–3m long, and filled with carbonised oak and alder (Carlin 2008, 89–91, 101 and fig. 58). In fact, the Cringleford pits are far closer in size to the features identified as 'iron ore-roasting pits' at Laurel Farm (0.25–1.3m wide and 0.06–0.39m deep), although with much less evidence for *in-situ* burning. However, the total absence of any other evidence for iron ore extraction or processing at Cringleford (e.g. quarry pits, ironstone fragments, smelting slag) renders such an identification highly unlikely.

Overall, a definitive conclusion regarding the 'original' function of the charcoal pits at Cringleford, whether they were below-ground components of charcoal clamps or were simply used to dispose of residues from charcoal burning, cannot be reached on the basis of the available evidence. The same minimally scorched appearance could arise from a process that was either relatively low-heat, one in which the majority of the heat generated was directed upwards rather than outwards, or one that was intentionally designed to maintain a reducing (low oxygen) environment, as would be expected in a charcoal stack.

Very little artefactual material was present in the charcoal pits, being limited to a clay pipe fragment, a sherd of 19th-century pottery and a shard of modern glass, none of them well stratified. These finds were almost certainly deposited during 18th- and 19th-century agricultural land use and have nothing to do with the date or function of the charcoal pits. Charcoal fragments of suitable size for radiocarbon dating were extracted manually during the excavation or were taken from bulk soil samples prior to or following flotation. Charcoal samples from four pits were sent to the Bristol Radiocarbon Accelerator Mass Spectrometry Facility (BRAMS) for dating. These consistently returned calibrated dates spanning the middle Anglo-Saxon to early medieval period, but most likely between the 9th–10th/early 11th centuries – the late Saxon period (Table 1).

The charcoal pits were scattered across the site, with the main concentration apparently in its central northern area (Trenches 4, 5, 10, 11 and 12), but at least one outlying pit was found in Trench 26, some distance to the south of the nearest identified pit in the main 'cluster'. Pits across the site were all the same age, so their location does not appear to have any chronological significance.

Undated field boundary ditches

Aside from the charcoal pits, a number of ditches were identified in the trenches. These appear to form parts of two main systems: the first made up of narrow and 'sinuous' ditches with leached fills, orientated north-west to south-east by north-east to south-west, and a second system formed by a set of marginally more substantial ditches, aligned east-north-east to west-south-west by north-north-west to south-south-east (Figure 4). The former ditch system may be of some antiquity, potentially as early as the Bronze Age, based on the ditches'

morphological similarity to the later prehistoric (*c.* 1500–800 BC) field systems that are widely found on light soils in the Suffolk and Norfolk river valleys and along the Cambridgeshire fen edge. The alignments of the second system are also slightly at odds with the modern field layout and must therefore be earlier than the mid-19th century, by which time the extant field pattern was already more-or-less established and the site was, in any case, part of a single large field (Figure 4). They might be early post-medieval (*c.* 16th- to 18th-century) but later Iron Age, Roman, Anglo-Saxon or medieval dates are also possible.

ANALYSIS OF THE WOOD CHARCOAL

By Dana Challinor

Introduction

Eleven samples, taken from seven burnt pits, were submitted for analysis of the charcoal and selection of suitable material for radiocarbon dating. These types of burnt pits are frequently found on sandy sites around Norwich and Ipswich and are often found to date to the Anglo-Saxon or early medieval period. The samples came from three of the slightly larger pits ([155], [158] and [152]) and four of the smaller ones ([106], [141], [160] and [176]). Radiocarbon dating places the pits in the late Anglo-Saxon period.

Methodology

Standard identification procedures were followed, using identification keys (Hather 2000; Schweingruber 1990) and modern reference material. The charcoal was fractured and examined at low magnification (up to x45), with representative fragments examined in longitudinal sections at high magnification (up to x400). All of the samples were scanned in the first instance for suitable dating material and the full results recorded in the site archive. A sub-sample from each feature was then analysed, with thirty fragments recorded. Observations on maturity and other features were made where appropriate. Classification and nomenclature follow Stace (2019).

Results

Preservation of the charcoal was generally good, with mid- or large-sized fragments (up to 8mm). High levels of vitrification were occasionally noted in some fragments. All of the samples were dominated by *Quercus* sp. (oak), with single roundwood fragments of *Clematis vitalba* (traveller's joy) in Pit [152] and *Corylus avellana* (hazel) in Pit [160] (Table 2). Scanning of additional samples from the pits did not yield any additional species identifications. The majority of the oak charcoal exhibited tyloses, indicating the presence of heartwood, although high levels of fragmentation inhibited some determination of maturity. Positive identifications of sapwood and roundwood were rare. A number of fragments exhibited slow growth, with few or no latewood pores visible.

