Please cite this as: Gaunt, K, van Tongeren, T. and Christie, C. 2024 Fenland Fields: Evolving Settlement and Agriculture on the Roddon at Viking Link Substation, Bicker Fen, Lincolnshire, Internet Archaeology 67. https://doi.org/10.11141/ia.67.10

Fenland Fields: Evolving Settlement and Agriculture on the Roddon at Viking Link Substation, Bicker Fen, Lincolnshire

Kim Gaunt, Tim van Tongeren and Claire Christie

With contributions by Sue Anderson, Julie Dunne, Richard Evershed, Alison Foster, George Haberfield, Derek Hamilton, Sara Machin, Roderick Mackenzie, Ruth Shaffrey, Rebecca Sillwood and Kate Turner. Illustrations by Tom Watson, Beata Wieczorek-Oleksy and Marc Zubia-Pons

Archaeological mitigation undertaken by Headland Archaeology (UK) Ltd at Bicker Fen, Lincolnshire, uncovered the remains of two distinctly different enclosure systems situated on a raised roddon (the dried raised bed of a watercourse). The earliest of these systems was characterised by a series of inter-linked enclosures that formed part of a larger complex farmstead developing around the mid-2nd century AD. The enclosure system subsequently evolved through phases of maintenance and expansion, potentially following changes in agricultural practice or as a result of environmental influences. Features in the northern part of the excavation provide some evidence for industrial activity, including iron smithing and bone working, within the settlement. Zooarchaeological evidence, however, suggests that the main economic focus of this rural community was beef production. It seems that the farmstead remained occupied until at least the 4th century AD, with radiocarbon dates suggesting continued activity of some kind into the 5th century.

The Saxon field system was situated to the east of the Roman settlement and is geographically independent. The system is less substantial in nature than the Roman enclosures, characterised by curvilinear boundaries and irregular enclosure sizes. Radiocarbon dating suggests that activity took place between the 6th and 10th centuries AD. During this phase, the focus appears to have been pastoralism. This, together with the transient nature of the system and many maintenance phases, suggests seasonal or otherwise *ad hoc* land use away from the core of any settlement.

1. Introduction

Archaeological investigations at the Viking Link Convertor Station, Bicker Fen, Lincolnshire, uncovered two main periods of activity. Roman and Saxon features were identified, concentrated on relatively high ground in the Fen landscape extending across a *roddon* - an area of raised land formed as a result of infilled tidal creeks and estuarine streams. The excavations were undertaken by Headland Archaeology (UK) Ltd for Ian Farmer Associates (IFA) as part of the mitigation works relating to the construction of an electricity interconnector between Revsing, Denmark, and Bicker Fen, Lincolnshire (Figure 1; Headland Archaeology forthcoming). The cable route extends through the authority areas of East Lindsey District Council (ELDC), North Kesteven District Council (NKDC), Boston Borough Council (BBC) and South Holland District Council (SHDC), with a Converter Station building to be constructed in South Holland. The Viking Link Convertor Station site is located to the north of North Ing Drove, Donington, Lincolnshire (TF 18709 37380).

The Roman activity, concentrated within excavation areas SMR1, SPE1 and SPE2, comprised part of a complex farmstead characterised by a ditched enclosure system with evidence for maintenance and modification. The finds assemblage, radiocarbon dating and subsequent Bayesian modelling indicate activity occurring from the 2nd to 4th/5th centuries AD. The pottery assemblage included grey wares, some colour-coated and samian ware, and a tazza, used to burn incense, which can be dated to the 3rd or 4th century AD. Other Roman-period finds include a glass bead, worked bone and worked stone. The animal bone found in relation to the Roman-period features is dominated by cattle, with the presence of mature as well as juvenile individuals. There is also evidence to suggest the handling of cereals during this period including glume wheats, free-threshing wheats and barley.

The Anglo-Saxon field system, consisting of boundaries and enclosures, extended over the excavation area SMR6 immediately to the east. The boundaries are narrower than the Roman-period enclosures and more curvilinear in nature. They are also more short-lived and show many maintenance phases. This probably indicates landscape use on a seasonal or ad hoc basis, rather than a more permanent utilisation. In addition to Anglo-Saxon pottery, finds from the period include a fragmented bone comb that dates between the mid-7th and 10th centuries AD. The pottery, comb and radiocarbon dating suggest that a mid-Anglo-Saxon date is most probable. The zooarchaeological assemblage includes evidence of cattle, horse, pig, sheep, goat, chicken and goose. The importance of fish as a food source rises relative to the Roman period, as is evidenced by remains of cod, flounder, flatfish, garfish, scad, salmon, pike and spined stickleback. The palaeobotanical assemblage indicated the presence of cereal crops, primarily barley, and pulses including broad bean and pea, which may have been cultivated as part of a seasonal rotation.

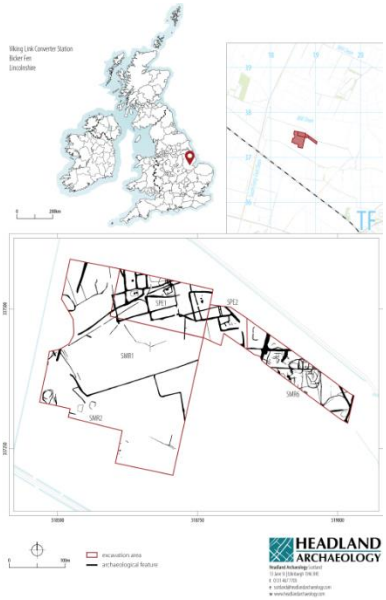

Figure 1: Viking Link Converter Station site location. Image credit: Headland Archaeology (UK)

2. Archaeological Background

The site at Bicker Fen sits within a rich archaeological landscape, with cropmarks of possible Roman date including field boundaries and trackways identified largely situated on roddons. Saxon activity is also noted with artefact scatters, industrial activity and settlements to the east and south of the site, including Donnington. As a result of this, prior to mitigation archaeological works generated a desk-based assessment (Arcadis Consulting (UK) Ltd 2017a), Aerial Photographic and Lidar Assessment (Trent & Peak Archaeology 2017), Geophysical Survey (Headland Archaeology 2017a) and Trial Trenching (Headland Archaeology 2017b).

ONLINE ONLY

Figure 2 (interactive image): Roman and Saxon activity within 5km of Viking Link. Image credit: Headland Archaeology (UK) [Download image]

2.1 Roman Lincolnshire

During the Roman period, Lincolnshire was home to two major roads that connected the city of Lincoln (Lindum Colonia), with key Roman settlements in other parts of the country. Ermine Street connected London with York, crossing Lincolnshire between Stamford in the south and Winteringham on the bank of the Humber in the north. The second Roman road is Fosse Way, which connected Lincoln with Exeter via Leicester, Cirencester and Bath (Margary 1967). The presence of a regional centre as well as significant infrastructure benefitted the entire region, influencing the development and distribution of settlements.

The Roman legionary fortress of Lindum was founded at the earliest during the reign of Emperor Nero (AD 58-68). It was most likely after AD 86 when Lindum was awarded the status of 'colonia', or a settlement for retired soldiers (Jones 2002, 34). As it developed, the settlement became a hub for social, political and economic activity and a second enclosure was added. The original settlement, or upper colonia, was walled in the first half of the 2nd century AD while the lower colonia - the new enclosure - was given walls during the late 2nd or early 3rd century. Archaeological evidence for the settlement includes a forum, baths, temples, buildings and shops (Whitwell 1970, 27). The importance of Lincoln as a regional centre is further underlined by the likely presence of a Bishop of Lincoln at the Council of Arles in AD 314 (Jones 2002, 119). During the last century of Roman presence, the city developed further, and the influence of Christianity becomes more widespread. Lindum Colonia not only profited from the presence of two major roads, but also from strong connections with other settlements and the North Sea via canals. The Fosse Dyke Canal, for example, connected Lincoln with the Rivers Humber and Trent as well as with the North Sea (Cumberlidge 2009). Car Dyke connects the River Witham near Lincoln with the River Cam near Cambridge and runs from there across the Fenlands to the Wash (Bond 2007). Accessibility of the marshy area improved with the construction of the so-called Fen Causeway, which ran between Denver in Norfolk and Peterborough, where it connected to Ermine Street (Hall and Coles 1994, 107-8). The trajectory of this road was situated some 35km (21 miles) south of the excavation site, suggesting that its direct impact on the site's activity may have been limited. However, to the south of the site lies Salter's Way, believed to originate in the Roman period, connecting Donington with the settlements of Saltersford and further afield (Arcadis Consulting 2017b, 35).

Extensive Roman activity surrounding the site at Bicker Fen was noted to the south of Salter's Way including a large cropmark complex, settlements and possible salt production sites (Figure 2). Several salt production sites were noted to the west with further settlements to the north. In general, it can be stated that Romano British settlement in the northern Fenlands had a small and rural character (Hall and Coles 1994, 111). Pottery assemblages found suggest a limited prosperity for the settlements, and zoological assemblages as well as field and enclosure systems are indicative of agricultural land use. Any industry in the northern Fenlands seems to have taken place on a small and local scale. Evidence for more widespread iron working and pottery production can be found on the western Fen edge (Hall and Coles 1994, 112-13). Along the edge of the Wash, roughly between Wrangle in the north and Downham Market in the south, various settlements are related to salt production, as is evidenced by the presence of salterns (Hall and Coles 1994, 115-19).

2.2 Anglo-Saxon Lincolnshire

One of the most underexplored periods in British archaeology is the transitionary phase between Roman and Anglo-Saxon influence. In general, it can be assumed that there was some degree of continuity in the everyday life of people living in Lincolnshire, but it is evident that change was imminent. Lincolnshire is situated in the part of England that was colonised by the Angles, a people originating from the current border region between Germany and Denmark. The Angles settled in the part of England approximately between Ipswich and Cambridge in the south and Leeds and York in the north. It is likely that Lincolnshire was initially part of a small tribal kingdom named Lindsey, which was absorbed by Northumbria in the 7th century (Higham and Ryan 2013, 138-40).

The Roman city of Lincoln declined during the late 4th century, but it is unlikely that it was completely deserted. The church of St Paul in the Bail was built within the Roman forum in the late 4th century. A larger building replaced the initial church in the 5th century and was demolished during the 6th century (Higham and Ryan 2013, 40). This evidence suggests a gradual transition from Roman to Anglian influence. Roman Christianity was apparently not abruptly replaced but existed alongside Anglian paganism for at least some time.

In contrast to funerary evidence, early Anglo-Saxon settlements are a rare discovery in most of south and south-east England. Settlements are more frequently found in East Anglia and the East Midlands, but especially the earliest sites remain elusive. The Fenland Archaeological Survey found that early and middle Anglo-Saxon settlement locations are often relatively far away from later medieval towns and villages while late Anglo-Saxon settlement is found closer to later sites (Hall and Coles 1994 , 122). The presence of various large early Anglo-Saxon cemeteries in Lincolnshire suggests that there must have been a continuation of occupation. This is evident, for example, in the northern Fenlands, with the large cemeteries of Quarrington being situated approximately 17km (10.5 miles) north-west of the excavation site. An early and mid-Saxon settlement, including field and enclosure systems, was found to be related to these burial grounds. (Taylor *et al*. 2003, 231). In Sleaford, just north of Quarrington, more evidence was found for Anglo-Saxon burial as well as mid- to late Anglo-Saxon settlement. This place is mentioned in a charter from AD 852 as the location of a Saxon estate (Taylor *et al*. 2003, 233).

Even closer to the excavation site, two Roman sites at Gosberton and Pinchbeck see a continuation of use into the early and middle Saxon period. A total of nine Saxon sites were unearthed in and around Gosberton, some 6.5km (4 miles) south of the excavation site. All but one of these sites returned early Anglo-Saxon pottery and six sites also returned mid-Saxon pottery. The location of the Gosberton and Pinchbeck sites on low mounds was the likely cause of abandonment by the 9th century, influenced by sea level fluctuation. A further mid-Saxon site at Quadring, located on one of the highest roddons in the area, survived into the late Saxon period, as evidenced by finds of Stamford ware (Hall and Coles 1994 , 122-124). In general, there is limited evidence for industry in and around currently known settlements. Instead, the roddons seem to have been used for various forms of agriculture. In some places, including Pinchbeck (*c*. 12km/7.5 miles south of the excavation site) parts of the Romano-British land surface are covered by marine silt and silty clay, suggesting a process of flooding. It is thought that this flooding starts during the 4th century, and early Anglo-Saxon evidence suggests it had subsided by the 6th century (Hall and Coles 1994, 114). For much of the evidence, it is impossible to say whether it points at continuity from the Romano-British into the Anglo-Saxon period. While some continuation of ordinary rural life in The Fens can be expected, the evidence of flooding during the late Roman period suggests abandonment and later resettlement of at least part of Fenland south of the excavation site.

3. The Excavated Evidence

The backdrop of the excavations is the Lincolnshire Fen landscape. Geologically, this landscape is situated on a bedrock formation, formed during the Jurassic period, which is named Oxford clay. Historically, this part of Lincolnshire has witnessed regular sea-level fluctuations, resulting in an ever-changing coastline and the build-up of tidal flat deposits. As a result of these changing circumstances, the stratigraphy is currently dominated by loamy and clay-rich superficial tidal flat deposits and the groundwater level is high (BGS Geology Viewer; Cranfield University 2020, Soilscape 21). Roddons are a key feature of this landscape and influence the overall distribution and development of archaeological sites (Smith *et al*. 2010).

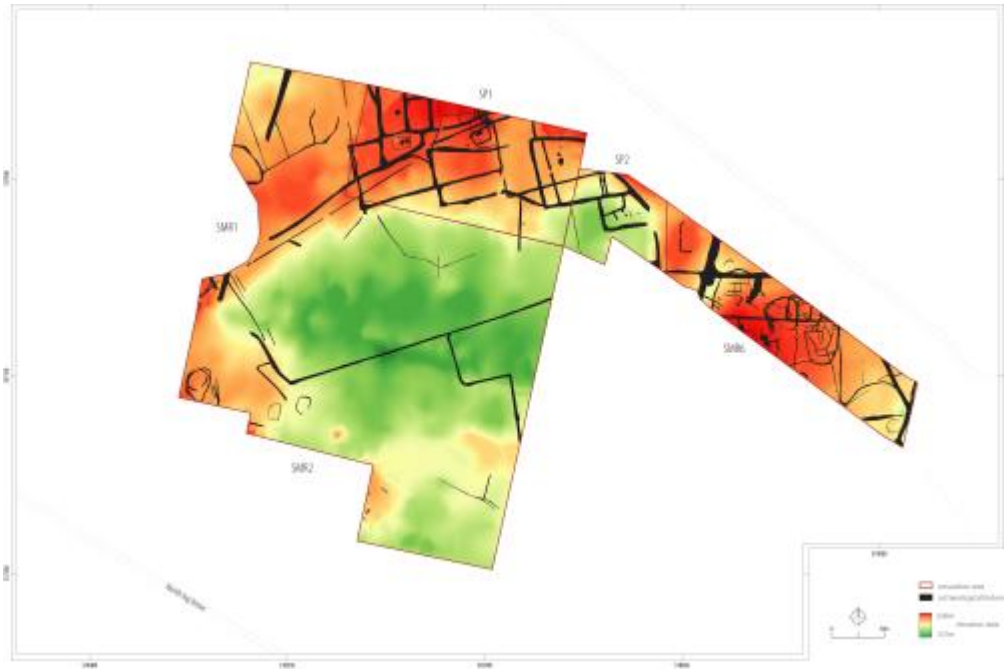

Figure 3: Topographic survey of the site showing the archaeological features extending across the higher ground. Image credit: Headland Archaeology (UK)

The excavations at Viking Link revealed evidence of Roman and Saxon activity extending across a roddon, with the extent of the high ground influencing the distribution of features (Figure 3). Roman activity was concentrated to the west comprising well-defined rectilinear enclosures with a droveway and possible structures. To the east, a busy network of Saxon boundaries and enclosures were uncovered that were more short-lived in nature (Figure 4). A programme of targeted radiocarbon dating was undertaken, with sample selection based on key stratigraphic relationships and suitability of material. A total of 17 radiocarbon dates were obtained indicating Roman activity from the 2nd to 4th/5th century AD and Saxon activity from the 6th to 10th centuries (Table 1).

ONLINE ONLY

Table 1: Radiocarbon dates from Viking Link Converter Station calibrated in OxCal 4.4.2 (Bronk Ramsey (2009); r5 Atmospheric data from Reimer *et al*. (2020); dates within the text presented at 95.4% probability) and rounded outward to 10 years

ONLINE ONLY (VIDEO)

Figure 4: Site development over time. Image credit: Headland Archaeology (UK)

3.1 Remnants of the Romans: establishing enclosures

The earliest activity identified within the excavation area at Viking Link comprised a network of large Romano-British enclosures, clearly part of a larger farmstead. This enclosure system was located on the southern edge of a silt roddon with very few features extending beyond (Figure 5).

ONLINE ONLY

Figure 5 (interactive image): Phased site plan of the Roman activity. Image credit: Headland Archaeology (UK) [Download image]

A series of ditches potentially indicate the presence of boundaries pre-dating the establishment of the main enclosures. To the north, Ditch 1890, Ditch 1793 and Ditch 1620 are truncated by the main enclosures and do not follow the primary alignments. To the south-east, Ditch 1156 is aligned north-west to south-east and is truncated by the southern ditch of Enclosure 12. A small assemblage of Roman pottery was recovered from the ditches, with the majority recovered from Ditch 1793. The stratigraphically earlier ditches indicate that the observed Roman enclosures may represent the

reorganisation of earlier systems of landscape management that do not survive in the archaeological record.

The core of the enclosure system covered an area 96m north-west to south-east by 194m north-east to south-west and was comprised of twelve identifiable rectangular enclosures (Table 2; Figure 6). The central area defined by enclosures 5, 6, 7, 8 and 10 contained two possible structures, pits and the remains of a droveway, which influences the organisation and development of the site. To the north three further enclosures adjoined the central area, enclosures 1, 3 and 4, with Enclosure 2 extending beyond the limit of excavation. A series of intercutting ditches were located in the eastern corner of Enclosure 4 from which a rich artefactual assemblage was recovered. The enclosures extended to the east, enclosures 8 and 12, with indications of boundaries continuing beyond the limit of excavation. The differing dimensions of these enclosures, which shifted to larger enclosures toward the southern edge of the roddon, highlights the potential differences in function as the activity moved away from the suspected focus of activity in the north.

Figure 6 (interactive image): Site plan with excavated sections. Image credit: Headland Archaeology (UK) [Download image]

Table 2: Roman enclosure dimensions

Enclosure	Area (Length x Width)
1	35m x 15m
2	3m x 9m
3	22m x 13m
4	22m x 34m
5	22m x 22m
6	18m x 28m
7	20m x 51m
8	18m x 27m
9	20m x 53m
10	25m x 48m
11	11m x 46m
12	36m x 71m

The enclosures were defined by ditches that measured 1.6-4.7m in width and 0.13-1.07m in depth. The boundary ditches contained a variety of alluvial clay and silt deposits, many of which were noted throughout the full extent of the enclosure system, potentially resulting from the seasonal or regular flooding of the ditches. The 'U' shaped profile of many of these deposits indicates that most ditches were subject to regular clearance and maintenance, possibly also on a seasonal basis. It is important to note that these maintenance activities are likely to have resulted in the removal of much of the artefactual and environmental material from the ditches. Consequently, the datable material

recovered from the site may be more representative of the periods of disuse and a cessation in clearance activities than the periods of maintenance associated with more active use of the enclosure system. Radiocarbon dating and analysis of the artefactual material suggest that commencement of this activity dates to the mid-2nd century.

3.1.1 Central droveway

A possible droveway was identified extending across the central enclosures and forms a key component of the enclosure layout. This droveway was visible within the excavation area running for a total length of 225m on a north-east to south-west alignment, defined by parallel ditches. The northern ditch, Ditch 1983, was substantial measuring *c*. 3m in width and 0.51m in depth. This ditch extended from the western edge of excavation to Enclosure 6, with a *c*. 5.5m gap before continuing through Enclosure 7 as Ditch 1401. Cereal grain from the third fill of Ditch 1401 was radiocarbon dated to cal AD 220-350 (SUERC-110273). The fill represents the later backfilling of the ditch, suggesting an earlier date for its construction. The southern ditch, Ditch 1902, was considerably smaller, measuring 1.18m wide by 0.3m deep and containing only a single naturally infilled deposit of clayey silt. The southern ditch follows the same alignment as the northern but terminates before reaching Enclosure 10 and may have continued beyond the enclosures to the north-east. At its widest point the droveway measured 8.5m in width, narrowing as it extended through the enclosures to 2-3m.

The droveway appears to form part of the earlier phase of the enclosure system, potentially for the movement of livestock between the enclosures and wider pasture. Sections of the northern ditch appear to have been recut but were truncated by later maintenance activities associated with the enclosure system, indicating that it was not in use during the later phases of activity at the site (see section on *Maintenance*)

3.1.2 Structures and pits

Two possible structures were identified within Enclosure 6 and Enclosure 7. The remnants of both structures were identified only as shallow beam slots which formed rectangular enclosed spaces within the larger enclosures. No definitive evidence for upstanding structural remains were found.

Figure 7: Photograph of Structure 1. Image credit: Headland Archaeology (UK)

Structure 1 (Figure 7) was located within Enclosure 6 and enclosed a space 13m by 8.5m. The beam slot, 1302, which comprised the exterior of the structure, measured 0.42-0.68m wide and 0.13-0.25m deep and contained a single deposit of alluvial silt. The additional presence of two pits within the interior of this structure suggests that this structure was not related to occupation and instead likely

represents a small covered agricultural area, possibly for storage or industry. The two pits within the structure had distinctly different shapes, one being circular the other rectangular.

The rectangular pit, Pit 1355, was located centrally in the structure and measured 3.6m long by 2.2m wide and 1m deep, with vertical sides and a flat base. The pit contained three deliberately dumped deposits and an alluvial clay layer near its base. Frequent pot, moderate bone, rare metal (including the shank of an iron nail) and lithic inclusions were noted among the dumps of material, which is suggestive of a waste disposal pit, although this is likely just its final utilisation. A piece of potentially architectural stone was also found. The presence of an alluvial layer as the secondary deposit of the pit may suggest that at the time of its construction this pit was open to the elements, and possible flooding may provide an explanation of the later addition of a shelter covering the surrounding area.

The circular pit, Pit 1330, was located near the north-eastern corner of the structure, with a diameter of 4.00m and a depth of 0.55m with rounded sides and base. This pit contained six naturally infilled deposits of possibly wind-blown material. Analysis of samples taken from the pit identified spelt and wheat in the fills, as well as part of a small iron object. Cereal grain from the basal fill of the pit (1331) was radiocarbon dated to cal AD 120-240 (SUERC-110272, 2). The structure and pits likely formed part of the initial phase of enclosure as a key part of the enclosure layout. Two similar circular pits were also noted within Enclosure 1 where they are thought to represent waterholes.

Structure 2 was located on the eastern side of Enclosure 7 and is similar in size to Structure 1 (12 x 8m), However, Structure 2 otherwise appeared to be of a more substantial construction with beam slots measuring 1.02-1.60m wide and 0.30-0.40 deep. A small contemporary slot, 1746, extending into the structure from its southern edge, would have subdivided the internal space. The northern edge was truncated, with several stratigraphically later pits cutting the structure. One of these, situated at the north-western corner of the structure, was found to contain a 3rd to 4th century cylindrical glass bead, suggesting an earlier date for the structure, possibly contemporary with Structure 1.

3.1.3 Craft and industry

An area with significant artefactual material was noted at the south-eastern corner of Enclosure 4, adjacent to the northern limit of excavation (Figure 8). This material included a considerable quantity of 3rd to 4th century pottery, glass, and bone objects. The bone objects, which included a pin, a rough-out and working waste, and which were not identified anywhere else within the excavation area, are particularly indicative of industrial or craft activity. A number of features in this area also contained dumped and heat-affected material, which was completely absent from the other parts of the enclosure system. If industry was located in close proximity, as suspected, much of this material, which evidences more proactive human activity, could have made its way naturally into the ditches of this area.

Figure 8: Density of northern intercutting ditches relating to Roman industry during excavation. Image credit: Headland Archaeology (UK)

3.2 Expansion of the enclosure system

Following the initial establishment of the enclosures, a period of expansion was noted that established four new enclosures to the east (Figure 9). The initial phase of expansion appeared to primarily overlie the earlier Enclosure 12. The rectilinear Enclosure 13 defined an area *c*. 47 x 44m, with two north to south aligned ditches creating an internal division with a 2.5m wide entranceway. The ditches may represent an initial phase of expansion with the entranceway aligned to the existing enclosure system before Enclosure 13 was defined. The ditches of this new enclosure, Enclosure 13, contained alluvial silt and clay deposits similar to those noted among the ditches of the initial enclosure system and contained artefactual remains of a similar date, indicating that, although stratigraphically later, this initial sub-phase formed part of the continuous development of the site. An articulated cattle radius recovered from the basal fill of the main enclosure ditch dates this expansion to cal AD 230-380 (SUERC-110491), which is contemporary with dates from the main enclosure system. The expansion potentially occurred within a century or so after the initial establishment of the enclosures in the west.

Figure 9: Drome image of features extending to the east. Image credit: Headland Archaeology (UK)

Enclosures 14 and 15 adjoined the south-eastern extent of Enclosure 13 and were far smaller in scale, reminiscent of those within the existing system. The ditches all contained a distinct sequence of deposits (Figure 10), which after a brief period of basal windblown material, consisted of distinct layers of grey-blue alluvial clays topped with a distinct layer of decomposed organic material. The presence of this organic material indicates that the ditches were left unmaintained for long enough at the time of deposition for plants to form a layer within the ditch, which were later buried beneath further alluvial silt deposits. This organic layer was also noted as a lower fill among some of the maintenance recuts in the west of site (detailed below), which may indicate a contemporary deposition period. However, with the exception of the organic band, the fill profile of the ditches is unique to this area of the site, possibly indicating a slight disparity in infilling periods or conditions between the areas.

Figure 10: Eastern expansion fill sequence, with cattle lower right hind leg ABG *in situ* . Image credit: Headland Archaeology (UK)

The final phase of expansion was noted as a recut to the southern boundary of Enclosure 13, which continued to the east to expand Enclosure 15, creating a new sixteenth enclosure against the eastern boundary of the enclosure system. The expanded Enclosure 15 contained several deposits, shallow pits and gullies of unknown function, but which contained dark dumps of ash-like material. Finds from the features of Enclosure 15 were unfortunately undiagnostic, consisting primarily of small pot sherds, and are contemporary with the other Roman artefactual material recovered from elsewhere on the site.

Table 3: Expansion enclosures dimensions

Enclosure	Sub-Phase	Area (Length x Width)
13	1	48m x 35m
	2	48m x 43m
	3	48m x 43m
14	2	15m x 15m
15	2	12m x 16m
	3	22m x 30m
16	3	35m x 26m

3.3 Continued maintenance

Although ongoing maintenance was noted among the fills of all enclosure ditches, a more extensive period of maintenance and reorganisation was also recorded, evident across the enclosure system.

The primary function of these recuts appears to have been to re-establish specific sections, as they were often noted terminating part-way along the earlier ditches. This may have been due to an increased level of alluvial deposition, possibly as a result of their proximity to the edge of the roddon, and probable wet ground. Alternatively, it is possible that agricultural activity during this period was focused more specifically in these areas and had moved away from the activity in the north. Certainly, the entrances to Enclosures 6 and 9 appeared to be closed by the recuts, and the nature of the trackway to the south-west had also changed with the removal of the ditch along its southern edge.

No direct stratigraphic relationships were recorded between the maintenance activities in the west and the expansion of the enclosure system to the east, and as such these activities may be broadly contemporary. The dates of the artefactual remains from both periods range between the 1st and 4th centuries AD. However, the distinct sequence of deposits noted among the ditches of the eastern enclosures, which was not observed in the western recuts, suggests that infilling of the ditches occurred at different times. The radiocarbon dates from the maintenance activity dated the recuts to cal AD 250-420 (SUERC-110283) and cal AD 430-580 (SUERC-110286), indicating that this activity may post-date the other Roman activity on the site, with the ditches possibly remaining open or at least visible into the early Anglo-Saxon period.

3.4 Transition

Despite late radiocarbon dates gathered from the maintenance phase, no activity was identified on site that could be definitively dated to the early Anglo-Saxon period. However, this does not preclude the possibility that activity continued through this period. Anglo-Saxon Enclosure 1, for example, was located in an otherwise empty space between the datable Roman and mid-Saxon activity and contained no datable material. Its form also does not adhere to the patterns of enclosure activity seen on the site in either the Roman or mid-Anglo-Saxon periods, being rectilinear in plan but considerably narrower and shallower than the Roman enclosures. Additionally, the stratigraphically earliest sub-phases of activity associated with the mid-Saxon enclosures were also undated by either artefactual material or by radiocarbon dating, and may represent small-scale transitional activity. Furthermore, it is possible that the distinct lack of early Anglo-Saxon artefactual material indicates continuity in the use of existing late Roman wares by the local population beyond the end of the Roman period rather than the abrupt abandonment of a well-established agricultural landscape in AD 410.

3.5 Anglo-Saxon agriculture

The mid-Anglo-Saxon activity at Viking link was situated both to the east and west of the Roman farmstead and consisted of enclosures and open field systems respectively (Figure 11). Very little interaction was noted between these activities and the Roman settlement. It is unclear why this is the case, as it is probable that space was limited on the higher ground of the roddon. The two most likely explanations for the distinctly separate stratigraphies of the two periods are that either the water level of the Fens had risen during this period, making reutilisation of the Roman enclosure system difficult to impossible or, conversely, that the system was still largely visible in the landscape and therefore avoidable. If the system did continue to exist within the landscape it is probable that for some reason it was not considered fit for the agricultural practices being employed during the Anglo-Saxon period.

ONLINE ONLY

Figure 11 (interactive image): Site plan of Anglo-Saxon activity in the east. Image credit: Headland Archaeology (UK) [Download image]

3.5.1 Activity in the east

In addition to the undated Anglo-Saxon Enclosure 1, four enclosure spaces were located in the east of excavation area SMR 6 (Figures. 12 and 13), stretching over an area 180m in length and which started *c*. 60m south-west of the Roman boundaries. These enclosures were broadly oval or sub-oval in plan and consisted of multiple sub-phases of ditch activity. These sub-phases may represent seasonal establishment of the enclosure spaces, often being utilised for as little as a single season, rather than becoming a permanent fixture in the landscape.

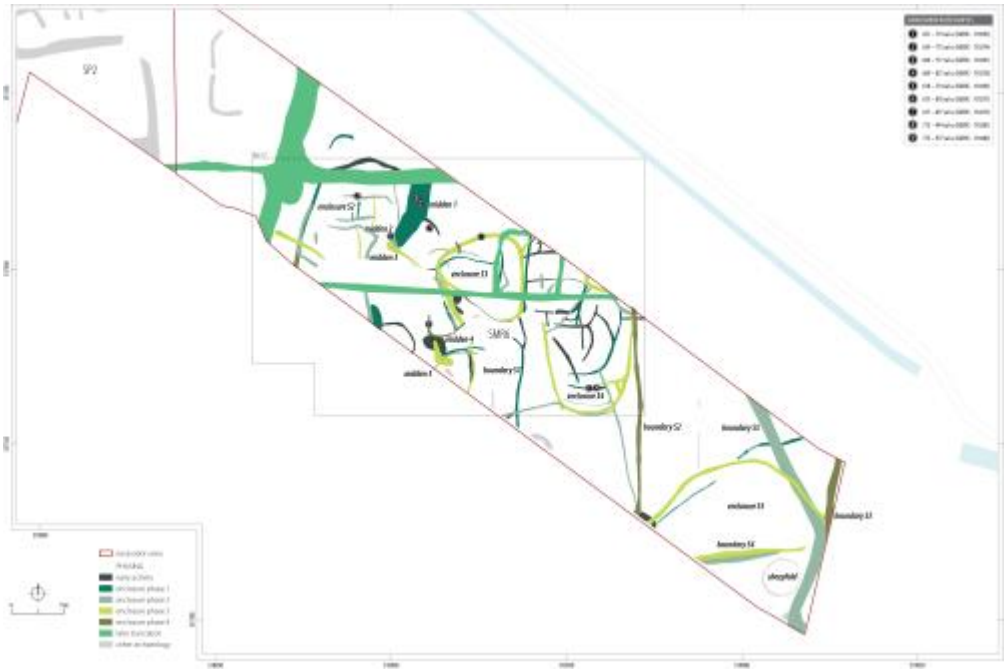

Figure 12: Phased Anglo-Saxon Activity. Image credit: Headland Archaeology (UK)

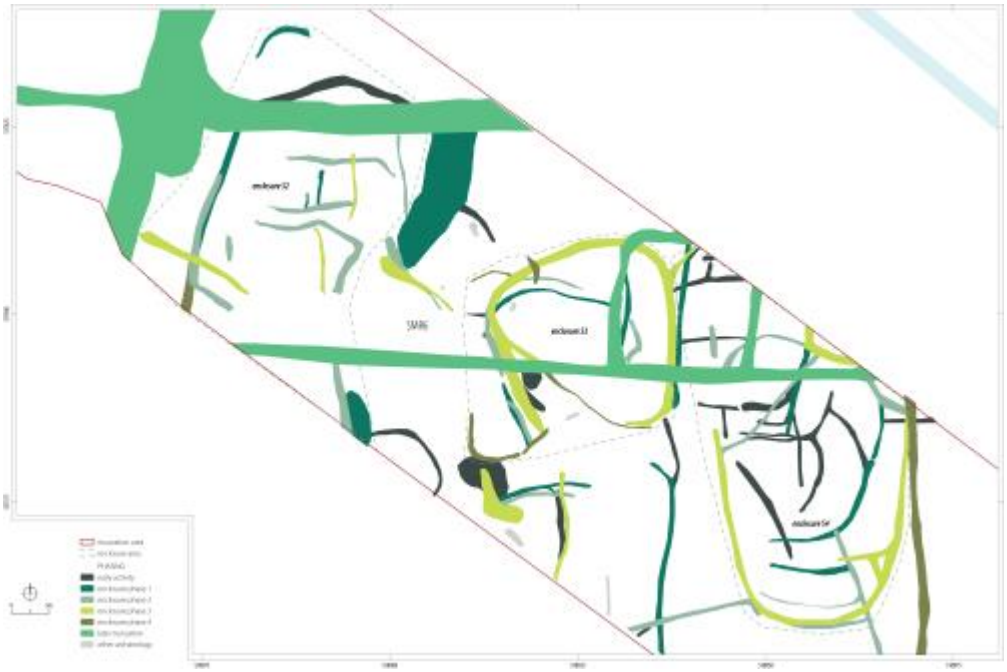

Figure 13: Anglo-Saxon enclosures. Image credit: Headland Archaeology (UK)

3.5.1.1 Enclosure 2

Enclosure 2 was the westernmost of the enclosures, and its associated ditches covered a total space of *c*. 47m x 29m. The enclosure was defined by ditches 4297 and 4901, the latter being recut by Ditch 4382. A number of short ditch sections crossed the interior, potentially representing sub-divisions or multiple phases of development. A charcoal sample date gathered from one such ditch, Ditch 4904, returned a date of cal AD 650-780 (SUERC-110274).

The strip of land immediately to the west of this enclosure, Midden areas 1-3, contained a number of features rich in dumped deposits of probable waste material (Figure 14). This material included some of the best-preserved cereal grain recovered from the site, which returned radiocarbon dates between cal AD 660 -950 (SUERC-110276, SUERC-110275, SUERC-110281). A date from a cattle tooth was also recovered (cal AD 660-780; SUERC-110291). The cereal grain assemblage from these features

included bread/club/rivet wheat, and hulled straight barley grains with silicified plant macro-remains recovered from the pits of Midden 2, suggesting they have been exposed to heat.

Figure 14: Anglo-Saxon activity: central midden area. Image credit: Headland Archaeology (UK)

3.5.1.2 Enclosure 3

The area of Enclosure 3 measured 28m x 27m with multiple phases of development noted prior to the establishment of the enclosure ditch, Ditch 4911 (Figure 15). A cattle skull from the basal fill of Ditch 4911 was radiocarbon dated to cal AD 650-780 (SUERC-110292). Enclosure 3 was U-shaped with a south-facing opening. Further adjoining boundaries extended to the north and to the south where Ditch 4819 may have formed a continuation separating Enclosure 3 from a series of pits.

Figure 15: North-facing section of intercutting Saxon enclosure ditches, Enclosure 3 . Image credit: Headland Archaeology (UK)

Pit 4624 (Midden 4) was sub-circular in plan and measured 7.40m x 5.04m x 0.40m. It contained a series of naturally infilled deposits from which no artefacts were recovered. This was cut by an irregularly shaped feature 4820 (Midden 5) which measured 9.4m x 2.30-3.00m x 0.88-1.20m and contained pottery and animal bone. Ditch 4873 cut Midden 4 and continued as Ditch 4873 to cut Enclosure 3. Charcoal from the top fill of this ditch was radiocarbon dated to cal AD 670-880 (SUERC-110277), potentially indicating a similar date for much of the activity associated with and surrounding Enclosure 3.

3.5.1.3 Enclosure 4

A group of linear ditches define the stratigraphically earliest phase of activity in this area underlying Enclosure 4. The ditches, 4928, 4826, 4825 and 4868, were similar in dimensions and contain sterile fills. These were truncated by a series of curvilinear ditches, which were in turn were truncated by curved ditches extending to the south and adjoining a north-west to south-east aligned ditch, Ditch 4827. Samples of cereal grain and chicken bone from the basal fill of Ditch 4871 forming part of this sequence were radiocarbon dated to cal AD 670-780 (SUERC-110293) and cal AD 770-980 (SUERC-110282). This sequence is truncated by the ditch defining Enclosure 4, Ditch 4932, which like Enclosure 3 was U-shaped but with a north-facing opening. The enclosure surrounds a space measuring 23m x 26m.

3.5.1.4 Boundary ditches

Boundary 1 was located between enclosures 3 and 4 running for 30m from the southern limit of excavation to the south-eastern corner of Enclosure 3. Activity at enclosures 2-4 appears to be defined by Boundary 2, which extends across the excavated area. Boundary 2 extended for *c*. 60m and measured 1.10-1.3m x 0.43-0.52m with fills of greyish-brown clayey-silt. Boundary 2 truncated part of the latest ditch of Enclosure 4. This ditch aligns with Boundary 3 at the eastern extent at the site, which extends for 22.8m, and was similar in form and dimensions. Boundary 4 may extend between these although no relationship could be identified. The space between boundaries 2 and 3 contained comparatively sparse archaeology. It is possible that it represents a transitional enclosure, between the use of the ovular enclosure system and its extension into rectilinear spaces.

A very large boundary ditch (S5) was also noted in this area located 48m to the east of Enclosure 4. This ditch measured 70m long by 3.5m wide and was over 1m deep (its base unreachable owing to safety concerns). The southern portion of this ditch was orientated north-north-east to south-south-west, and turned to the north-west halfway along its length. This alignment is not consistent with any of the other ditches or enclosures recorded within the excavation area. The extreme size and depth of this ditch, compared with the other archaeology from the site, appears to indicate that it functioned as a more permanent division of the landscape, perhaps as the final eastern boundary to the activity.

3.5.1.5 Enclosure 5

The final curvilinear enclosure, Enclosure 5, was defined by a ditch that extended for *c*. 63m and measured 0.95-1.08m x 0.10-0.45m. The ditch is comparable to those of the other enclosures and truncates Boundary 5, suggesting it forms part of the main phase of activity.

3.5.1.6 Summary

The complex sub phasing of the ditches of Anglo-Saxon enclosures 2, 3 and 4 are all indicative of the short-lived or temporary nature of the activity that took place in this area of the site. The evidence from Viking Link is likely to represent seasonal use and disuse of enclosures in order to graze cattle. Evidence from the zooarchaeological assemblage is also consistent with these enclosures being for livestock, likely a herd of dairy cattle.

3.5.2 Activity in the west

Unlike the eastern Anglo-Saxon activity, the western activity did not constitute obviously enclosed spaces as its signature. Instead, it comprised a number of thin linear boundaries, largely orientated north-west to south-east and north-east to south-west (Figures. 16 and 17). These boundaries have been interpreted as the small divisions of an open field system, possibly to indicate furlongs within the field. No Anglo-Saxon artefactual remains were recovered from this area of the site, with instead only a very small amount of residual Roman wares identified. The archaeobotanical and archaeozoological assemblages from this area were also extremely limited indicating the possibility of more arable, rather than pastoral, land use in this area. It is also probable that the ditches of this area were not

utilised for long enough for significant quantities of material to accumulate within them, as the majority do not exhibit any obvious evidence of maintenance over time.