Discussion

The function of the burnt pits is uncertain. They were not directly associated with a settlement area, nor did they produce occupation debris; therefore, they presumably represent an activity occurring in the countryside. Possible interpretations include charcoal burning or campfires relating to pastoral farming. The absence of charred cereal remains rules out arable activities such as crop processing or drying. The charcoal from the Cringleford pits was predominantly oak heartwood, which has a high calorific value, especially if pre-seasoned. The use of heartwood signifies that trees of some maturity were utilised, since heartwood does not usually form in oak until around fifteen to twenty-five years of age (Paradis-Grenouillet and Dufraisse 2017). Although no individual fragments exhibited more than eighteen years' growth, the absence of ring curvature suggests that the wood came from the trunkwood or large roundwood of trees significantly older than this. This indicates an investment in wood procurement, requiring felling and chopping, which is incompatible with the gathering of fallen branches and deadwood for use on a campfire. The charcoal assemblages from small, temporary cooking fires used, for instance, by shepherds tending their flocks, would typically derive from roundwood of small diameter, representing easily accessible and harvestable wood from a variety of local trees and shrubs. If heathland were available, gorse or heather would also make excellent fuel and could be easily harvested.

Consequently, the charcoal evidence from these pits suggests that charcoal making is a more likely function. At the nearby site of Laurel Farm, Thorpe St Andrew, twenty-one late Saxon/ early medieval charcoal-making pits were found (Bishop and Proctor 2011, 97). These pits were clearly burnt *in situ*¸ producing copious amounts of charcoal, and were found in association with ironworking activities, including a series of ore-roasting pits. All of the charcoal assemblages were dominated by oak, including a large component of heartwood, although the authors point out that heartwood tends to survive better through the burning process than the outer wood (Austin and Gray 2011, 102). They also concluded that the common presence of detached charred bark fragments indicated that the wood was burnt in the form of roundwood/stemwood, rather than converted. This is possible, and consistent with medieval documentary evidence and traditional practices, in which charcoal clamps were composed of roundwood of 6cm to 25cm diameter, sawn into lengths of about 1m, which were then seasoned prior to burning in a domed stack covered with turf (Bond 2007, 280–290). However, the presence of charred detached bark on its own merely signifies that bark was not removed prior to burning and could have come from halved or quartered lengths rather than whole roundwood. Certainly, in the Cringleford charcoal, there was insufficient evidence to suggest the burning of whole roundwood.

Additionally, despite a traditional use of diverse taxa (usually sourced from coppiced stems of mixed deciduous woodland), there was a clear preference for oak at both Cringleford and Laurel Farm. This picture is replicated in two presumed charcoal-making pits (one Anglo-Saxon and one early medieval) excavated at Easton, a few miles north-west of Cringleford, which also produced charcoal assemblages dominated by oak heartwood, with rare fragments of holly (*Ilex aquifolium*) (Challinor 2019). This suggests a localised practice using larger, mature oak wood, perhaps utilising a variation on the round mounded wood stack. One

possible approach to this is a type of low rectangular mound used in modern-day Tanzania, which is more appropriate for larger lengths or widths of logs (TFCG 2012). Some of these large rectangular-type stacks are built over shallow pits (Kelley 1996, 4).

There was little evidence for *in-situ* burning in the Cringleford pits. Areas of light scorching around the pits' sides and bases are perhaps more in keeping with dumps of still-hot charcoal from a process taking place somewhere nearby. However, the evidence is not conclusive and it remains possible that the pits were themselves parts of the charcoal clamps, with the low level of scorching reflecting the fact that the heat generated mainly radiated upwards into the stack rather than outwards. Whatever the 'original' function of the pits, their contents are likely to represent burial of sweepings/waste from the charcoal-burning process. Historical documents record that, after a charcoal burn, charcoal was graded for different purposes; in the 17th century AD, for instance, wood colliers in the Weald reserved the larger portions of charcoal for ironworks, while medium-sized and smaller charcoal was taken into London for domestic and other uses (Bond 2007, 292). Many of the historic – and current – uses for small charcoal did not exist in the Anglo-Saxon period (*e.g.* gunpowder), and it is likely that this smaller material was considered waste (and/or was deemed too difficult or uneconomical to transport). The charcoal at Cringleford was highly fragmented and did not include particularly large pieces.