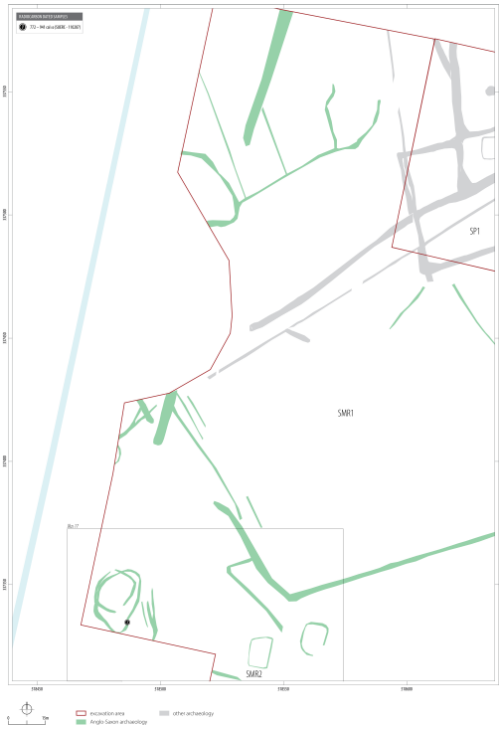

Figure 16: Anglo-Saxon activity in the west. Image credit: Headland Archaeology (UK)

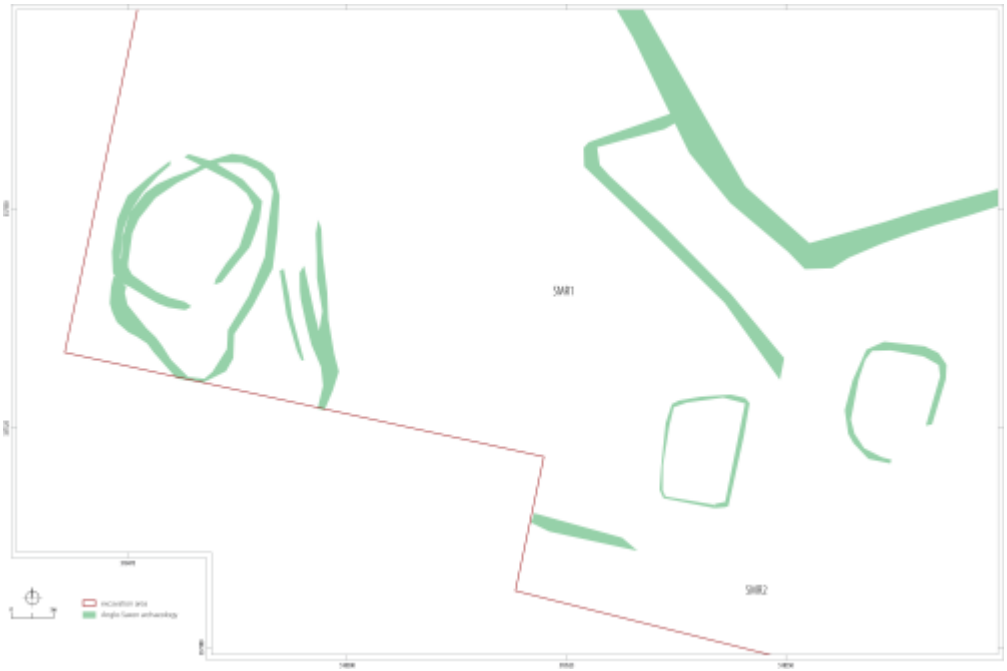

Figure 17: South-western enclosures. Image credit: Headland Archaeology (UK)

Four small rectangular enclosures were identified in this area of the site. The first constitutes the only supposed Anglo-Saxon archaeology that had any stratigraphic relationship with the Roman enclosure system. This was located against the northern limit of excavation, just to the west of the intercutting area of industrial activity. It enclosed a space of 12 x 10m and contained largely sterile fills, with any earlier artefactual remains recovered probably resulting from the disturbance of the earlier archaeology. This small enclosure not only truncated the ditches of the Roman enclosures in the area but also a number of small plough lines, indicating that between the cessation of the Roman activity and the establishment of the enclosure the area was under plough.

The remaining three enclosures were all situated in the south-westernmost corner of site (Figure 18), on the roddon situated on the other side of the area of lower, wetter, ground. These three enclosures all measured between 8-11m wide by 11-15m long and were orientated broadly north to south. The westernmost of these exhibited an earlier, less rectangular, phase where the enclosure had been larger (16m wide by 24m long). A cattle molar from this earlier phase was dated to cal AD 770-950 (SUERC-110287), which might indicate that this activity was contemporary with the later sub-phases of Anglo-Saxon enclosure in the east. The exact function of these enclosures is unclear; however, it is possible that they are the result of temporary pens for livestock.

Figure 18: Anglo-Saxon activity: ditches of open field system. Image credit: Headland Archaeology (UK)

3.5.3 Post-medieval boundaries

The final activity noted at Viking Link consisted of post-medieval field boundaries. These boundaries crossed the site on a north-north-east to south-south-west alignment and truncated all earlier activity (Figure 19). The majority were unexcavated during the project as they contained obviously modern infills of brick and rubble and were extant on the first edition Ordnance Survey maps of the area, dating to 1888.

Figure 19: Drone photograph looking north over the site mid-excavation. Image credit: Headland Archaeology (UK)

However, some smaller, post-medieval enclosures were also noted. One was situated to the north of the Roman expansion activity, while a small system was also located truncating the eastern Anglo-Saxon enclosures. The northerly enclosure produced Bourne D Ware pottery dating to between the 15th and 17th centuries, while the eastern system contained an early to mid-18th century bowl base. Unlike the Roman and Anglo-Saxon activity, which relates to small-scale pastoral agriculture, these post-medieval ditches predominantly relate to the large-scale reclamation of the Fens that took place in earnest in the 18th century.

4. Artefactual Evidence

The finds from Viking link include pottery from the Roman and early medieval period as well as small quantities of metalwork, worked animal bone, glassware and worked stone. The find categories are addressed by individual specialists below, with supporting data provided in Appendix 1. Full specialist reports including methodologies are available in the physical site archive.

Appendix 1: Artefact data [Download as XLSX]

4.1 Roman pottery *by Sara Machin*

Table 4: Summary of assemblage by stratigraphic phase

Row Labels	Count	Weight (g)	MNV	EVE
0. Earlier Boundaries	29	326	10	0.27
2. Expansion	140	2400	48	2.27
3. Maintenance	167	3652	72	2.31
4. Later Developments	8	146	6	0.08

1. Establishing Enclosure	511	6182	183	6.4
5. Roman Unphased	19	300	8	0.41
9. Unstrat	34	656	18	0.35
7. Activity to the south-west	12	409	8	0.17
6. Anglo-Saxon (east)	8	168	8	0
8. Post-medieval	1	1	1	0
Grand Total	**929**	**14240**	**362**	**12.26**

The Viking Link excavations recovered a total of 929 sherds (14.240kg) of Roman pottery with a mean sherd weight of 15.32g. The material exhibits slight to severe abrasion, with the majority only moderately abraded. The assemblage represents a minimum of 362 vessels. There is a high incidence of undiagnostic body sherds, reflected in the relatively low EVE of 12.26 for an assemblage of this size. The assemblage is associated with Roman and Anglo-Saxon settlement features, with material recovered from ten Roman and four middle Saxon phases (Table 4). Within these phases, the pottery can be assigned to feature groups as described below. Decoration is rare in the assemblage, recorded on only 35 sherds.

Table 5: Fabric codes and description

Ware Type	Fabric Code (CLAU)	NRFRC	Fabric description	Ct	%Ct	Wgt (g)	% Wgt
AMPH	DR20	BAT AM1/2	Dressel 20 amphorae	1	0.11%	327	2.30%
FINE	CC		Other colour-coated wares	7	0.75%	166	1.17%
FINE	NVCC	LNV CC	Lower Nene Valley colour-coated ware	140	15.07%	2086	14.65%
LFINE	SPCC	SWN CC	Swanpool colour-coated ware	2	0.22%	32	0.22%
MLCO	DWSH	DAL SH	Dales ware; late shell-tempered;	167	17.98%	2079	14.60%
MORT	MOMH	MAH WH	Mancetter Hartshill mortaria	1	0.11%	30	0.21%
MORT	MONV	LNV WH	Lower Nene Valley mortaria	7	0.75%	508	3.57%
MORT	MORT		Mortaria - undifferentiated	1	0.11%	18	0.13%
OXID	CR		Miscellaneous creamware	1	0.11%	6	0.04%

OXID	OX		Miscellaneous oxidised ware	4	0.43%	37	0.26%
OXID	OXWS		Oxidised with white slip	2	0.22%	5	0.04%
REDU	BB1	DOR BB1	Black-burnished 1	1	0.11%	14	0.10%
REDU	BB2		Black-burnished 2	9	0.97%	254	1.78%
REDU	COAR		Miscellaneous coarse wares	22	2.37%	96	0.67%
REDU	GREY		Miscellaneous grey wares	462	49.73%	7113	49.95%
REDU	NVGW	LNV GW	Lower Nene Valley greyware	65	7.00%	1058	7.43%
SAM	SAMCG	LEZ SA2	Central Gaulish Samian	1	0.11%	8	0.06%
SAM	SAMCG-EG		Central or East Gaulish Samian	1	0.11%	3	0.02%
SAM	SAMSG		South Gaulish Samian	3	0.32%	50	0.35%
SHEL	SHEL		Miscellaneous undifferentiated shell-tempered	32	3.44%	350	2.46%
	TOTAL			**929**		**14240**	

4.1.1 Fabric groups

The assemblage is dominated by GREY, ubiquitous locally produced sandy grey wares (Table 5). These account for 50.0% of the assemblage by weight and 49.7% by count, meaning that the majority of the assemblage can only be broadly dated to the Roman period. Where fabric or form is distinctive, it has been possible to assign some GREY sherds to the production centres at Rookery Lane or Swanpool, giving a 3rd to 4th century date for these (see catalogue). The range of forms in the GREY assemblage is limited, with examples of bowls, dishes and jars noted, with jars dominating. Jars are further categorised by rim shape. Bowls include examples of flanged bowls of varying sizes. Two sherds of a tazza recovered from Ditch 1796 [Enclosure 7, North) are of particular interest in the GREY assemblage. The sherds are hard-fired and highly burnished. They feature three raised areas around the vessel, which have been notched (Figures 20 and 21). Tazze typically have a pedestal base and are usually associated with burning incense (Davies *et al*. 1994), and some have ritual associations, with examples associated with burial and cremations at other sites. Tazze are found in both frilled and notched forms, with notched said to be later than frilled, and tending to replace the latter in the 3rd and 4th centuries (Grimes 1930, 169). Tazza were among the corpus of forms produced at the pottery production centre at Market Rasen (Darling 2005). A notched example in an oxidised ware, of similar shape and form to the Viking Link example, was recorded at Colchester (Symonds and Wade 1999, form 724). Notched decoration is also present on an example from Elms Farm, Essex (Biddulph *et al*. 2015). Notched decoration is noted on jars from the kiln site at Swanpool (Webster and Booth 1947, 70).

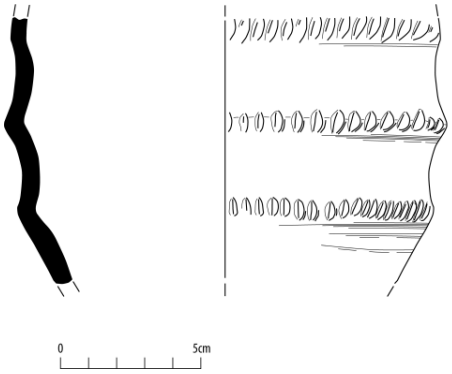

Figure 20: SPE1 (1609); GREY; TAZZA body sherds of hard-fired grey ware vessel, three sections to body with notched cordons. Image credit: Headland Archaeology (UK)

ONLINE ONLY

Figure 21: Roman Tazza by Headland Archaeology. Available on Sketchfab. Image credit: Headland Archaeology (UK).

A range of decorative techniques were noted within the GREY assemblage, including burnished wavy lines and burnished lattice. Of note is the example of linear rusticated decoration, recorded on body sherds derived from two vessels (2 sherds, 16g Ditch1401, Trackway; 5 sherds, 39g, Ditch 3159, Later developments). This type of decoration has been noted to be geographically characteristic as well as closely dated. The linear rustication is typically found north of a line running from the head of the Severn Estuary to East Anglia (Lee *et al.* 1994, 17). While found on pre-Flavian sites, it is especially prevalent on Flavian sites, continuing into the Trajanic period with the end of the tradition typically given as AD 130 (Thompson 1958, 21). The production of these wares at North Hykeham has been dated to the Flavian period. These sherds, if originating from North Hykeham, would represent some of the earliest material in the assemblage. A number of sherds with double incised lines around the shoulder have been recorded and may well have derived from rusticated vessels where it is used to delineate the area of rustication (Thompson 1958, 26). Decoration on five vessels was recorded where both the fabric and decorative techniques are consistent with products from the kiln at Swanpool (Webster and Booth 1947).

Other reduced wares include 65 sherds (1058g) of Lower Nene Valley greyware (NVGW). These diagnostic forms include dishes with plain rims, these being the most common NVGW dish form in the 3rd century (Perrin 1999, 86). The examples were recorded from Ditch 1745 (Structure 2) and Ditch 1796 (Enclosure 7, North) and Ditch 1797 (area of craft and industry). There is a small assemblage of black-burnished wares, along with miscellaneous coarse wares.

Oxidised wares are rare, comprising only seven undiagnostic body sherds (48g). Shell-tempered wares are dominated by local fabric, Dales ware (DWSH), which accounts for 14.6% of the assemblage by weight, 18.0% by count. Dales Ware is dated from AD 230-370 by Gillam (1951, 160) although, its presence has been recorded form as early as AD 200 elsewhere (Darling and Precious 2014, 83) who note the earliest presence in Lincoln from the 3rd century onwards. The Dales Ware assemblage comprises in the main the classic Dales ware jar form (JDW), along with single examples of a bowl with expanded rim (BEXR) and a lid. In Lincoln assemblages, Dales Ware lids are rare and are generally dated to the mid-late 4th century (Darling and Precious 2014, 88); the Viking Link example was unstratified. There are a further 32 sherds (350g) of miscellaneous shell-tempered wares.

Amphorae are represented by a single body sherd recovered from Ditch 1342 (Enclosure 7, East, Maintenance). The sherd is in fabric DR20, of Baetican origin and likely derived from a Dressel 20. There is a small assemblage of mortarium, comprising nine sherds with a total weight of 556g, representing a minimum of 6 vessels. The majority of the mortarium can be identified as deriving from the Lower Nene Valley (MONV) including a large fragment of reed-rimmed mortaria with the typical slag-based trituration grits, recorded from Ditch Group 3273 (Figure 22). This is an example of a Perrin M19 (1999, 129), typologically dated to the 3rd century. The other diagnostic MONV example, from Ditch 1796 (Enclosure 7, North), is a Perrin-type M36 (1999, 132), typologically later 3rd to 4th century in date. The only other diagnostic mortaria is an example of a hooked flange type mortarium,

from Mancetter Hartshill (MOMH). This type is noted in Lincoln assemblages from the early to mid-3rd century, also recovered from Ditch 1796 (Enclosure 7, North).

Fine wares are dominated by Lower Nene Valley colour-coated wares (NVCC; Table 5), accounting for 14.6% of the assemblage (by weight). The assemblage is dominated by dishes and bowls, with examples of dishes with plain upright rims (DPRS) being the most common. This form, Perrin 231-235, was produced from the later 2nd century onwards though most are typically of 4th-century date (Perrin 1999, 101). The examples in the assemblage were recovered from features dating to the establishment of the enclosures along with some unstratified examples. Also common were dishes with rounded rims, NVCC copies of NVGW (Lower Nene Valley greyware forms), with a production date range the same as for the DPRS. All examples of these were recorded from the initial phase of enclosure. There is also a range of forms in the NVCC assemblage imitating Samian vessels. Two examples of both B18/31 and B36 were noted, along with single examples of B31, B36 and B37. The main period of production for samian imitation vessels at Nene Valley was the mid-later 3rd century to the early 4th century (Perrin 1999, 102). Such imitations were also being produced at the same time by both the New Forest (Fulford 1975, types 61-3) and Oxfordshire (Young 1977 , types 44-53) industries. The initiation samian vessels at Viking Link were recorded from throughout the Roman phase, with an imitation type 36 (B36) recorded from Ditch 1796 (Enclosure 7, North). One unusual sherd, in the form of a very narrow neck of a jar, was recorded from Pit 4362 within SMR6 and is likely residual (Figure 23). This sherd derived from a narrow-necked jar, Perrin type 191 (1999, 94) and is an unusual form, dating to the later 3rd to 4th century. As with the assemblage as a whole, decoration is rare on the NVCC assemblage, with only two examples of rouletted decoration noted. One is on a small fragment of beaker recorded from the topsoil and the other on a hemispherical bowl from Ditch 1126 (Enclosure 13, Expansion). The fine wares also included two sherds of Swanpool colour-coated ware (SPCC), comprising a rim and body sherd derived from a hemispherical bowl (BHEM) recovered from Ditch 1342 (Enclosure 7, East, Maintenance). Seven sherds of undiagnostic colour-coated wares were also recorded.

Imported wares comprise solely samian wares, present in both Central and Southern Gaulish fabrics. The assemblage consists of 5 sherds with a total weight of 61g. The assemblage includes a small rim sherd of a Curle 23 (Webster 1996, 67) derived typically from a cup and dish 'set'. These forms were made in the late Flavian period with East Gaulish examples imported up to the mid-3rd century. The Viking Link example derived from Ditch 1791 (area of craft and industry). This example has been burnt, making it difficult to determine the fabric more accurately. The remainder of the samian is undiagnostic in form; however, a sherd from Pit 4178 (Roman-unphased) of La Graufesenque origin was noted to have a partial repair hole present to the edge of the sherd.

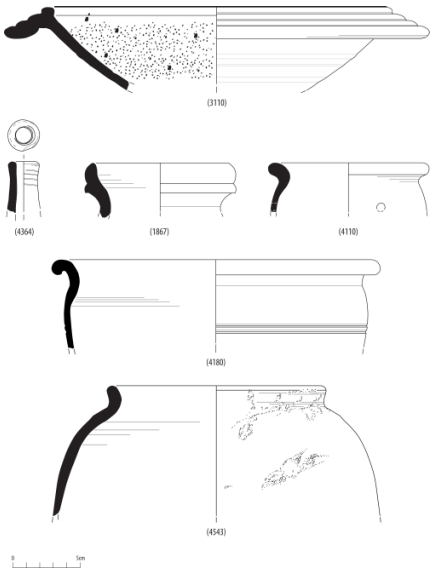

Figure 22: SPE1 (3110) MONV; large fragment of reed-rimmed mortaria with slag grits; (D&P 1760-1770)
Figure 23: SMR6 (4364) NVCC; rim from narrow-necked jar; four grooves around; Perrin 1999, 99; type 191
Figure 24: SPE1 (1867) GREY; partial rim of collar-rimmed jar (D&P 1022-6) without notched

decoration - present at both Rookery Lane and Swanpool
Figure 25: SPE2 (4110) GREY; everted rim jar; burnt exterior surface with residue; post-firing hole with associated spalling to shoulder; potential suspension hole; same vessel as 4243
Figure 26: SPE2 (4180) GREY; curved rim jar; Darling and Precious 2014 type fig. 104. 985-7; double groove below shoulder
Figure 27: SMR6 (4543) LIM; hump-shoulder globular, rim top flat; rim diam 170mm . Image credit: Headland Archaeology (UK)

4.1.2 Phased groups from excavation areas SPE1 and SPE2

An assemblage of 917 sherds with a total weight of 13.995kg of Roman pottery was recovered from features within areas SPE1 and SPE2, with pottery recorded from features that overlap between the two areas. The assemblage equates to a minimum of 351 vessels with an EVE of 12.26. The assemblage is discussed below by key phase.

4.1.2.1 Earlier boundaries

A total of 29 sherds (326g) of Roman pottery was recovered from features associated with the earlier boundaries. Of these 15 sherds, weighing only 24g, were from Sample 068 taken from Ditch Group 1620. The remainder of the material was recovered from Ditch Group 1793. The assemblage equates to a minimum of 10 vessels with an EVE of 0.27. The assemblage comprises grey wares (GREY) along with shell-tempered pottery of Dales Ware (DWSH) and other miscellaneous shelly fabrics (SHEL). They were largely undiagnostic in terms of form, with examples of flanged bowls and jars noted.

4.1.2.2 Establishing enclosure

An overall total of 511 sherds (6182g) of Roman pottery was recovered from ditches, pits and structures assigned to the establishment of the enclosure system. The assemblage equates to a minimum of 183 vessels with an EVE of 6.4. This is the largest phased assemblage in terms of sherd count. It mainly comprises reduced wares (GREY; BB2; COAR) along with shell-tempered wares. The Nene Valley wares are present in colour-coated, greywares and mortaria, along with the only example of Mancetter-Hartshill mortaria. This material included an assemblage from Ditch Group 1796 comprising 125 sherds weighing 1666g. This included a large assemblage, 26 sherds (346g), of Nene Valley colour-coated wares, along with 55 sherds (748g) of GREY and 30 sherds of DWSH. This assemblage included the tazza (see above). Ditch Group 1454 contained 60 sherds with a total weight of 808g, comprising in the main greyware (GREY). Ditch Group 1413 contained 16 sherds (219g).

Area of craft and industry

The assemblage includes a total of 200 sherds (2049g) of Roman pottery recovered from features located in the north-eastern corner of Enclosure 7 and south-eastern corner of Enclosure 4, associated with craft production. In terms of fabrics, the assemblage is similar in composition to that recorded from the enclosure system, with an absence of mortarium. The two most common fabrics are again GREY and NVCC. The largest assemblage from this area derived from Ditch 1797 that extended south from the northern limit of excavation, and comprised 146 sherds (1721g), the composition of which reflects the composition of the whole area. Other ditch groups contained smaller assemblages (Ditch 1364-6 sherds, 78g; Ditch 1791-2 sherds, 9g; Ditch 1794-14 sherds, 30g; Ditch 1795-5 sherds, 24g). An assemblage of 27 sherds (187g) was recorded from ditches 1799 and 1792. This comprised greyware (GREY), Dales ware (DWSH) and Nene Valley colour-coated wares (NVCC). The assemblage comprised solely undiagnostic body sherds.

Trackway

An assemblage of 15 sherds with a total weight of 205g was recorded from the trackway ditches. This represents a minimum of 12 vessels, with EVE of 0.03. As reflected by the EVE measurement, the majority of the sherds were undiagnostic body sherds, with GREY fabrics representing 14 sherds (125g). Ditch1401 (Northern Trackway Ditch, North-east) contained a total of 13 sherds (195g) while two sherds of Nene Valley greyware came from Ditch 1902 (Southern Trackway Ditch).

4.1.2.3 Eastern expansion

A total of 140 sherds (2400g) of Roman pottery was recovered from features associated with the expansion of the enclosure system. The assemblage equates to a minimum of 48 vessels with an EVE of 2.27. The assemblage is comprised of just four fabrics, with DWSH and GREY dominating. The diagnostic forms are jars, along with a single example of a BB-type flanged bowl in GREY. The largest assemblage was recovered from Ditch 1126 (Enclosure 6), 24 sherds weighing 952g. The assemblage comprised GREY and NVCC fabrics. The Nene valley ware comprises a dish with triangular rim, Perrin-type 217 (1999, 101) dating from the mid-2nd century onwards, and a rim sherd of a hemispherical bowl with rouletted decoration, potentially imitating a Samian Dr 37 form. The rouletted decoration resembles a Perrin-type 240 (1999, 102) dating from the later 3rd to early 4th century. The assemblage from Pit 4211 (Enclosure 15) includes fragments of the same vessel recovered from Ditch 4944 (see Unphased below).

4.1.2.4 Maintenance

This phase sees an increase in the volume of pottery as well as the range of fabrics present. The assemblage totals 167 sherds weighing 3652g and was recovered from ditches dated to this phase of the settlement. This equates to a minimum of 72 vessels with EVE of 2.31, again representative of the lack of rim sherds in the assemblage. All the pottery was recovered from ditches, with a large assemblage recovered from Ditch 1342 (Enclosure 7, East). This assemblage included a range of fabrics, including a single body sherd of central Gaulish samian ware and the only sherd of amphorae from the site.

An assemblage of 26 sherds (562g) of Roman pottery was recovered from Ditch 2026, which is the primary recut of the main enclosure system. The assemblage equates to a minimum of 17 vessels with an EVE of 0.625. The assemblage comprises Nene Valley wares both colour-coated (NVCC) and greywares (NVGW), Dales Ware (DWSH) and GREY reduced wares. The colour-coated wares are largely undiagnostic, including a sherd of a hemispherical bowl. The GREY wares include sherds of possible Rookery Lane origin (Webster 1960). This includes the partial rim of a collared-rim jar (Figure 24), akin to Darling and Precious type-1022-6 (2014, fig. 106), albeit without the notched decoration. Forms of this type were produced at both Swanpool (Webster and Booth 1947) and Rookery Lane (Webster 1960), though could equally have been the product of a more local production centre.

4.1.2.5 Later developments

A small assemblage, five sherds (43g), was recorded from Ditch 1321, which cuts the Roman ditches within the area of craft activities. The ditch is comparable in form to those across the Anglo-Saxon area of activity. The assemblage comprised three sherds of greyware (GREY) along with single sherds of coarse ware (COAR) and Nene Valley colour-coated ware (NVCC). The only diagnostic sherd was a rim fragment from a NVCC bowl with triangular rim, dating from the mid-2nd century onwards.

A single sherd of GREY pottery was recovered from Ditch 1698, which also cuts the Roman enclosure system. It is a heavily abraded partial base, undiagnostic in form. A further two sherds were recovered from Ditch 1406.

4.1.2.6 Unphased Roman

A further 19 sherds, 300g, were recorded from unphased Roman features. Within this assemblage were two sherds of small jars, both with post-firing perforations to the shoulder. One recorded from Ditch 4944 exhibits a burnt residue to the exterior (Figure 25) and is part of the same vessel from Pit Group 4211. The other is a curved rim jar, of Darling and Precious type-985-7 (2014, fig. 104) with a suspension hole and double incised lines below the shoulder (Figure 26).

4.1.3 Phased groups from excavation area SMR1 (activity to the south-west)

A total of four sherds (77g) of Roman pottery was recovered from features within area SMR1. The assemblage equates to a minimum of three vessels. All were undiagnostic body sherds with no rims present. Two fabrics were present in the assemblage, two sherds of Oxford white-slipped ware (OXWS) and two sherds of greyware (GREY), the larger of the GREY sherds was recovered from Ditch [3156], it has a fabric characteristic of the products from Rookery Lane. All the pottery was recovered from features associated with peripheral activity. The fabrics indicate a 3rd-4th century date for the material.

4.1.4 Phased groups from excavation area SMR6 (Anglo-Saxon East)

The assemblage from SMR6 is small (8 sherds; 168g) and largely undiagnostic, with the majority dating broadly to the Roman period. The diagnostic fabrics indicate a date range from AD 170, with an example of a 3rd-century form in NVCC. All the Roman pottery from this area was recovered from features dated to the middle Saxon period and therefore can be considered residual in these features.

4.1.5 Discussion of fabrics and forms

The peaks of activity are shown to be in the initial phase of establishing the enclosure and in the maintenance. The pottery dates almost exclusively from AD 200 onwards. The composition of the assemblage is generally consistent across all the Roman phases of activity (Figure 28). Shell-gritted ware present were mostly represented by Dales Ware jars, with a few sherds of miscellaneous shell-tempered fabrics.

The range of fabrics, dominated by greyware and Dales ware, with small quantities of table ware, is comparable with that from Stallingborough (Rowlandson 2011). From the later 2nd century, the coarse wares are not easily attributed to a kiln or kiln group, with greyware production known from a number of sites in the vicinity of the city of Lincoln, namely Lincoln recourse (Corder 1950), Rookery Lane (Webster 1960), Swanpool (Webster and Booth 1947), Torksey, Little London and Knaith. With similarities in fabrics, it is often the forms that are relied upon to determine the origin of vessels. However, it should also be considered that the greywares could have been made at kiln sites more local to the site at Viking Link. The presence of samian, finer greywares, and colour-coated wares, which would have functioned as table wares, suggest domestic activity at the site. The tazza, as discussed above, is suggestive of ritual activity.

Romano-British fine wares, mostly Lower Nene Valley colour-coated wares, account for 16.04% of the assemblage by both weight and count. Samian ware is rare, representing less than 0.5% of the assemblage, demonstrating that much of the activity at the site is focused in the decades after the cessation of the importation of samian ware in the mid-3rd century AD. The Nene Valley wares represent a pattern of regional trade commencing in the mid/late 2nd century.

This proportion of fine wares, including Nene Valley wares, is comparable to the assemblage from Triton Knoll-SMR06 (Rowlandson 2020), though lacking the imported wares seen in the Triton assemblage, where they are assumed to be a result of maritime connections. The assemblage has affinities with that from both Lincoln (Darling and Precious 2014) and Old Sleaford (Elsdon *et al.* 1997), with coarse grey and shell-tempered wares dominating, supplemented by fine wares from the Nene Valley kilns. Similarly, the sites at Sutterton, located 8km to the east (Davies 1996; Precious 1996; Leary 2008) have assemblages, albeit small, of similar composition and date range. Nene Valley fine wares contributed a substantial proportion of the fine wares in the 3rd and 4th century at Old Sleaford (Elsdon *et al*. 1997) and Long Bennington (Leary 1994), where they are in the majority compared with Oxford and Swanpool products.

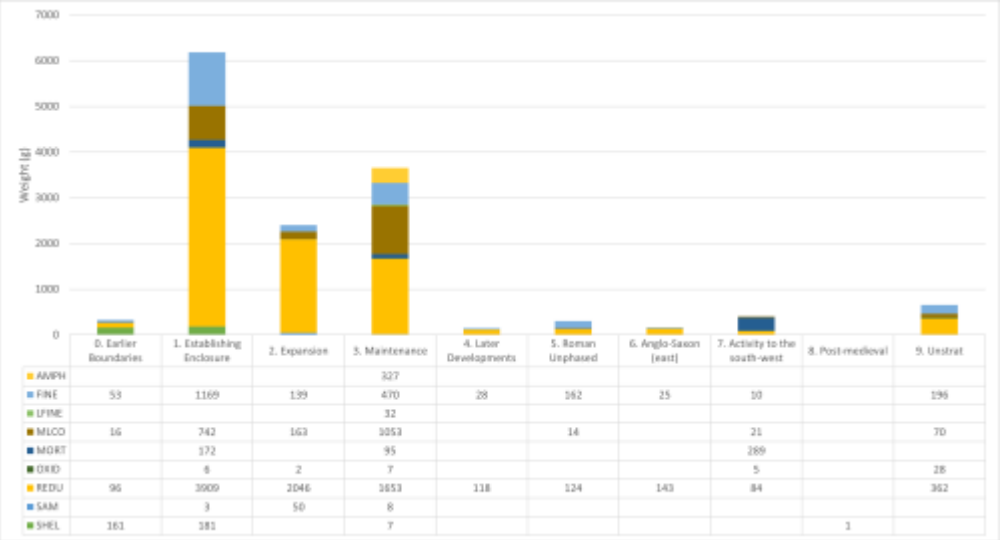

Figure 28: Fabrics present by phase (weight (g)). Image credit: Headland Archaeology (UK)

While 44 individual form types were recorded these can be broadly categorised into six groups, along with undiagnostic body sherds, which account for 24.03% of the assemblage by weight. The identified forms present are dominated by jars, accounting for 52.3% of the assemblage by weight.

Beakers are present only in the initial phases (Figure 29) of the enclosure while the only amphorae recorded is from the maintenance phases. Mortaria are present primarily in the initial phases of enclosure. A Mancetter-Hartshill example, dating from the early to mid-3rd century was recorded, along with a Lower Nene valley mortaria dating to the 3rd century. The mortaria are typical of regionally traded wares from the mid- to late Roman period in the area and consistent with consumption associated with small-scale domestic occupation.

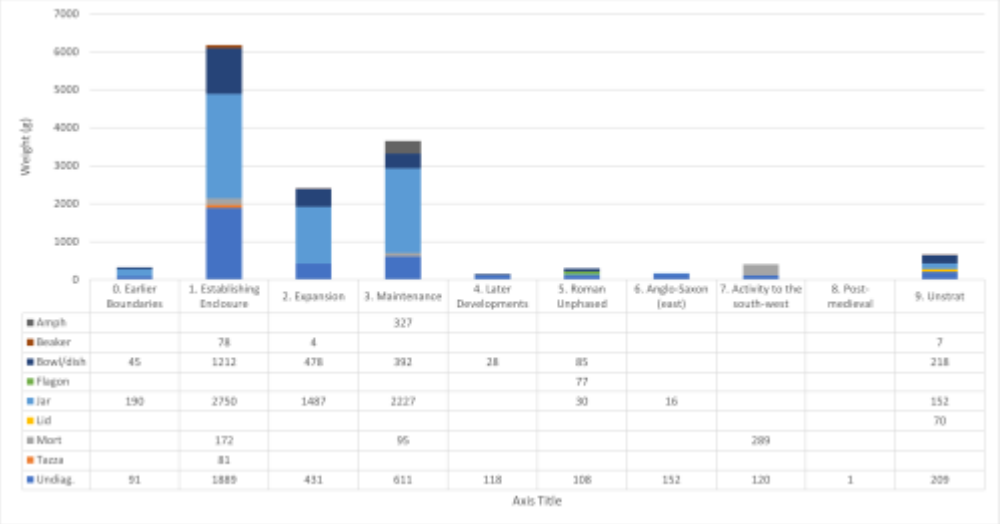

Figure 29: Forms present by phase (weight (g)). Image credit: Headland Archaeology (UK)

Overall, the composition of the assemblage in both fabric and form suggests a settlement dating to the later Roman period, from the mid-2nd century AD onwards extending into the 4th century. The rusticated wares evidence some earlier settlement activity, while samian vessels can be curated for a prolonged period of time. The earlier sherds derived from earlier waste material incorporated into later features, along with the small assemblage of Iron Age pottery reported separately. The bulk of the Roman pottery is utilitarian in nature, comprising a range of jar and bowl forms, manufactured by local industries in reduced, and shell-tempered wares. The presence of a small assemblage of samian along with regionally traded colour-coated fine wares and mortaria suggests access to more refined wares to supplement the utilitarian vessels.

4.2 Anglo-Saxon pottery *by Sue Anderson*

Post-Roman pottery totalling 730 sherds (3291g) from 33 contexts was recorded. Of these, 726 (3277g) were of early/mid-Anglo-Saxon date (Table 6), three were possibly medieval and one was undated. Early/middle Anglo-Saxon fabric groups have been characterised by major inclusions and pottery codes and date ranges follow the Lincolnshire Fabric CNames as far as possible.

4.2.1 Early/mid-Anglo-Saxon pottery

Table 6: Distribution of Early Anglo-Saxon (EAS) pottery by fabric

Fabric	CName	Date range	No	Wt/g	eve	MNV
Anglo-Saxon Shell-tempered fabrics	ESAXSH	450-650	1	1		1
Early Anglo-Saxon grog and mixed inclusions	ESGMI	450-650	2	17		2
Early/mid Saxon fine sandy	ESFS	450-800	25	653	0.05	3

Early to mid Anglo-Saxon chaff-tempered ware	ECHAF	450-800	2	5		1
Limestone-tempered Anglo-Saxon	LIMES	450-850	8	98		5
Early to mid Anglo-Saxon greensand quartz	ESGS	550-800	1	20		1
Early to mid Saxon sandstone-tempered	SST	550-800	7	61		4
Iron-tempered fabrics	FE	550-800	5	164	0.1	3
Oolitic limestone-tempered fabrics	LIM	550-800	11	232	0.12	5
Southern Maxey-type ware	RMAX	650-950	663	2020	0.62	25
North Lincolnshire Oolitic Maxey-type	NLOMAX	700-850	1	6		1
Totals			*726*	*3277*	*0.94*	*51*

The estimated vessel equivalent of 0.94 is based on seven measurable rims; three other rim fragments could not be measured. Measurements of handmade vessels are always approximate unless a large proportion of the rim is present. For this reason, the minimum number of vessels (MNV), based on sherd families, was estimated for each context, producing a total MNV of 51 vessels.

Small quantities of early and early/mid-Anglo-Saxon handmade wares were recovered in a variety of fabrics, but the majority of vessels in the assemblage were Southern Maxey-type wares, based on the range of fossil shell inclusions (Spoerry 2016, 97). Other fabrics included examples dominated by quartz sand, limestone, sandstone or ferrous oxide, but most contained a background scatter of this range of inclusions.

The early Anglo-Saxon group included the rims of two jars, a bowl and two hanging vessels. Nineteen body and base sherds from Ditch 4541 (4543, Enclosure 3), in ESFS fabric with occasional sandstone, were part of a hump-shouldered globular vessel. A jar with a vertical flat-topped rim from the same context was in an oolitic fabric, as was a bowl with a vertical rim. Pit 4362, fill (4363), contained a small fragment of a flat-topped flaring rim from a jar, tempered with abundant (leached) fine limestone and sparse, coarse, rounded ferrous oxide. A globular hanging vessel with a vertical rim from Ditch 4823 (4665, Boundary 1) was in a silty fabric (recorded as ESFS), while another in a ferrous oxide fabric was globular with an inturned rim and was found in Ditch 4484 (4486, Midden 1); both had vertical pierced lugs. Four bases were present, two flat-angled, one flat with a rounded angle, and one rounded. No sherds were decorated.

Although large in terms of sherd count, the Maxey-type ware group included 618 sherds from Ditch 8117 (8118, Enclosure 4), which appeared to be largely from a single vessel, with perhaps one other also present, although the condition of the sherds made this impossible to ascertain. The main vessel in this context was another hanging vessel with an upright pierced lug. Unusually for this area and fabric, it appeared to have a thick *Schlickung*-like slip covering part of the body, although many areas of the outer surface were worn. This type of coarse slip is more commonly seen on early Saxon vessels in Essex and south Suffolk, so it is possible that the surface of this vessel was 'repaired' with the addition of a new layer of clay during its use. Other identifiable forms in this group comprised a possible bowl with a flat-topped beaded rim in Ditch 4908 (4369, Midden 1) (similar to a jar rim from Maxey; Addyman 1964, fig. 14.43), a thin-walled globular jar with a short squared-off vertical rim from Ditch 4871 (4783, Enclosure 4), and another jar with a vertical rim from Ditch 4908 (4369, Midden 1). The thin-walled vessel was associated with a radiocarbon date of 670-774 cal AD, and two other Maxey-type ware sherds from Ditch 4488 (4492, Midden 1) had an associated date of 772-944 cal AD. Bases included one sagging example and three flat.

4.2.2 Later and undated pottery

One small body sherd (3g) of probable early medieval shelly-sandy ware (SSW) containing fine sand, coarse shell and ferrous oxide was found in Ditch 8097 (8098). Two abraded joining sherds (10g) of a jar rim of everted form with a flat-topped everted tip were found in Ditch 4541 (4605, Enclosure 3); the vessel was tempered with abundant (leached) shell (SHW) and had oxidised surfaces, and is likely to be of early to high medieval date. A tiny fragment (<1g) from bulk sample <812> in Ditch 8072 (8073, Enclosure 4) contained fine shell inclusions (SHW) but was otherwise undiagnostic.

4.2.3 Discussion

A moderate quantity of Anglo-Saxon pottery was recovered, most of it from the fills of ditches (Table 7). The only large concentration of sherds (N=617) was in Ditch 8117 (8118), but as this group represented between one and three vessels it was comparable with quantities from other contexts across the site, none of which had an MNV greater than 3. This suggests that a thin scatter of rubbish, probably dispersed across the fields during manuring, was incorporated into the fills of the ditches when they were infilled. The overall average sherd weight for the assemblage is 4.5g, which is quite low for the fairly robust and thick-walled pottery produced in this period, although some relatively large sherds are also present.

Table 7: Distribution of fabrics by site phase (MNV)

Fabric	5R	2MS	3MS	4MS	5MS	U-MS	Un
ESAXSH			1				
ESGMI		1	1				
ESFS		1			2		
ECHAF		1					
LIMES	1	1	1	1		1	
ESGS						1	
SST		1	1		1	1	
FE			1		1	1	
LIM			1	2	2		
RMAX		1	8	5	9	1	1
NLOMAX			1				

The range of fabrics in this assemblage is comparable with a group excavated at nearby Quarrington (*c*. 10km to the north-west), which was dominated by sandstone-tempered fabrics but also included oolitic, sandy and iron ore fabrics, as well as Southern Maxey-type ware (Young 2003 , table 2). One noteworthy difference, however, is that Ipswich ware did not occur at Donington. This ware has been found at Quadring and Gosberton, to the south of Donington (Blinkhorn 2012, 81-2), and given Donington's location on a Roman road and close to the Fen-edge, it would be expected here too, but perhaps its absence is due to the lack of settlement evidence within the excavated area. Also of

interest is the presence of three vessels tempered with abundant red ferrous oxide, which Young notes tends to be more frequent to the east and north of Lincoln (Young 2003).