Why waste remains from a charcoal burn were dumped into pits rather than left on the surface to degrade is a matter for conjecture. One possibility is to prevent unintentional fires, although native woodlands are not prone to forest fires (Rackham 1989, 24–25). It is likely that charcoal making would have occurred within the woodland from which the wood was sourced, since the finished product is easier to transport than the wood. The narrow growth rings seen in the Cringleford charcoal, similar to growth signatures seen at Laurel Farm (Austin and Gray 2011, 102), indicate periods of slow growth caused by less than optimum conditions, such as growing in dense woodland. This would suggest that there were local pockets of closed woodland around late Saxon to medieval Norwich, alongside more open and heathland areas, which were exploited for charcoal making and industry. The evidence from both Cringleford and the site at Easton appears to represent small-scale activity, presumably for local consumption in the city, and perhaps particularly to supply the considerable needs of the ironworking industry which flourished there in the late Saxon period (Woolhouse and Cowgill 2009).

DISCUSSION AND CONCLUSIONS

Radiocarbon dating has shown the charcoal pits to be of late Anglo-Saxon (9th- to 10th-/early-11th-century) date. This accords well with the Anglo-Saxon to early medieval radiocarbon dates for many other similar 'burnt pits'/ 'charcoal pits' recorded in excavations around Norwich (*e.g.* Laurel Farm, Thorpe St Andrew (Bishop and Proctor 2011); Mayton Wood, Buxton with Lammas (NHER 39833); Dereham Road/ Cardinal Close, Easton (Challinor 2019)), as well as at other sites in Norfolk, Suffolk and further afield.

The charcoal in the Cringleford pits is predominantly oak heartwood, deriving from systematic burning of good-quality timber from the trunks and larger branches of mature oak trees, a

valuable resource which would have required a considerable investment of time and labour to fell and prepare, as well as expertise to build and manage an effective charcoal burn. The charcoal in the pits is likely to be waste material that was considered too small to be useful or economical to transport.

The reason why the waste charcoal was deliberately buried, rather than just being left on the ground surface, is unclear. This could have been a measure to mitigate against forest fires, although native broadleaf woodlands are not that susceptible to conflagration (Rackham 1989, 24–25). This raises the possibility that, despite the apparently minimal evidence for *in-situ* burning, the pits were themselves parts of the charcoal clamps, with their contents consisting of material that was discarded during the process of sorting/ grading charcoal after a burn. This waste material was either deliberately discarded into the pits, which would have been exposed once the stacks were opened, or else it was casually deposited on the ground surface and some of it became incidentally incorporated into them. However, as discussed above, their small size compared to the charcoal-burning pits excavated at Laurel Farm and other sites does not sit well with identification as integral components of the charcoal stacks, and the question of the pits' 'original' function remains open.

The destination of the end products of the charcoal burning is not certain, but is perhaps most likely to have been the developing city at Norwich, which experienced significant growth during the 10th and 11th centuries AD. In particular, it is known that there was a major ironworking industry operating in the Coslany area, in the north of the city, at this time, which must have required considerable inputs of raw materials including charcoal (Woolhouse and Cowgill 2009). At Laurel Farm, Thorpe St Andrew, on the east side of Norwich and a similar distance from the historic city centre as Cringleford, there were a combination of charcoal-burning pits to supply fuel and ore-roasting pits for heating iron ore obtained from the natural gravels to remove any impurities (Bishop and Proctor 2011, 79–104 and 122–24).

Charcoal-burning pits have frequently been found in association with ironworking features elsewhere, for example, at Cross Leys Quarry, Wittering, Cambridgeshire, where several clusters of charcoal-rich pits were radiocarbon dated to about cal. AD 520–660 (Peterborough HER 51192, 51311; Abrams 2002; Abrams and Wilson 2004), and at Bestwall Quarry, Wareham, Dorset, where nearly 1000 oak charcoal-filled pits were found over a wide area and returned radiocarbon dates mostly in the range cal. AD 700–850 (Ladle 2006). Charcoal is less likely to have been used in domestic hearths, as its manufacture required significant investment of labour and raw materials, usually from carefully managed woods (the conversion rate of wood to charcoal is around 7:1 or, at best, 5:1).