At least three vessels were in a relatively unusual 'hump-shouldered' form (cf. Myres 1977 , fig. 15), in ferrous, oolitic and sandy fabrics, which are most closely paralleled by examples from Norfolk and Yorkshire (Myres 1977, nos 1808 and 2344). Two were recovered from Ditch 4541 (4543, Enclosure 3, Figure 27) in the latest middle Saxon phase, and the ferrous-tempered one was from Pit 4362 (4364), which has an associated radiocarbon date of 677-877 cal AD, perhaps suggesting that this form was a relatively late development in the early Anglo-Saxon period.

Three hanging vessels were all from different site phases; an ESFS example from phase 2, an RMAX example from phase 4 and an FE one from phase 5. This type of vessel, with an upright lug on the rim, tends to be more common in the middle than the early Anglo-Saxon period, perhaps suggesting that activity on the site began towards the end of the latter period.

4.3 Organic residue analysis *by Julie Dunne, George Haberfield and Richard P. Evershed*

Lipids, the organic solvent-soluble components of living organisms, i.e. the fats, waxes and resins of the natural world, are the most frequently recovered compounds from archaeological contexts. They are resistant to decay and are likely to endure at their site of deposition, often for thousands of years, because of their inherent hydrophobicity, making them excellent candidates for use as biomarkers in archaeological research (Evershed 1993).

Table 8: Sample name, site, context, spot date, period, vessel type, lipid concentration (µg g^{-1}), *δ13C and Δ13C values and attributions of pottery lipid residues from the Viking Link site*

Sample					**Lipid Concentration**				
Name	**Site**	**Context**	**Date**	**Vessel Type**	**µg g^{-1}**	**$\delta13C_{16:0}$**	**$\delta13C_{18:0}$**	**$\Delta^{13}C$**	**Attribution**
VIK01	SPE2	4180	ROM	Necked jar	7557.6	-27.3	-29.8	-2.5	Ruminant adipose
VIK02	SMR6	4369	SAX	Bowl with a flat-topped beaded rim	2862.1	-27.9	-29.2	-1.3	Ruminant adipose
VIK03	SMR6	4543	SAX	‘hump-shouldered’ form	52.1	-25.6	-31.1	-5.4	Ruminant dairy
VIK06	SMR6	8118	SAX	Hanging vessel with an upright pierced lug	1354.3	-27	-29.1	-2.1	Ruminant adipose
VIK07	SPE1	1347	ROM	Large JDW dales ware jar with flat rim	1070.9	-28.2	-31.1	-2.9	Ruminant adipose
VIK08	SMR6	4783	SAX	Thin-walled globular jar with a short squared-off vertical rim	18715.4	-27.6	-29.7	-2.1	Ruminant adipose
VIK09	SPE2	1013	SAX	Neckless ovoid jar	660.1	-28.2	-33.2	-5.1	Ruminant dairy

VIK10	SPE1	1409	ROM	Everted rim jar	335.4	-28	-31.6	-3.7	Ruminant dairy

Lipid analysis and interpretations were performed using established protocols described in detail in earlier publications (Correa-Ascencio and Evershed 2014). Ten potsherds were analysed, with 8 sherds yielding interpretable lipid profiles (Table 8; Figures 30 and 31). The mean lipid concentration from all lipid-yielding sherds was 4.0 mg g^{-1}, with a maximum lipid concentration of 18.7 mg g^{-1} (VIK08, IASHC ovoid/round-shouldered jar). A further four potsherds contained high concentrations of lipids (e.g. VIK01, 7.6 mg g^{-1}, VIK02, 2.9 mg g^{-1}, VIK06, 1.4 mg g^{-1} and VIK07, 1.0 mg g^{-1}, comprising an IASH necked jar, IASH Oval jar, IASH jar(?) and Dales Ware jar, respectively), demonstrating excellent preservation. The lipid profiles were dominated by free fatty acids, palmitic (C_{16}) and stearic (C_{18}), typical of a degraded animal fat (Figures 30 and 31; Evershed *et al*. 1997a; Berstan *et al*. 2008).

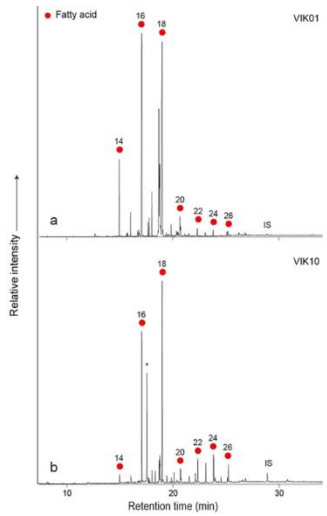

Figure 30: Partial gas chromatograms of acid-extracted FAMEs from Viking Link pottery extracts of a. VIK01, IASH necked jar, b. VIK10, DWSH everted rim jar; red circles, n-alkanoic acids (fatty acids, FA); * denotes sulfur; IS, internal standard, C_{34}n-tetratriacontane. Numbers denote carbon chain length . Image credit: Headland Archaeology (UK)

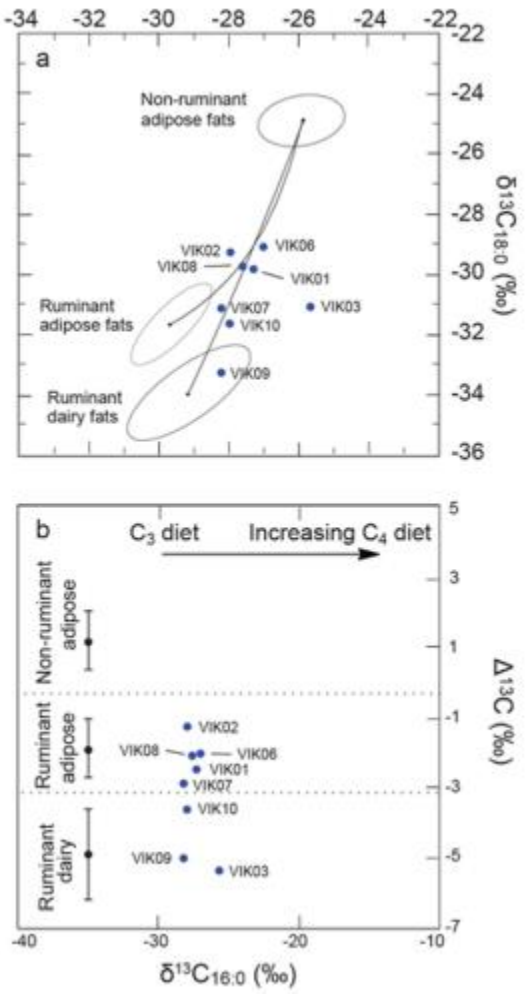

Figure 31: Graphs showing: a. $\delta^{13}C$ values for the $C_{16:0}$ and $C_{18:0}$ fatty acids for archaeological fats extracted from the Viking Link ceramics. The three fields correspond to the P=0.684 confidence ellipses for animals raised on a strict C_3 diet in Britain (Copley *et al*. 2003). Each data point represents an individual vessel. Figure b. shows the $\Delta^{13}C$ ($\delta^{13}C_{18:0}$ - $\delta^{13}C_{16:0}$) values from the same potsherds. The ranges shown here represent the mean ± 1 s.d. of the $\Delta^{13}C$ values for a global database comprising modern reference animal fats from Africa (Dunne *et al*. 2012), UK (animals raised on a pure C_3 diet) (Dudd and Evershed 1998), Kazakhstan (Outram *et al*. 2009), Switzerland (Spangenberg *et al*. 2006) and the Near East (Gregg *et al*. 2009), published elsewhere. Image credit: Headland Archaeology (UK)

4.3.1 Discussion

Lipid recovery from the site was good at 80% with 8 of the 10 sherds yielding interpretable lipid profiles, and with many vessels containing extremely high concentrations of lipids, suggesting they were subjected to sustained use in the processing of high lipid-yielding commodities. Lipid recovery was comparable to that of Romano-British pottery from Hornsea Offshore Wind Farm Project, Lincolnshire, at 78%, and from two Iron Age/Romano-British sites in Lincolnshire (Goxhill and Immingham), which yielded similar lipid recovery rates at 86% and 85%, respectively (Dunne and Evershed, unpublished data).

4.3.1.1 Meat and milk

Of the 8 lipid-yielding vessels (Table 8), three (38%) were used to process ruminant dairy products and five (62%) to process ruminant carcass products. Although a small dataset, these data are similar to those obtained from analysis of Romano-British pottery from the East Midlands Gateway site where four of the Romano-British vessels were used for dairy processing (25%), similarly suggesting dairying was of greater importance at this site in the Iron Age, reducing in the Roman period (Dunne and Evershed, unpublished data).

Although the Viking Links lipid results suggest that the processing of animal carcass fats was more important than dairying, this somewhat contrasts with the analysis of cooking pots from the site of Stanwick, where dairying seems to be an important component of the Romano-British economy (at 40% of vessels compared to 25% at EMG), at a level consistent with the preceding Iron Age population, although ruminant carcass product processing dominates at Faverdale (Copley *et al*. 2005; Cramp *et al*. 2011; 2012). However, it should be noted that dairy products may have been processed in different types of vessels (e.g. wooden bowls, animal skins). Furthermore, this is a small dataset.

There is little evidence for non-ruminant (pig) product processing in the 8 lipid-yielding vessels from Viking Link vessels, although the site faunal data suggests the presence of pig in both the Roman and Saxon assemblages. However, it should also be noted that non-ruminant lipids could also originate from the processing of goose and domestic fowl (Colonese *et al*. 2017), whose faunal remains were identified at the site.

4.3.1.2 Plant processing

The presence of even-numbered long-chain fatty acids, likely originating from plant epicuticular waxes, strongly suggests the processing of leafy plants within two of the vessels analysed (25% of lipid-yielding vessels). At Viking Link, both vessels containing plant-derived lipids were used to process dairy products, suggesting that plants may have been added to milk for consumption, for example, as a type of gruel or possibly in the making of more 'solid' dairy products, such as cheese.

4.4 Glassware *by Rebecca Sillwood*

The glass assemblage comprised four fragments of Roman glass, all from Area SPE1 (Table 9).

Table 9: Summary of glass by area and phase

Area	Phase	Group(s)	Vessel/?Bead		Vessel		Bottle		Bead	
			Qty	Wt (g)	Qty	Wt (g)	Qty	Wt (g)	Qty	Wt (g)
	RB	1745	1	1						
SPE1	RB	1417, 1797			1	1			1	1
	RB	1342					1	5		
Total			1	1	1	1	1	5	1	1

Ditch 1745 [1692], Structure 2, contained a small pinkish-red translucent fragment of glass of uncertain form and date. The piece is possibly a fragment of vessel glass or feasibly part of a bead. Strong monochrome colours, such as red, can be found in Roman tablewares (Price and Cottam 1998 , 15) and beads of Iron Age and Roman date (Guido 1978, 12-13).

Two glass objects were recovered: the first, a colourless vessel fragment from Ditch 1797 [1407] (Figure 32b) and the second a small complete bead from Pit [1417] truncating Structure 2 (Figure 32a). The vessel fragment is colourless and possibly of Roman date but is tiny and undiagnostic. The bead is more useful for dating as it is of translucent cobalt blue glass and of square cross-section, similar to Guido's form 7 (1978, 92, fig. 37). This type of bead, of this strong colour, tends to be 3rd-4th century AD in date (Guido 1978, 96).

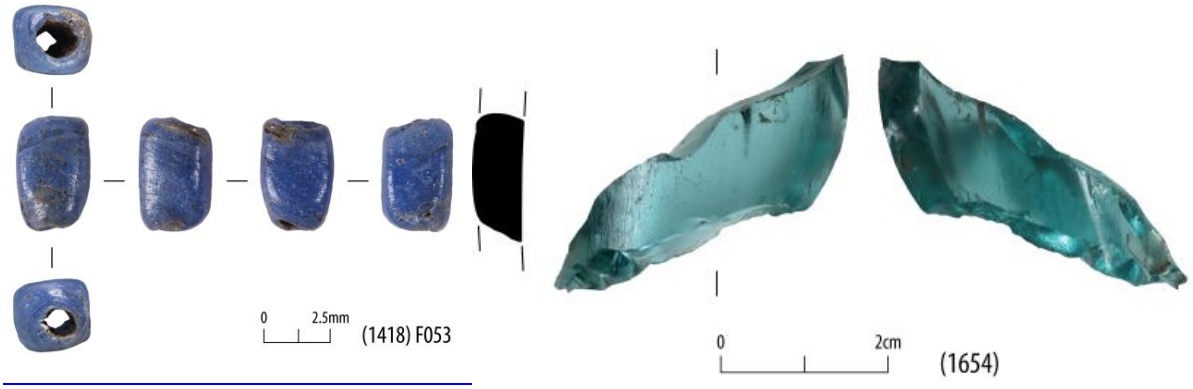

Figure 32a: Glass bead - sample 53; Pit [1417], (1418). Image credit: Headland Archaeology (UK); Figure 32b: Glass bottle - Ditch [1651], (1654). Image credit: Headland Archaeology (UK)

The largest fragment of glass from this site was a piece of naturally coloured blue-green bottle, comprising the curving cylindrical part of the neck of the vessel, from Ditch 1342 [1651]. This type of vessel can only be broadly dated to the Roman period.

4.5 Worked bone *by Rebecca Sillwood*

Twenty-six pieces of bone forming at least six bone artefacts were recovered from two areas of the site; five came from area SPE1 and one came from area SMR6 (see Appendix 1 for catalogue). The bone finds were very obviously of two different functional categories, with those pieces from Area SPE1 representing probable bone pin making or at least bone working in the vicinity; the find from SMR6 was a comb, representing dress and personal possessions or hygiene.

4.5.1 Bone-working finds

Two incomplete pins were recovered from Ditch [1395] (north-eastern corner of Enclosure 7) and Ditch [1407] located *c*. 7m to the north. The first pin (SF2; Figure 33c) was incomplete but in two joining pieces consisting of the hipped shank and the tip. The second pin was also an incomplete hipped shaft, this time missing its tip (Figure 33b). Both pins were of circular section, and both lacked their most diagnostic part: the head. Both were highly polished cortical bone pieces, with incomplete lengths of 61mm and 53mm respectively and a maximum diameter of 6mm and 5mm respectively. These pins, though missing what is normally the most distinctive part of the object, can be dated as later Roman, as they have the distinctive hipped or 'swollen' shaft which Crummy (1983, 20) discusses as being a probable reaction to the tendency of tapering straight shafts to break. The swollen shank, therefore, is a strengthening addition to the pin to prolong its usage and is only associated with Crummy's Types 3-6 (Crummy 1983) which, in Colchester, only appear after *c.* AD 200 (Crummy 1983 , 22), meaning these pins are likely to be of 3rd to 4th century date.

Four pieces of bone forming at least three objects continue the bone-working evidence here and were divided over ditches [1407] and [1820] located in the same area (Figure 33d and 33e). These three objects are facetted, worked, peg-like objects, with angled tips on at least two of the pieces. The exact use for these objects is uncertain - similar objects were recorded from Wavendon Gate (Hylton 1995, 130, fig. 76, no. 109) where they were identified as 'Whittled bone. Roughly cut peg-shaped object' (Hylton 1995 , 129). Colchester also produced several similar items, where they are described as 'double-ended pegs' (Crummy 1983, 160, fig. 196, nos 4387-4389), which were recovered from the extensive Butt Road bone-working industrial site. The angled tips of these pieces imply artful creation of that shape for some purpose, rather than these being roughouts for pins, though the presence of finished pins on the site might imply pin making. MacGregor (1985, 44) states that evidence for bone working can often be found on Roman sites, 'but the scale is usually small and the nature of the product unspecified', which appears to be the case here.

Finally, an incomplete sheep metatarsal with some working to the posterior face of the distal end was recovered from ditch [1846] (Figure 33a). The face has undergone some working and has been cut so the posterior face of the bone is fairly flat. This may be for use as an object, perhaps a handle for a knife or similar (Crummy 1983, 108, fig. 110; Hylton 1995, 131, fig. 77), but has not been finished.

The evidence for bone working from this site is minimal, though could include pin and other object manufacture. The interpretation of the evidence from this area points to the settlement focus being

outside of the excavated area, to the north, and it is perhaps there that more extensive bone-working evidence might be found including a workshop. Structures forming workshops can be found associated with bone-working waste, though without such evidence it is difficult to ascertain the scale of the possible industry here. It seems likely that the bone working here was meant to supply the local area with objects of bone, though without a focal point for the activity, this remains conjecture. Bone working is a craft activity that can take place on many types of Roman site, including military, such as at Wroxeter Legionary Fortress (Webster and Chadderton 2002), villa complexes, such as Gestingthorpe, Essex (Smith 2016, 237) and small towns such as Colchester, Essex (Crummy 1983). There was a small amount of evidence for bone and antler working from a roadside settlement at Fosse Lane, Shepton Mallet (Ferris 2001). It can therefore be seen that bone working is not an uncommon occurrence on Roman sites of all dates, and the uses to which bone could be put were many, including as decorative inlays, pins, and handles for implements, among others.

Figure 33: a. Worked bone - Ditch [1846], (1849). b. Bone pin - Ditch [1407], (1409) c. Bone pin - SF2; Ditch [1395], (1396) d. Bone peg/roughout - two complete pieces; Ditch [1407], (1409) e. Bone peg/roughout - two complete pieces; Ditch [1820], (1822). Image credit: Headland Archaeology (UK)

4.5.2 Bone comb

Fifteen pieces of bone made up an incomplete composite comb (SF4) from Area SMR6, found within Ditch [4365]. The main sections remaining include part of a side plate and possible end plate, plus several teeth fragments (Figure 34). This is a double-sided comb and the side plate has decorative notches along its edge, similar to examples from Flixborough in Lincolnshire (Foreman 2009, 85, fig. 1.31) and Fishergate in York (Rogers 1993, 1399, fig. 683). In both cases they appear to span the mid-7th to the mid-10th century.

The comb from this site is evidence for the presence of settlement, and though the comb does not appear (from what remains) to be an elaborately decorated example, it shows some individual care for appearance and hygiene.

Figure 34: Bone comb - SF4; Ditch [4365], (4368) a. line drawing b. photograph . Image credit: Headland Archaeology (UK)

4.6 Metalwork *by Rebecca Sillwood*

The metalwork assemblage comprised three iron and two copper-alloy finds, mainly from area SPE1 but with one find from area SMR01 (Table 10). Most of the metalwork was fragmentary and undiagnostic with only broad dating possible for most pieces. The finds were assigned to several phases of Roman activity. The metalwork was subject to X-radiography and the catalogue updated by specialists with any new information or identification.

Table 10: Summary of metalwork by area and phase

Area	Phase	Group	Iron		Copper Alloy		Total
			Qty	Wt (g)	Qty	Wt (g)	
SPE1	Establishing Enclosure	1330	1	1			2
		1355	1	2			3
		1745			1	1	2
		1342			1	1	2
SMR01	-	3252	1	5			6
Total			**3**	**8**	**2**	**2**	**15**

One iron possible hobnail and one copper-alloy possible coin make up the most identifiable Roman metalwork from this site. Neither are definite identifications. The hobnail may be simply a small tack as it lacks the more pronounced domed or pyramidal head normally associated with Roman hobnails. Hobnails are exclusively associated with footwear of Roman date but cannot be closely dated within the Roman period. The coin is mainly identified based on size and form, no detail can be made out. A minim, the smallest denomination of Roman coin can measure anything from *c.* 4mm in diameter, whereas this object is so corroded that diameter is not certain, but a width of 7mm has been recorded. The coin may be of 4th century date but given the corroded nature of the object this should be treated with caution.

The remaining finds include a probably post-medieval button fragment, intrusive in an earlier context, and two iron nails that cannot be closely dated.

4.7 Metallurgy *by Roderick Mackenzie*

A small assemblage of metallurgical debris was recovered from the excavations. All this material has been visually inspected only. Before discussing the type of residues in the assemblage, it is worth noting that metal production is not the only potential source of slag-like material that may be found on archaeological sites from the Iron Age to Roman period. Various pyrotechnic processes can produce slag by-products; these include 'industrial' activities, involved in the manufacture of materials such as glass and ceramics, as well as 'non-industrial' events, such as the burning down of wattle and daub buildings or funeral pyres (Keys 2012, 2; Salter 2005, 1-2).The quantities of residue types present at each site are shown in Table 11.

ONLINE ONLY

Table 11: Quantities and residue types per site subdivision

Apart from site SPE1, only sites SPE2 and SMR6 produced slag residues that are likely to be anthropogenic in origin. With exception of the single piece of smithing microresidue recovered from SMR6, all of the fragments of slag from sites SPE2 and SMR6 appear to be fuel ash slag. It is worth noting that smithing microresidues, such as the SMR6 piece, could have been easily carried from their point of origin because of their small size.

Site SPE1, comprising largely Roman features, contained significant amounts of both diagnostic and undiagnostic residues, and these were particularly concentrated in the fills of ditches 1386, 1407 and 1820, all located within the same area. The diagnostic residues include three fragments with the distinctive plano-convex morphology of slag that has formed and then solidified within the base of a blacksmiths hearth (from contexts 1387, 1409, 1826), and examples of this type of slag is commonly referred to in literature as 'smithing hearth bottoms'. The smithing hearth bottoms (from 1387 and 1826) are shown in Figure 35.

Figure 35: Industrial waste - smithing hearth bottoms from 1387 and 1826. Image credit: Headland Archaeology (UK)

The smithing hearth bottom recovered from Ditch 1820 (1826) has a relatively fresh fracture surface and this has revealed a relatively dense matrix that is dark grey in colour. There are a few small localised areas of porosity in the fracture surface, with individual vesicles ranging in size from <0.1mm to approximately 2.5mm diameter. Visual inspection of the fracture surface suggests that the slag is an iron silicate type, which fits with it being by-product of pre-industrial ironmaking processes, and what one might expect given its morphology.

Other materials recovered from SPE1 may also to relate to smithing and include 80 fragments of probable iron production slag and at least 3 fragments of hearth lining material. There are also 9 pieces of compacted iron-rich earth and charcoal - possibly pieces of earth floor from a workshop/forge area.

Interestingly, a fragment of slagged clay hearth lining with part of 'tuyere hole' was recovered from the same feature (1820) as one of the fragments of smithing hearth bottom. The fragment of hearth lining with the partial tuyere hole is shown in Figure 35. A tuyere is the technical term used to describe fire resistant nozzle(s) that are used for blowing air into furnaces and metalworking hearths. The diameter of the hole in the fragment found would allow a relatively small tuyere to poke through the clay lining into the smithing hearth, and this suggests 'craft scale' blacksmithing using a relatively small hearth.

The main concentration of metalworking residues from SPE1 and SPE2 were recovered from the fills of features that were located very close to the northern boundary of the area of excavation. Although no archaeological features clearly relating to an ironworking area were found, the amount and distribution of the residues assemblage strongly suggest that iron smithing was being carried out in the immediate area, either during or immediately prior to deposition of the residues. It seems

improbable that the waste from ironworking activities would have been carried very far to dispose of, which suggests that the location of the blacksmiths workshop/working area could lie just outside the area excavated.

The amount of residues in the assemblage are suggestive of a relatively small scale of production; however, it is worth bearing in mind that the assemblage may be a small part of waste generated, and that more lies buried in archaeological features outside the area excavated.

A map of Roman iron production sites in Lincolnshire (Schrüfer-Kolb 2004, fig. 25c) shows three other potential ironworking sites roughly 15km west of SPE1, and these are clustered around the area of a possible crossing point of two Roman roads, one of which potentially extended eastwards in the direction of SPE1. Schrüfer-Kolb also mentions the definite presence of a Roman iron-smelting site around 10km south-west of SPE1. The reasonably close proximity of iron smelting and Roman roads may have made it relatively easy for raw materials to be sourced by ironworkers based in the area of SPE1, either for local domestic use or for trade.

4.8 The worked stone *by Ruth Shaffrey*

A total of six pieces of worked stone were retained, five from SPE1 and one from SMR6. These are reported on by excavation area below.

4.8.1 Excavation area SPE1

The five fragments of stone from SPE1 comprise four pieces of quern and one piece of possible building stone. This is a small fragment of limestone from Pit 1355, Structure 1, with saw marks on two right-angle faces, suggesting it is an edge fragment of ashlar. The four querns are fragments of rotary type and all are made of Millstone Grit. A fragment from Ditch 1491 (1493), located in the north-eastern area of the site, is of flat-topped type with a circumferential angle that suggests it is from a large diameter stone, possibly mechanically powered (although the diameter is uncertain). Two other fragments of petrographically identical stone were found in Ditch 1647 (1650) and 1651 (1653) and it is possible that all three are from the same object. Another rotary fragment from Ditch 1647 (1649) is made of a slightly different, less feldspathic, slightly micaceous type of Millstone Grit with a harder quartz cement. This also appears to be of flat-topped type but it has been heavily reused as a whetstone both across the grinding surface and the circumference, so it is not possible to reconstruct its original dimensions. Millstone Grit was a common quern material in the south Lincolnshire/north Cambridgeshire region during the Roman period with widespread finds from Roman period sites, including nearby Helpringham (Bell *et al*. 1999, 42-3).

The querns and possible millstone are highly fragmentary with one also reused as a whetstone. The small fragment size and reuse combined with the lack of evidence for occupation suggests that the querns were used elsewhere originally and probably dumped on the site. They do, however, provide evidence for cereal processing somewhere relatively nearby during the Roman period and the possible millstone hints at the presence of a mill of some kind in the vicinity. Intensified cereal processing was widespread in Roman Britain (if regionally variable), but the final stage is typically under-reported because it is not represented by archaeobotanical remains in the archaeological record, and only by millstones or structural remains. There has been no detailed survey of millstone evidence in this area, but the author has seen Roman millstones from Grantham and Spalding and there is a possible example from Sleaford (Mann 2003 , 2). These suggest that there was some centralisation in the wider area, although no evidence for a mill is currently known in the immediate vicinity of the site.

4.8.2 Excavation area SMR6

A crudely rectangular sandstone block was found in Ditch 4315 (4316, Figure 36). This has a worn upper surface, dished at one end. It could be from a much larger grinding stone/saddle quern originally but wear across the rest of the upper surface suggests additional use as a whetstone and it is more likely that all the wear results from use as a sharpening stone.

Figure 36: SMR6 - Whetstone - Ditch 4315 (4316). Image credit: Headland Archaeology (UK)

5. The Environmental Evidence

The environmental categories are addressed by individual specialists below with supporting data provided in Appendix 2. Full specialist reports are available in the physical site archive.

ONLINE ONLY

Appendix 2: Environmental data [Download as XLSX]

5.1 Vertebrate remains *by Alison Foster*

The analysed animal bone assemblage from Bicker Fen consisted of hand-collected bone (55.5kg) and vertebrate remains from 160 sediment samples. The site encompassed two main periods of archaeological features: a Romano-British enclosure system interpreted as a structured, multifunctional settlement with evidence for intensive agricultural activity, and an agricultural field system in an adjacent area dated to the middle Saxon period. The analysis of the animal bone assemblage has provided insights into livestock practices, pathological condition, butchery and the use of wild resources. The comparative analysis of the Roman and Saxon assemblages has illuminated differences in cattle size, activity and potential dietary differences.

5.1.1 Methodology

Data were recorded onto Excel sheets, as shown in Appendix 2. Subjective records were made of the state of preservation, colour of the fragments, and the appearance of broken surfaces, with additional information recorded concerning the number of (refitted) fragments per bone, carnivore gnawing, burning, butchery and fragmentation, including fresh breakage, where appropriate.

Fragments were identified to species or species group using a comparative reference collection and published works (e.g. Schmid 1972). Fragments that could not be identified to species were grouped into size categories: large mammal (assumed to be cattle, horse or large deer (cervid)); medium-sized mammal 1 (assumed to be sheep/goat (caprine), pig or small deer); medium-sized mammal 2 (from a cat or hare-sized mammal) and completely unidentifiable. Distinctions between sheep and goat bones were undertaken using comparative material, with reference to Prummel and Frisch (1986) and Zeder and Lapham (2010). Equid remains were also examined with reference to Johnstone (2004, chapter 4) and Hanot and Bochaton (2018). Skeletal elements which could be identified to species/species group were recorded using the diagnostic zones method described by Dobney and Rielly (1988). Vertebrate remains from sample residues were recorded by number (semi-quantitatively), weight, and maximum linear dimension of the largest fragment. The presence of burnt fragments was also noted. Small mammals and amphibians and fish were identified using comparative reference collections and published works (e.g. Lawrence and Brown 1973; Ratnikov 2001; Froese and Pauly (Fishbase 2023)).

Tooth wear stages (TWS) for cattle, caprines and pigs were recorded using the scheme outlined by Grant (1982) and age categories follow those defined by O'Connor (2003). Age estimates for equid incisors follow Silver (1969). Where present, epiphyseal fusion data were recorded and ages estimated following Silver (1969). Mammal bones were described as 'juvenile' if the epiphyses were unfused and the associated shaft fragment appeared spongy and porous and 'neonate' if the element was also tiny. Metrical data were collected where possible, following the systems established by Von

den Driesch (1976). Withers heights were calculated for cattle using multipliers published by Matolcsi (1970) and Von den Driesch and Boessneck (1974) and for equids using Von den Driesch and Boessneck (1974). Equid heights are given in both centimetres and hands (1 hand = 4 inches) Nomenclature follows Harris and Yalden (2008) for mammals, Svensson *et al*. (2009) for birds, Arnold and Ovenden (2004) for amphibians and Froese and Pauly (2023) for fish.

5.1.2 Results

5.1.2.1 Hand-collected bone

Table 12: Viking Link: hand collected vertebrate remains. Number of identified specimens (NISP) by phase. Associated bone groups (ABGs) counted as one bone

		ROMAN	SAXON	
Species		**TOTAL**	**TOTAL**	**GRAND TOTAL**
Canis familiaris L. 1758	domestic dog	12		12
Equus caballus L. 1758	domestic horse	3		3
Equid	horse/donkey/mule	52	15	67
Cf. equid		1		1
Sus scrofa domestic L. 1758	domestic pig	24	15	39
Ovis aries L. 1758	domestic sheep	3	5	8
Caprine	sheep/goat	34	67	101
Bos taurus domestic L. 1758	domestic cattle	292	153	445
Large mammal		896	269	1165
Medium-sized mammal 1		84	169	253
Medium-sized mammal 2		2	3	5
Unidentified mammal		1316	610	1926
Anser sp.	goose		4	4
Anas sp	dabbling duck	1		1
Gallus gallus domestic L. 1758	domestic chicken	1	3	4
Galliform			1	1

Goose-sized			2	2
Chicken-sized			3	3
Unidentified bird			1	1
Gadus morhua L. 1758	cod		11	11
Large gadid			2	2
Unidentified fish			29	29
Total		**2721**	**1362**	**4083**

The excavations produced 6593 fragments, which represented 4083 bones after all practically possible refits had been made. Two-thirds of the material (2721 bones) was recovered from the Romano-British enclosure system, with the remaining 1362 bones from features relating to Saxon activity. The bulk of the remains (approximately 90%) derive from enclosure ditches with a smaller component from pits. The bones were generally well preserved, with approximately 70% of fragments from the Romano-British features and 64% of those from Saxon features described as having 'good' surface preservation, although the assemblage as a whole was severely fragmented, with abundant fresh breaks occurring during recovery. As a result, only a relatively small percentage of bones could be identified to species/species group, totalling 422 (15%) from the Romano-British assemblage and 271 (20%) from the middle Saxon assemblage. The bone was recorded by sub-phase but given the small quantities of material, the extent of fragmentation and consequent paucity of useful data, meaningful inter-phase analysis was not possible, and the material has therefore been combined into two main phases: Romano-British and mid-Anglo-Saxon (Tables 12 and 13)

Table 13: Viking Link: hand-collected vertebrate remains (mammal bone). Minimum number of individuals (MNI) by phase with percentage of total identified specimens per species

Phase	Cattle	Caprine	Equid	Pig	Dog	Total
ROMAN						
Total	101	24	37	21	8	191
Percentage	53	13	19	11	4	
SAXON						
Total	65	44	12	14		135
Percentage	48	33	9	10	0	
Grand Total	166	68	49	35	8	326

5.1.2.2 Vertebrate remains from environmental samples

Vertebrate remains were extracted from the residues of 160 sediment samples. One hundred and thirteen samples produced only very small amounts of indeterminate fragments, which were quantified and tabulated but not included in the analysis (Appendix 2). The remaining 47 samples produced identifiable mammal bone from larger taxa as well as occasional remains of small mammals (mouse/vole) and amphibians. Metrical and age-at-death data from larger taxa has, where available, been incorporated into the hand-collected component for size and mortality analyses. A significant amount of fish bone was recovered. This has been analysed together with the hand-collected fish and the results are presented below.

The assemblage is summarised in the following tables: Table 12 presents a summary of the hand-collected vertebrate remains identified to species (NISP - number of identified specimens); Table 13 presents the minimum number of individuals (MNI) by phase; tooth wear stages are recorded in Table 14 with age categories assigned to cattle, caprine and pig mandibles and loose teeth; Vertebrate remains extracted from environmental sample residues are quantified in Table 15 and fish bone, both from samples and hand-collected, in Table 16. A complete bone by bone catalogue is also included with details of preservation, fragmentation, all available metrical data and tooth wear stages (Appendix 2).

5.1.3 Roman

Hand-collected vertebrate remains from Romano-British features totalled 2721 fragments. The majority of the fragments (approximately 90%) were recovered from ditches with the rest from pits and post holes. Approximately two-thirds of the remains were described as of 'good' preservation with most of the rest 'moderate', although Ditches 1235 and 2026 produced a few fragments in poorer condition. Recovery damage was extensive, with 85% of the assemblage displaying freshly broken surfaces. Approximately 1% had been chewed by carnivores. These were identified to a range of species and sizes but with larger taxa dominating. A similar, very small, percentage of the bones showed evidence of butchery.

Mammal remains were limited to the main domesticates. Cattle were by far the most frequent with a significantly smaller proportion of caprines, some positively identified as sheep (*Ovis aries*) (see Table 12). Pig, equid, probably horse (*Equus caballus*), and dog made up the remainder of the mammal bone. Avian remains were very sparse, comprising a single duck bone and a partial chicken skeleton. The assemblage was notable for a high number of associated bone groups (ABGs), mostly of cattle lower limbs. The cattle ABGs include: a foreleg from Ditch 4944 (4107; Enclosure 14); a fully articulated foot from Ditch 1413; right and left hock elements from Ditch 1342 (1493; Enclosure 7), almost identical measurements suggest that these may be from the same cow, and a foreleg from (1633) of the same ditch; the lower hind leg of a sub-adult individual and two additional feet from Ditch 1983 (1842) and more phalanges and articulating thoracic vertebrae from this ditch (1560); the foot of a very young calf and the lower hind leg of an adult cow from Ditch 1126; a lower leg from enclosure boundary 4207; and metatarsals and hock bones from two different individuals in Ditch 2026. The right hind leg of an equid was found in Ditch 1342 (1347), with elements recovered comprising the tibia, navicular-cuboid, calcaneus, astragalus, metatarsal and a 1st phalanx. This context also produced the skeleton of a foetal lamb/kid. Two further partial skeletons - the chicken and a very young piglet - were present in Ditch 1413 (1403), with additional elements of these two individuals recovered from the residue of sample 52.

Few bones with butchery marks were recorded and there were no obvious patterns of deposition. Around a third of the butchered fragments were found in ditches 1795, 1796, 1797 and 1799, all excavated in an area to the north of the site, but this only amounted to 12 bones distributed between three different sub-phases. It is possible that these remains represent originally larger dumps of butchered refuse in this location, with fragmentation and other taphonomic processes having obscured the evidence. Butchery was most frequently seen on cattle and large mammal bone, most of which is also likely to be of cattle and included chops to the ends of long bones to divide the carcass into joints and some split long bones, presumably for access to the marrow within. Two scapulae had shallow cut marks on the neck and blade where the meat had been removed, and a rib displayed a light chop typical of the 'chop and snap' technique often seen on this element. A chop to the semi-lunaris articulatory surface of a pig ulna shows where this element was separated from the distal humerus. The remaining butchered bones were an equid atlas with a chop mark to the cranial side, probably inflicted during decapitation, and an equid humerus chopped across the distal shaft. The humerus also displayed tooth scoring typical of dog gnawing and suggests that this bone was from a horse carcass broken up to feed dogs.

Several pathological conditions and non-metrical traits were observed on the bones, discussed below.

5.1.3.1 Cattle

Cattle remains from this phase totalled 292 bones (Table 12). Age categories determined by tooth wear stages of 24 mandibles and teeth are summarised in Table 14. This small number cannot show any meaningful patterns in the data, although the presence of two individuals classed as 'elderly' shows that at least some of the cattle are being kept into old age. They may represent females kept for breeding purposes or draught cattle, which were generally surplus males, castrated and used for hauling until they were slaughtered for beef at the end of their useful life. The absence of mandibles and teeth of juveniles could be the result of survival/recovery bias of these smaller and more fragile elements, although calf bones representing four individuals were found in ditches 1126 and 1401. Greatest length measurements from eleven complete elements were used to estimate shoulder heights. The maximum estimated height was 142cm, the minimum 112cm and the mean 125cm - a little larger than the 3rd and 4th century cattle from Roman Lincoln (Dobney *et al*. 1996, 143). Additional calculations were carried out on the breadth measurements where available to enable a statistically significant comparison with the smaller mid-Anglo-Saxon cattle dataset, with the results presented below.

Table 14: Viking Link: ageable mandibles and teeth categorised by tooth wear stage, following O'Connor (2003)

Age category	Neonate	Juvenile	Immature	Sub-adult	SA1	SA2	Adult	A1	A2	A3	Elderly	Total
Roman												
Cattle			3	4	2	2	4	3	1	2	3	24
Caprines				1			4			2		7
Pigs			1		1				2			4
Saxon												
Cattle		1	3	1			1	2	1	2		11
Caprines			1	1			1			1		4
Pigs				1		1						2

5.1.3.2 Caprine

Caprine remains (37 bones) made up a relatively small component of the assemblage. Some were identified more closely as sheep and it is likely that most if not all of the undistinguished caprine bones are also of sheep. Mortality data were sparse, but some elements with unfused epiphyses (including the humerus of a young lamb/kid) showed a flock being bred and raised locally. Very few measurements were possible and none that could provide shoulder height estimates.

5.1.3.3 Pig

Twenty-four pig bones and teeth were recovered. Epiphyseal fusion evidence was missing on the majority of the bones but in several cases ages could be estimated by the size and porosity of the surviving fragments. The few mandibles and loose teeth with wear stages showed that some animals had survived until the eruption and wear of the 3rd molar (sub-adult and adult pigs) but most of the post-cranial assemblage was composed of fragments of small elements from juvenile and immature

animals, including several piglets. The canine teeth of two male pigs were present but these were of relatively young animals and unlikely to represent breeding stock.

5.1.3.4 Equid

A total of 53 equid remains were present, some being identified as horse (*Equus caballus*). On the whole, the fragments occurred singly per context, although a small concentration of eight bones and an articulated foreleg was found in Ditch 1342. Tooth eruption/wear and epiphyseal fusion showed that a small but significant proportion of the remains were of young animals under two years old. These included teeth from a reconstructed maxilla of a horse around a year old and unfused long bones from a further eleven immature individuals, three of which were clearly young foals. Four elements with lateral length measurements suitable for calculating withers heights gave heights of 113.5cm (just over 11 hh); 137cm (13.2 hh); 143.5cm (just over 14 hh) and 149cm (just over 14.2 hh). Three of these are surprisingly large but not outside the range recorded for the period. The smaller one is within the breed standard range for a modern Shetland pony, which is similar in size to the very small horses seen in the Iron Age.

5.1.3.5 Dog

Twelve dog bones were found, including three left metatarsals from Ditch 1175 (1151), which are likely to be from the same dog. Epiphyses, where present, were all fused, indicating skeletally mature animals but there were no measurements of complete elements suitable for calculating shoulder heights. However, comparison with modern reference material showed most of the bones to be from dogs similar in size to a fox or modern collie. The three metatarsals from Ditch 1175 (1151) were from a much bigger dog, being comparable to some of the longest Late Iron Age/Early Roman metapodials found at Weatherlees, Kent (Grimm 2009). Although the available metrics do not allow for the height of the dog to be extrapolated, the metatarsals are expected to be within the size range for a large canine from this period.

5.1.3.6 Birds

The sole chicken remains from this phase were a partial skeleton from Ditch 1413 (1403). The tarsometatarsus of this individual displayed a fused spur core, strongly suggesting a male chicken over 12 months old, although spurs in older hens are not uncommon. Measurements could be taken from most of the elements, which offered the opportunity to investigate the size and morphology of the chicken by comparison with metrics of modern heritage chickens and red jungle fowl using principal component analysis.