It is perhaps unsurprising that other low-density scatters of similar small, charcoal-rich pits, of Anglo-Saxon to early medieval date, and probably similar in function, are frequently encountered in excavation in the hinterlands of other Anglo-Saxon towns, most notably around the *emporia* at Ipswich (*e.g.* Suffolk HER IPS 719 (Clover 2013); IPS 725 (Woolhouse 2014); IPS 756 (Jones 2015); MRM 157 (Woolhouse 2016)), but also close to monastic settlements such as Peterborough (*Medeshamstede*) (Webley 2007). The apparent concentration of such features on sites in the hinterlands of Ipswich and Norwich is likely to be linked with the development of those settlements into major centres of population and industry in the middle

and late Anglo-Saxon periods, respectively. While ironworking may have been a particular stimulus to charcoal production in the Norwich environs, the presence of the Ipswich Ware pottery industry might have provided a similar impetus for charcoal burning in the countryside around Ipswich from the late 7th/ early 8th century onwards.

Use of the site for charcoal burning in the late Saxon period, utilising mature oak trees, poses some interesting questions for wider issues of local landscape history. If, as conjectured, the first phase of undated field boundary ditches at the site dates from the Middle to Late Bronze Age, then there must subsequently have been woodland growth here at some point between the later Bronze Age and the Anglo-Saxon period. Evidence for later prehistoric field systems and Anglo-Saxon to medieval charcoal burning frequently occur together, on sand and gravel sites, across Norfolk and Suffolk, sometimes in areas of known former common heathland, and usually with a distinct absence of archaeological evidence for activity during other periods of history.

There has been speculation that these elements might together amount to a distinct heathland 'archaeological signature', which could perhaps then be extrapolated to identify other, undocumented, areas of former common land (Albone 2019). Certainly, there is no historical record of the Cringleford site being within a heath or common. Although its archaeological record of prehistoric(?) fields, Anglo-Saxon charcoal burning and otherwise low-intensity land use would fit this suggested heathland archaeological signature, the environmental evidence (narrow growth rings observable in the heartwood) indicates a landscape of closed-canopy woodland rather than open heath, in Anglo-Saxon times at least.

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FIGURE LIST AND CAPTIONS

Figure 1 Site location

Figure 2 The charcoal pits

Figure 3 Photos of selected charcoal pits

Figure 4 Undated ditches, overlain on Cringleford tithe map

Context	Cut	Lab code	Material	Radiocarbon age BP (before AD 1950)	Calibrated date (95.4% probability)	Period
(151)	[152]	BRAMS-3551	Charcoal (*Clematis Vitalba* roundwood)	1129±25	778–790 (1.9%), 828–840 (1.3%) or 865–988 (92.2%) cal. AD	Middle to **late Anglo-Saxon**
(105)	[106]	BRAMS-3552	Charcoal (*Quercus* roundwood)	1009±25	982–1045 (89%), 1095–1120 (5.6%) or 1142–1147 (0.8%) cal. AD	**Late Anglo-Saxon** to early medieval
(159)	[160]	BRAMS-3553	Charcoal (*Corylus Avellana* roundwood)	1115±25	883–990 cal. AD	**Late Anglo-Saxon**
(175)	[176]	BRAMS-3554	Charcoal (*Quercus* roundwood)	1132±25	778–790 (2.5%), 810–815 (0.6%), 826–841 (1.9%) or 863–986 (90.5%) cal. AD	Middle to **late Anglo-Saxon**

Table 1: Radiocarbon dating

Methods employed by the Bristol Radiocarbon Accelerator Mass Spectrometry Facility (BRAMS) are described by Knowles, Monaghan and Evershed (2019). Calibration was performed using OxCal software v4.3.2 (Bronk Ramsey 2009; 2017) and the IntCal13 atmospheric calibration curve (Reimer *et al*. 2013).

	Feature	106	141	152	155	158	160	176
	Context no.	105	139	151	153	157	159	175
	Sample no.	8	7	2	3	5	9	10
Clematis vitalba L. traveller's joy	roundwood			1				
Quercus sp. oak	heartwood	13	19	18	22	20	13	11
	sapwood			(2)			2	(1)
	roundwood	2					1	1
	indeterminate maturity	15	11	9	8	10	13	17
Corylus avellana L. hazel	roundwood						1	
Bark				++				+

Table 2: Charcoal from the burnt pits (showing fragment counts)

Brackets denotes cf. identification; +=present; ++=frequent

13 APPENDIX 4: OASIS FORM

OASIS ID: preconst1-416589

Project details

Project name	Round House Way, Cringleford: Mitigation Analysis
Short description of the project	A programme of further analysis was carried out in connection with an archaeological trial trench evaluation carried out by Pre-Construct Archaeology on land west of Round House Way, Cringleford, Norfolk (NGR TG 1863 0578), in February 2019. The aim of the analysis was to ascertain, as far as possible, the date and function of a number of small, charcoal-rich, pits found during the evaluation. Similar, but often undated, pits are frequently found in archaeological work around the Norwich outskirts, as well as elsewhere in Norfolk, Suffolk and the wider region. Radiocarbon dating confirmed, as expected, that the 'charcoal pits' at the site are of Anglo-Saxon, specifically late Saxon, date (9th- to 10th-/early-11th-century AD). Analysis indicates that the charcoal in the pits is predominantly oak heartwood from the trunks and large branches of mature trees. As such, it is likely to derive from systematic burning of wood for charcoal manufacture, probably consisting of waste fragments that were considered too small to be useful or economical to transport. The products of this charcoal-burning industry are perhaps most likely to have supplied demand in the growing late Saxon town at Norwich, not least the ironworking industry that flourished in the Coslany area during the 10th to 12th centuries.
Project dates	Start: 11-02-2019 End: 15-02-2019
Previous/future work	Yes / No
Any associated project reference codes	2013/1494 - Planning Application No.
Any associated project reference codes	APP/L2630/A/14/2227526 - Planning Application No.
Any associated project reference codes	ENF145714 - HER event no.
Any associated project reference codes	CNF48541 - HER event no.
Any associated project reference codes	NWHCM: 2019.78 - Museum accession ID
Any associated project reference codes	preconst1-345065 - OASIS form ID
Type of project	Field evaluation
Site status	None
Current Land use	Cultivated Land 2 - Operations to a depth less than 0.25m
Monument type	DITCH Uncertain
Monument type	CHARCOAL PIT Early Medieval
Significant Finds	OAK CHARCOAL Early Medieval

Methods & techniques	"Sample Trenches"
Development type	Housing estate
Prompt	Planning condition
Position in the planning process	After full determination (eg. As a condition)

Project location

Country	England
Site location	NORFOLK SOUTH NORFOLK CRINGLEFORD Land West of Round House Way, Cringleford, Norfolk
Postcode	NR46UD
Study area	5.85 Hectares
Site coordinates	TG 1863 0578 52.605243871311 1.229170630641 52 36 18 N 001 13 45 E Point
Height OD / Depth	Min: 24m Max: 30m

Project creators

Name of Organisation	Pre-Construct Archaeology Limited
Project brief originator	Norfolk Historic Environment Service
Project design originator	Myk Flitcroft (RPS Heritage)
Project director/manager	Tom Woolhouse
Project supervisor	Matthew Jones
Type of sponsor/funding body	Developer
Name of sponsor/funding body	Kier Homes

Project archives

Physical Archive recipient	Norwich Castle Museum
Physical Archive ID	NWHCM: 2019.78.
Physical Contents	"Ceramics","Environmental"
Digital Archive recipient	Norwich Castle Museum
Digital Archive ID	NWHCM: 2019.78.
Digital Contents	"Ceramics","Environmental","Stratigraphic","Survey"
Digital Media available	"Database","Images raster / digital photography","Spreadsheets","Survey","Text"

Paper Archive recipient	Norwich Castle Museum
Paper Archive ID	NWHCM: 2019.78.
Paper Contents	"Ceramics","Environmental","Stratigraphic","Survey"
Paper Media available	"Context sheet","Plan","Report","Section","Unpublished Text"

Project bibliography 1

Publication type	Grey literature (unpublished document/manuscript)
Title	Land West of Round House Way, Cringleford, Norfolk: Report on Further Analysis of the Late Saxon Charcoal Pits
Author(s)/Editor(s)	Woolhouse, T.
Other bibliographic details	PCA Report No. R14164 (Rev1)
Date	2020
Issuer or publisher	Pre-Construct Archaeology
Place of issue or publication	Pampisford
Description	58 page bound A4 typed report with three colour figures, four colour plates, radiocabon dating certificates x 4, and draft publication article for Norfolk Archaeology.

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Entered on	2 March 2021

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PCA 25 years
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