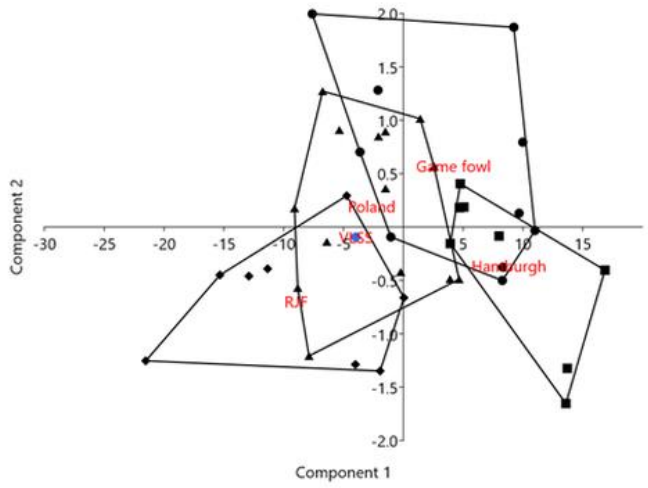

Figure 37: Principal Component Analysis - humerus: VLSS chicken compared with modern heritage breeds. Image credit: Headland Archaeology (UK)

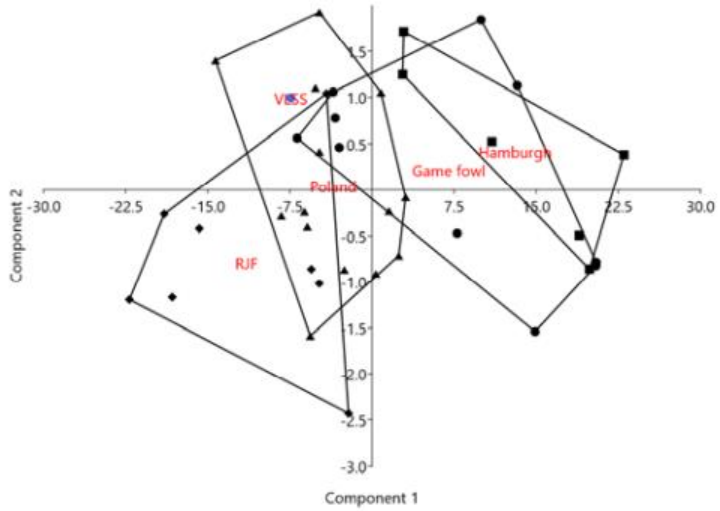

Figure 38: Principal Component Analysis - tarsometatarsus: VLSS chicken compared with modern heritage breeds. Image credit: Headland Archaeology (UK)

Component 1 reflects length while Component 2 is related to robusticity. Analysis showed the humerus (Figure 37) closely resembling jungle fowl (the small, ancestral species of the domestic chicken) and Poland bantams, a light, Mediterranean type kept for egg-production and exhibition. The tarsometatarsus (lower leg bone) was relatively stouter (Figure 38), a modification that is associated with increased body weight. This is consistent with previous studies of Romano-British chickens, suggesting a small type tending towards increased robusticity in the lower limbs (Foster 2018). Results of analyses on the coracoid, ulna and tibiotarsus (not reproduced here) showed these elements also trending with the jungle fowl and Poland bantam.

A humerus from Ditch 1797 (1409), the same size and morphology as a male mallard, was the only hand-excavated duck bone from this phase, although a slightly porous coracoid from an immature duck was found in the residue of sample <19> from Pit 1093 (1094).

5.1.4 Mid-Anglo-Saxon

Hand-collected vertebrate remains from mid-Anglo-Saxon features totalled 1362 fragments (after refits). Most of the material (approximately 90%) was recovered from ditches, with the rest from pits, a gully and other features. Approximately two-thirds of the remains were described as of 'good' preservation with most of the rest 'moderate' - similar proportions to the Roman material. A few poorer preserved bones were present in scattered deposits with no discernible concentrations. Damage during excavation was not as severe as in the Roman assemblage: approximately 40% of the fragments had fresh breaks. Approximately 0.7% of the fragments, mostly large mammal elements, had been chewed by carnivores. Butchery evidence was also rare, with just 3% of the bones affected.

Identified species were limited to cattle, caprine (with some sheep), equid (some with diagnostic features on the molars strongly resembling those of horses) and pig. Unlike the Roman assemblage, there were no identifications of dog remains but the few chewed bones suggest that there were dogs nearby. Bird bones included the remains of goose and chicken, with further unidentified fragments also likely to be goose and chicken. Small but significant concentrations of cod (*Gadus morhua*) cranial bones were found in enclosure Ditch 4911, ditch/pit 4920 which truncated it and Pit 4385 nearby. These are discussed together with the hand-collected fish bone and the fish from Roman deposits in section 5.1.7.

Similar to the Roman assemblage, the Saxon remains also yielded a number of associated bone groups (ABGs), mostly cattle bones. Articulating elements were found in: Ditch 4871 (4811) (a cattle hock joint); Ditch 4908, which produced four different ABGs from different cuts: the head, atlas, axis and two cervical vertebrae of a young calf from fills of context 4366 [4365], a tibia and tarsals from 4922 [4488], two articulated thoracic vertebrae from context 4413 [4412] and a lower leg from context 4486 [4484]; ditch 4911, which contained three ABGs: two scapulae, a distal humerus and some

vertebrae and ribs of a young calf from context 4499 [4498], and two cattle feet from contexts 4692 [4690] and 4502 [4437]; and pit 4385, which also contained a cattle foot.

Butchered elements were scarce - only 43 bones displayed chop marks or knife cuts, approximately 3% of the total fragments. There were no significant concentrations: the highest proportion occurred in MS5, in which 6% of the assemblage from that sub-phase was affected. Most of these were recovered from the fills of enclosure ditch 4911. Of the butchered assemblage as a whole, much of the evidence was seen on the long bones and vertebrae of cattle and large mammal. A few of these had been chopped at the articulatory surfaces during jointing but the majority of the butchered component consisted of split long bones; a process that is usually associated with marrow extraction. Occasional elements from sheep-sized animals showed small cuts to long bone shafts and ribs. Pathological lesions and non-metrical traits are discussed below.

5.1.4.1 Cattle

A total of 153 cattle bones and teeth were present. Wear stages from mandibles and teeth (Table 14) and recordable epiphyseal fusion data were few and insufficient to construct any meaningful mortality profiles, but the skeleton of a very young calf recovered from ditch 4908 (4499) and a skull from ditch 4908 (4366), together with isolated fragments of calf bone from ditches 4814, 4817 and 4913, indicated the presence of breeding females on site. Just four long bones were suitable for estimating shoulder heights. The minimum height was calculated to be 110cm, the maximum 120cm and the mean 114cm. This would suggest smaller cattle in this phase compared to the Roman period but the dataset is too small for statistically significant results. An alternative method was used to examine the breadth measurements from both phases, which seemed to corroborate this trend and which is presented below.

5.1.4.2 Caprine

Seventy-two caprine bones were recovered, some identified more closely as sheep. Most of the remains were small fragments: only 12 were measurable and none of these were suitable for estimating shoulder heights. Age-at-death data was similarly sparse but it was evident that sheep-breeding was taking place on site as elements of neonates and young lambs made up a small component of the assemblage.

5.1.4.3 Pig

The pig assemblage was also small (15 bones) and mortality data from tooth wear and epiphyseal fusion was negligible, although it was clear from the size and porosity of the surviving fragments that most of the bones represented immature individuals. Two neonate piglet elements may be the remains of casualties. Tooth wear indicated the presence of three sub-adults, and a partly fused femur showed that another pig had died at around 3.5 years - well beyond optimal slaughter age.

5.1.4.4 Equid

Fifteen fragments were recovered, almost all were single occurrences from separate ditches. Very little can be inferred from the remains. All the bones were fused and there were no small, porous elements from foals. The only tooth was a well-worn 2nd premolar from an individual aged over 2.5 years. Just one measurable bone provided an estimated withers height of 142cm (14 hh).

5.1.4.5 Birds

Goose lower limb bones were recovered from ditches 4814 (4391 and 4394), 4871 (4783) and 4934 (8161). Measurements and comparison with modern reference material show the species to be very likely greylag (*Anser anser*). The remains were from contexts all interpreted as deliberately dumped material with abundant animal bone and are assumed to represent food waste.

Three chicken limb bones were found in Ditch 4869 (4802) and Ditch 4871 (4783). A tibiotarsus (context 4783) displayed the porous ends typical of a skeletally immature bird, probably under eight months old.

5.1.5 Pathologies

Cattle metapodia with splayed distal condyles were recovered from both phases. Romano-British examples comprised a metatarsal from a near-complete lower hind limb in which the medial distal condyle and the corresponding 1st phalanx were affected, and a metacarpal with both condyles

spread (both from ditch 1126; context 1195). The fact that these fore and hind limb elements are from the same cut - [1194] - suggests that they may be from the same individual. A similarly affected metapodial with spread distal condyles was recovered from a Saxon ditch (ditch 4932 (context 4729)). Metapodial asymmetry is not unusual in cattle and is often interpreted as remodelling in response to power transmission and stress absorption during traction such as ploughing (Bartosiewicz *et al*. 1993; De Cupere *et al*. 2000; Thomas *et al*. 2021). A cattle astragalus from Roman ditch 1464 (1465) showed a small area of eburnation (polishing) on the lateral distal side indicating loss of articular cartilage in this area, a symptom of osteoarthritis in the joint. This may be associated with age, draught activities or both. Two equid metacarpals with 'splints' (ossification and fusion of the ligaments between the 3rd metapodial, or cannon bone, and the minor metapodia to each side of it) were found in Roman deposits (ditch 1126 (1245) and ditch 1342 (1493)). On the first, a large area of bone growth (exostosis) had developed at the distal end of the medial metacarpal - a typical reaction to stress. In the second, the shaft of the 3rd metacarpal was swollen and the medial metacarpal had fused to it. A comparable metacarpal was recovered from a Saxon ditch (ditch 4937, (8065). This condition is often interpreted as a consequence of trauma or percussive exercise on hard surfaces, especially in young horses. However, it is also seen in zoo specimens of wild equids that have never worked (Bendrey 2007) and may, in many cases, be a condition that develops with age. The affected animals are often lame as the splint develops but recover once the condition stabilises.

Non-metrical traits were seen on several cattle mandibles. Mandibles from Roman ditches 1342 (1345) and 1401 (1371), and Saxon ditch 4905 (4325) were notable for the absence of the third pillar (hypoconulid) of the third molar. An additional mandible from Roman ditch 1983 (1560) had both an absent hypoconulid on the 3rd molar and an absent second permanent premolar. These dental anomalies are commonly noted in cattle mandibles, particularly in Romano-British and late-medieval populations (Miles and Grigson 1990; Andrews and Noddle 1975) and may be an indication of smaller breeding groups where an uncommon trait is more likely to be expressed (O'Connor 1988 89).

5.1.6 Roman versus Anglo-Saxon cattle size

A small amount of metrical data was gathered from the cattle bones. Shoulder height estimates were made where possible, giving mean heights of 124.5cm for the Roman cattle (n = 11) and 114cm for the Saxon cattle (n = 4), This suggests a reduction in cattle height by the middle Saxon period but comparison using four specimens cannot provide statistically significant results. A somewhat larger dataset was constructed using the 'log-ratio method' to allow comparisons of the breadth measurements from the two phases. Metrics from the same anatomical plane are highly correlated (Davis 1996; Meadow 1999) and can be combined to maximise the potential where data are limited. Measurements of element breadths from both phases were log-transformed and rescaled against corresponding values from a standard (in this case, the means from an assemblage of 4th-century cattle from Roman Lincoln (Dobney *et al*. 1996) using the algorithm 'log-ratio = log 10 (archaeological/standard)'. A value of zero indicates an archaeological specimen is the same size as the standard while positive and negative values indicate bones that are larger and smaller respectively. Metrics followed Von den Driesch (1976) and comprised: scapula (GLP); humerus (BT); metacarpal (Bp); tibia (Bd) and astragalus (Bd).

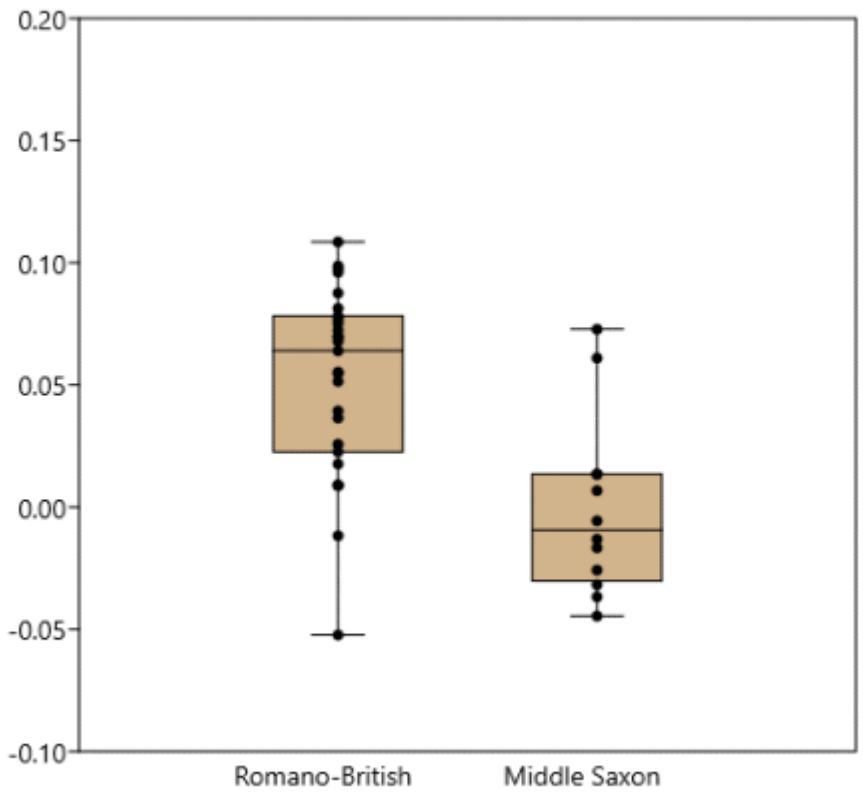

Figure 39: Log-scaled breadths of Romano-British (n = 27) and middle Saxon (n = 12) cattle elements relative to a standard (0.00). Image credit: Headland Archaeology (UK)

It is clear from the box plots (Figure 39) that the cattle from the Romano-British phase have broader bones than most of the middle Saxon cattle (Mann-Whitney U 51; p -0.0007, two tailed). The two points with the highest values on the middle Saxon plot both represent metacarpals, the second of the two being the metacarpal from Ditch 4932 (4729), which displays a spread lateral distal condyle, a pathology that has been interpreted as a response to traction (Bartosiewicz *et al*. 1993; De Cupere *et al*. 2000; Thomas *et al*. 2021). The middle Saxon dataset, though limited, may be cautiously interpreted as a smaller type of cattle, perhaps a dairy herd, with a few castrated males kept for ploughing and other heavy work around the settlement, while the more robust individuals in the Romano-British group perhaps reflect a beef herd as well as the larger animals required for the generally more intensive agricultural activity at this time. It is worth noting that a Romano-British metacarpal that also displayed spread condyles plots very closely with the Saxon metacarpal similarly affected.

5.1.7 Fish

5.1.7.1 Roman

Just three identifiable fish bones were found in Roman deposits, all of which were recovered by sampling. Isolated pike (*Esox lucius*) precaudal vertebrae were present in Contexts 4233 (a dumped deposit) and 1560 (a dumped layer in Ditch 1983) and a single eel (*Anguilla anguilla*) vertebrae was recovered from natural infill (Context 1371) of ditch 1401. The pike bones were probably incorporated into the discarded material that was dumped but the eel vertebra does not necessarily represent food remains, as this species can be found in ditches as well as streams and rivers inland and may have been of non-anthropogenic origin. The paucity of fish bones in the 94 samples from Roman deposits that produced bone is a little puzzling: a variety of fish were eaten at this time (Locker 2007) and it is possible that the local population were exploiting aquatic resources in the watercourses and coastal

areas nearby. The near absence of fish bones from the Roman phase may mean that no fish processing waste or kitchen refuse is being dumped in the area, but could also indicate continuity of a possible Iron Age tradition of fish avoidance, discussed by Dobney *et al*. (2007).

5.1.7.2 Anglo-Saxon

Virtually all the fish bone from the excavation was found in the residues of environmental samples from Saxon deposits (Table 15), with a notable concentration in sample 435, taken from context 4391, the fill of cut [4389] of Ditch 4814. A few large cod (*Gadus morhua*) cranial bones were hand-collected from enclosure ditch 4911, ditch/pit 4920 that truncated it and pit 4385 nearby. A range of species from different habitats were identified in the bones from the samples. Marine species present were cod, haddock (*Melanogrammus aeglefinus*), flounder/plaice (*Platichthysflesus*/*Pleuronectes platessa*), flatfish (Pleuronectidae), garfish (*Belone belone*) and horse mackerel or scad (*Trachurustrachurus*)**.** Migratory species (probably caught inland) were European eel (*Anguilla anguilla*) and salmon/trout (*Salmo* sp.) while evidence for obligate freshwater species was rare and limited to a few elements of pike (*Esox lucius*) and three-spined stickleback (*Gasterosteus aculeatus*). The complete lack of herring (*Clupea harengus*), which are a regular occurrence in Saxon fish assemblages, was unusual for this period. Also absent from the pit fills were any crushed vertebrae: the fragile bones of eels and other small fish can be damaged by chewing before they are swallowed and their presence can often indicate a cess component in a deposit, especially pits.

ONLINE ONLY

Table 15: Viking Link: fish bone, from samples and hand-collected (HC)

Eels are very common in Saxon assemblages and frequently dominate numerically, only partly due to the high number of vertebrae the species has compared with other taxa. They appear in Saxon accounts (e.g. the late 7th-century Laws of Ine of Wessex) as 'food render' or tax in kind and were often used to pay rents. They have predictable behaviour and are easy to catch with nets or wicker traps as they migrate, so their presence in this assemblage is to be expected.

Cod were not a widely exploited species in England before the revolution in marine fish exploitation around 1000 AD, widely discussed elsewhere (Barrett *et al*. 2004a; 2004b; 2008). The exception to this was coastal settlements, where they were caught using the hook and line technique. Comparison of the vertebrae to those of known-length modern reference cod indicate that these are larger fish of a metre length or more from deeper offshore waters, rather than the smaller, younger fish that shoal in coastal areas. Haddock were likely to have been caught by the same hook and line method.

Horse mackerel and garfish were also represented, albeit in small numbers. These species have been found in high numbers around the Wash, for example at Fishtoft, approximately 10 miles (16km) north-east along the Lincolnshire coast (Locker 2012) and Sedgeford on the Norfolk coast (Reynolds 2009). They are uncommon on other Anglo-Saxon sites and their presence in this area may reflect 'a specialised regional exploitation around the Wash' (Reynolds 2015). Garfish are a pelagic species, swimming in shallow coastal waters in the summer and deeper sea in the winter, making it probable that those found at the Viking Link site were caught in summer. The high frequency of flatfish also indicates coastal fishing, using nets or traps.

5.1.8 Small vertebrate remains

The few small vertebrate bones from sample residues that could be identified to species/species group are detailed in Table 16. Most of the carefully sorted samples produced only tiny fragments of unidentifiable bone from larger taxa so the lack of small mammals and amphibians across both sites likely reflects a genuine near-absence of the remains of these smaller animals. This may be the result of taphonomic processes: the surviving material was not particularly well-preserved. Sampled Roman deposits contained a few juvenile frog/toad bones from ditch 1235 and frog/toad bones from ditch 1342, including common frog (*Rana temporaria*), while a wood mouse (*Apodemus sylvaticus*) mandible and further frog/toad bones were recovered from pit 1355. Frog/toad bones were somewhat more common in Saxon deposits, being found in ditches 4909, 4819 and 4937; pits 4913 and 4637; and gully 8000. The only other identified small vertebrate remains from this phase were two field-vole molars from ditches 4896 and 4937. The amphibian remains suggest water, perhaps on a seasonal basis, in the features they occur in, especially the ditch with juvenile remains. This would have been fresh water as frogs and toads do not tolerate salinity.

ONLINE ONLY

Table 16: Viking Link: vertebrate remains recovered from sample residues. Key: 'SQ' = semi-quantitative abundance score relating to bone fragments; '1' = rare (1-5); '2' = occasional (6-15); '3' = frequent (16-50); '4' = abundant (51-200); '5' = super-abundant (200+); '(g)' = grams; 'MLD' = maximum linear dimension in mm

5.1.9 Discussion

The Romano-British excavation produced significantly more animal bone by fragment count than the Middle Saxon excavation: around two-thirds of the total number of fragments were from the ditches and associated features of the Roman enclosure system. There was no obvious surface preservation differences between bone from the two areas. However, the increase in the incidence of fresh breaks in the Roman assemblage suggests either adverse conditions at the time of excavation or that the Roman assemblage may have suffered a loss of integrity through taphonomic processes that was not apparent on the bone surfaces.

The hand-collected bones were identified almost exclusively as the remains of common domestic mammals, with cattle and caprine bone prevalent and a significant component of equid bones from the Roman deposits where they were the second-most numerous by fragment count. Occasional elements carried diagnostic features indicating they were probably horse (*Equus caballus*) bones but fragmentation meant that confident identification was not possible in most cases. A few bird bones were recovered, of domestic chicken, duck and goose. The duck and goose bones are likely to represent domestic species but exploitation of wildfowl cannot be ruled out in this coastal wetland area. Inter-phase comparisons are limited with such a small dataset but some tentative interpretations can be made. The MNI (minimum number of individuals) was calculated for the identified fragments of domestic mammals (cattle, caprine and pig) from the two phases and shows proportionally more caprines in the Saxon period than Roman, with very similar percentages for cattle and pigs (Figure 40).

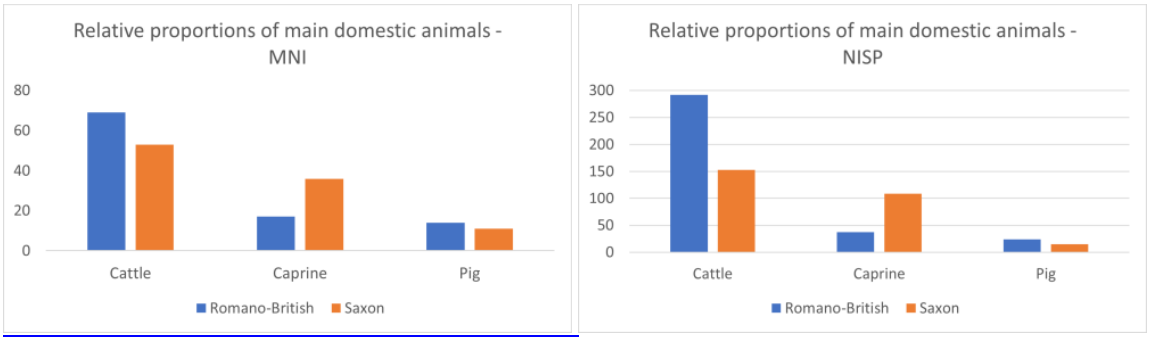

Figure 40: Relative proportions of main domestic animals using MNI (top) and NISP (bottom). Image credit: Headland Archaeology (UK)

When NISP data (adjusted to count ABGs as single elements) are used, the percentages show an overwhelming proportion of the remains from the Roman period to be cattle (83%). Although cattle usually dominate Roman assemblages, this is an exceptionally high number in which an unavoidably small dataset (under the >400 total NISP used by Albarella and Pirnie (2019)) undoubtedly plays a part, and survival/recovery bias in the assemblage may also be a factor. However, it does have a parallel at nearby Lynch Farm, Peterborough (Wilson 1975), interpreted as a Roman farmstead, where the percentage of cattle remains was similarly high at 82%. These high proportions are unusual for Roman fenland farms. Percentages of cattle remains in Roman assemblages are typically higher at military and urban sites and tend to be lower at rural sites, such as Orton Longueville (Davis 2001), where they constituted 53% of the NISP, or the late 1st and early 2nd century phases of Orton Hall Farm (King 1996), another nearby rural site, where they made up 37% (Figure 41). Fluctuating percentages over the two phases can be cautiously interpreted to indicate an increase in caprines in the Saxon period at the expense of cattle, although the relative amount of cattle remains high at a time when the proportion of pigs and sheep shows a general increase (Albarella and Pirnie 2019).

The rural middle Saxon assemblage at nearby Quarrington (Rackham 2003), however, shows similar proportions to the Viking Link site, being 59% cattle, 35% sheep and 6% pigs compared to 55% cattle, 39% sheep and 5% pigs at Viking Link.

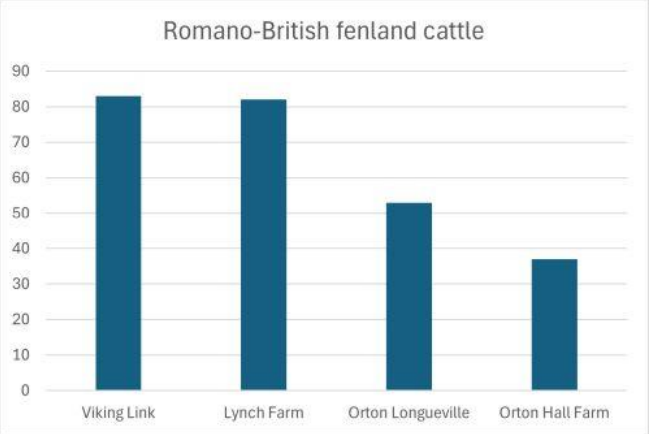

Figure 41: Percentages of cattle (using NISP) from Romano-British farms in the Fens. Image credit: Headland Archaeology (UK)

Categorisation of cattle epiphyses into early, intermediate, late and final fusion stages in the two periods (Figure 42) suggests an increase in the amount of late-stage fusion (indicating animals at least five years old) in the Saxon assemblage, which would be expected in a herd kept for dairying rather than beef.

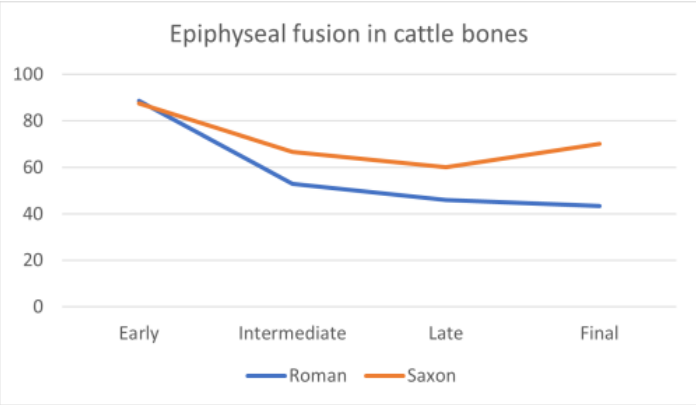

Figure 42: Cattle epiphyses fused/fusing in each of four age categories, by period . Image credit: Headland Archaeology (UK)

As is usual from archaeological assemblages, the majority of the pig elements are of skeletally immature individuals and most of the pigs seem to have been culled around or earlier than optimal slaughter weight. This is particularly noticeable in the Romano-British assemblage and may perhaps reflect the influence of Roman dietary preferences, as young pork was considered a delicacy among the elite. Estimated withers heights of the equids from both phases are consistent with the findings of Ameen *et al*. (2021), who reported a broad range of sizes in the Roman population. The Saxon horse at 14 hh is towards the top end of the range for the period, but at 14 hh it is still two inches (5cm) below the minimum height for a horse today and would be categorised as a pony by modern standards. The equid remains from both periods most probably represent horses, but several of the few identifications of Roman mules proposed by Johnstone (2010) occur at Fenland sites nearby (Longthorpe II (King 1987), Orton Hall (King 1996) and Stonea (Stallibrass 1996)) and the possibility of mule breeding in the Roman period cannot be ruled out. Instances of non-caballine equids in Britain are even rarer between the end of the Roman period and the Norman conquest (Johnstone 2010).

Butchery evidence was scarce and there were no conclusive spatial or temporal concentrations. The ends of some long bones had been chopped to disarticulate and joint the carcass, and a couple of helical fractures on small shaft fragments may indicate processing of long bones for marrow or

soup/stock. Chop marks on cattle bones made by heavy cleavers is characteristic of the Roman period, especially on urban and military sites (Maltby 2007), and their scarcity in the Roman assemblage may mean that disarticulation with knives was still a preferred method of butchery. There was no evidence for specialised butchery practices in either assemblage, such as the modifications seen on cattle scapulae in Roman assemblages from Lincoln that might have suggested preserved shoulder joints (Dobney *et al*. 1996), or vertebrae chopped axially to divide the carcass into 'sides'. However, this may result as much from preservation issues than actual practice and an unknown amount of evidence has almost certainly been lost through fragmentation.

The assemblage is notable for a significant number of ABGs (associated bone groups) deposited in the ditches and occasionally the pits of both areas. These are mainly the lower limbs of large mammals - robust elements that tend to survive rather better in archaeological deposits - which might suggest that differential preservation is a factor and they are perhaps the remains of more complete skeletons. However, a number of the deposits, in the Roman area at least, also produced fragile bones of much smaller, younger taxa. There does not seem to be any spatial or chronological pattern to the deposits: they occur in ditches across the site and in multiple sub-phases. They are mainly of cattle, but horse limbs and occasional sheep feet are also present. A foetal lamb/kid and a chicken skeleton were also found together in the same Roman ditch (1413, context 1403). Given that most of the bone groups of older animals are of heads and lower legs/foot bones, and very few of them seem to have been placed in ditch termini, pits or other contexts that might suggest they are 'special deposits', it is assumed that they represent the disposal of low-utility body parts after primary butchery, with the skeletons of the very young cattle, sheep and horses being casualties of accident or disease rather than slaughter. Several of the deposits that produced ABGs were interpreted as natural infilling, which suggests that the articulated limbs lay in the ditches and decomposed uncovered. Depending upon the time of year they were discarded, the decaying body parts would have made the surrounding area malodorous for quite some time. This could imply that the field systems and enclosures were some distance from the core of their associated settlements, although historic toleration for bad smells is not necessarily consistent with modern sensibilities.

The neonate and young cattle, equids, pigs and caprines reveal the presence of breeding females nearby in both periods and the assemblages as a whole suggest mixed farming regimes, with meat and dairy products for local consumption and male cattle kept for traction. The elevated cattle percentages, particularly in the Roman period, may reflect an increased requirement for draught animals as arable farming is intensified, as well as a rise in beef cattle. A range of fish species from different habitats were exploited in the Saxon period. Chicken bones are present in both phases, with occasional duck and geese that may be from domesticated flocks, but large populations of wildfowl would have been an available resource too and would almost certainly have been hunted.

5.2 Archaeobotany *by Lisa Gray and Kate Turner*

5.2.1 Introduction

This report provides an update of the previous assessment report on 234 samples, ranging from 3 to 60 litres in volume, recovered during archaeological excavations at the Viking Link Converter Station Site (VLSS), Donington, Lincolnshire (see assessment report for methodology). The excavation revealed a Romano-British agricultural settlement located upon a roddon (a dried raised silt riverbed formed by the draining of underlying peat deposits) that was replaced by a small Anglo-Saxon settlement/field system. The samples were recovered from ditches, pits and post-holes dating from the Romano-British to the Anglo-Saxon periods in areas SMR1, SMR2, SMR6, SPE1 and SPE2 (Table 17).

Table 17: Overview of samples assessed by scheme area

Area	Period	Samples Assessed
SMR 1	Middle - Late Roman	21
SMR 2	Undated	1

SMR 6	Anglo-Saxon	>68
SPE1	Middle - Late Roman	115
SPE2	Middle - Late Roman	24
N/A	Undated	>5
Total		234

5.2.2 Results

These samples produced plant macro-remains preserved by charring and silicification. A significant feature of many of these samples is the abundance of uncharred testas (seed coats) of rush (*Juncus* sp.) and duckweed (*Lemna* sp.). It is not clear if these are intrusive or are dried waterlogged archaeobotanical remains. The natural environment of the site pre-excavation was agricultural fields bordered by drainage ditches, and the footprint of the site was a roddon. Both past and present environments would have supported rush and duckweed plants but as no waterlogged preservation was observed during excavation these uncharred seeds are considered to be intrusive. Results of the assessment are presented in Appendix 2.

5.2.2.1 Roman Enclosures SPE1

The bulk of the assessed samples, 115 in total, were taken from features in SPE1. Activity in SPE1 is related to mid- to late Roman settlement, with pottery dating from the 2nd to 4th century recovered. Samples were taken from the fills of 71 ditch cuts, 11 pits, 2 post-holes, a furrow and a dumped layer.

Charred cereal grains were found in 43 samples. Hulled wheats (*Triticum dicoccum/spelta*), principally spelt (*Triticum spelta* L.), were the dominant cereals, with barley, emmer (*Triticum dicoccum*), oat (*Avena* sp.) and bread wheat also present. It was not possible to determine whether oats are of the wild or cultivated varieties owing to the lack of diagnostic floret material. The level of preservation of all species was generally poor, with most grains abraded, vesicular or fragmentary. Intermediate vesicular cereal fragments were common. Nine features produced charred assemblages with moderate preservation: dumped layer [1417], pit [1330], ditch [1368], ditch [1392], ditch [1407], ditch [1616], ditch [1629], ditch [1759] and ditch [1725]. Only one assemblage, taken from fill (1103) of ditch [1101], contained grains determined to be of a 'good' degree of preservation. Poor preservation is most likely the result of prolonged or high temperature combustion. Most of the assessed samples contained few (rare or occasional on the DAFOR scale) grains, with just one sample, taken from fill (1371) of ditch [1368], containing an abundance of grain. This feature produced a large quantity of spelt wheat grains. Fill (1493) of ditch [1491] also produced a moderate number of grains of spelt and bread wheat. In many cases, plant macro-remains came from samples with volumes of 40 and 60 litres, so the relatively small number of specimens per litre of sampled soil does indicate that they are general background waste. Sample <74>, taken from fill (1727) of ditch [1725], was a much smaller sample, suggesting that the relatively high occurrence of charred plant remains could be the result of primary deposition.

Charred cereal chaff was present in rare or occasional quantities in 11 samples. The most frequent type was grass-stem fragments and cereal-type culm nodes. Five samples also contained glumes and glume bases of spelt wheat. Fill (1493) of ditch [1491], as well as containing a significant number of spelt wheat grains, also produced frequent spelt what glume bases, suggesting that this deposit may constitute spelt processing waste.

Wild seeds were rare, recorded in 25 samples. The taxonomic composition of this assemblage was of low diversity. Aquatic species, notably club-rush, dominated, followed by knotweed-type ruderals. Other taxa present included wild grasses, dock (*Rumex crispus*), clover (*Trifolium* sp.) and mallow (*Malva* sp.), all weeds of arable land and grassland, and common spike rush, a wetland plant. As in other areas of the site, it is possible that the charred club-rush and spike-rush seeds found in several of the flots were associated with peat fuel, with fill (1346) of ditch [1343] containing 3ml of charred peat fragments.

Table 18: Hand-collected charcoal (SMR6 and SPE1)

Area	Feature type	Context	Number >4mm
SMR 6	Dumped layer	4492	1 (roundwood c10mm Ø)
SMR 6	Ditch -natural infilling	4671	2
SMR 6	Pit - natural infilling	4623	20
SMR 6	Ditch - deliberate backfill	4486	2
SMR 6	Ditch -natural infilling	4585	11
SMR 6	Ditch - natural infilling	4308	2
SMR 6	Ditch - natural infilling	4310	1
SMR 6	Ditch - natural infilling	4399	2
SMR 6	Ditch - deliberate backfill	4783	2
SMR 6	Ditch	4391	3
SPE1	Ditch - natural infilling	1826	11 (roundwood c10mm Ø)
SPE1	Ditch - natural infilling	1826	1
SPE1	Ditch - dumped layer	1420	3

Wood charcoal fragments of identifiable size were found in ten samples and two assemblages of hand collected charcoal (Table 18). Fragments of round wood were also present in hand-collected charcoal assemblages from contexts (1826).

Molluscs were relatively common, found in 43 samples (Table 19). Terrestrial species were dominant, with occasional freshwater mollusca also recorded. Ten samples contained fragments of marine mollusca, including oyster and mussel. Whole hand-collected marine shells were found in the contexts shown in Table 19.

Table 19: Hand-collected marine shell

Phase	Feature type	Context	Taxon	Number
SPE1	Ditch - natural infilling	1151	*Ostrea edulis*	1
SPE1	Ditch - natural infilling	1348	*Ostrea edulis*	5
SPE1	Ditch - natural infilling	1380	*Ostrea edulis*	1

SPE1	Ditch - deliberate backfill	1409	*Ostrea edulis*	2
SPE1	Ditch - deliberate backfill	1409	*Cerastoderma* sp.	1
SPE1	Boundary ditch	1441	*Ostrea edulis*	6
SPE1	Ditch - natural infilling	1516	*Ostrea edulis*	1
SPE1	Ditch - natural infilling	1528	*Ostrea edulis*	1
SPE1	Ditch - natural infilling	1595	*Ostrea edulis*	1
SPE1	Ditch - natural infilling	1610	*Ostrea edulis*	3
SPE1	Ditch - natural infilling	1690	*Ostrea edulis*	1
SPE1	Ditch - natural infilling	1849	*Ostrea edulis*	1
SMR 1	Ditch - deliberate backfill	3158	*Mytilus edulis*	1
SPE2	Pit - natural infilling	4033	bivalve	1
SPE2	Ditch - natural infilling	4107	*Ostrea edulis*	2
SPE2	Ditch - natural infilling	4108	*Ostrea edulis*	1

As with the samples from the other land areas, untransformed seeds and roots were common throughout. This assemblage is of limited diversity and resembled that recorded in samples from SMR1 and SMR6. Wetland and aquatic habitats were represented by rush and duckweed, with cultivated/waste ground indicated by species such as goosefoot, bedstraw, black-bindweed and campion (*Silene* sp.).

5.2.2.2 Roman Enclosures SPE2

A total of 24 samples were taken from features in SPE2. As with SMR1 and SPE1, activity in SPE2 is dated to the mid- to late Roman period. Samples were taken from the fills of 17 ditch cuts, 6 pits and a field boundary.

Recovery of charred plant remains was poor from these deposits, with only a small assemblage of charred cereals and wild plant seeds recovered. The preservation of these remains ranged from very poor to good. Grains were recorded in seven samples, and were of spelt, barley and bread wheat. Asymmetrical grains were, again, present and suggest the presence of six-row barley. Chaff was comparatively rare, found in only four samples. Glume bases and spikelet forks of spelt were recovered in addition to cereal-type culm nodes.

Wild seeds formed the bulk of the charred plant assemblage, with small to moderate numbers of seeds found in eight samples. Taxa present were club-rush, wild grasses, including brome (*Bromus* sp.), clover and knotweed. Sample <416>, taken from fill (4179) of pit [4178] contained a fragment of nutshell that resembled that of a Stone Pine nut (*Pinus pinea* L.), and sample <422>, taken from fill (4231) of pit [4230], a small number of charred pulses (Fabaceae).

None of the assessed samples produced more than 30 charred items in total, which suggests that these remains represent general background waste. Charcoal was present throughout, but in

generally small quantities. None of the sampled deposits produced any fragments suitable for radiocarbon dating.

Terrestrial molluscs were noted in four samples, with fragmented marine shell recovered from an additional two samples (Table 19). Whole hand-collected marine shells were also found. Untransformed seeds and roots were present in all of the assessed samples, with the latter providing evidence for post-depositional disturbance to the sampled contexts.

5.2.2.3 Saxon Enclosures SMR6

Sixty-eight samples were assessed from features in SMR6. Radiocarbon dating indicates that settlement activity in this area is primarily of Anglo-Saxon date, with contemporary pottery also recovered. Samples were taken from the fills of 52 ditch cuts, seven pits, a gully and a spread.

Cereal grains were present in 21 samples. Barley (*Hordeum vulgare*) was the predominant crop species, with bread wheat (*Triticum aestivum/durum/turgidum*) also recorded. Several of the barley grains were asymmetric in form, indicating the presence of six-rowed barley (*Hordeum vulgare* var. *hexasticum*). Grains were generally well preserved, and few unidentifiable specimens were recovered. Eighteen of the assessed produced low densities of material: typically less than 20 items in total. The richest assemblage was recovered from fill (4391) of ditch cut [4389], which contained abundant barley grains. Also of interest was the sample from ditch [4488], which contained well-preserved bread/club/rivet wheat and hulled straight barley grains, some still within their lemma and palea. One poorly preserved barley grain was hand collected from fill (4368) of ditch [4365].

Cereal chaff was rare, recorded in six samples. Grass (Poaceae) type stem fragments and culm nodes were identified, which could represent the remains of straw that was burnt as a fuel. Other possible food remains included seeds of broad bean in fills (4481) and (4672) of ditches [4479] and [4670] and a possible pea (cf. *Pisum sativum* L.) in fill (4560) of ditch [4559]. Legumes are high in protein and may have been grown as a food or fodder crop. A single well-preserved cherry/plum/sloe type (*Prunus* sp.) fruit and endocarp was also found in fill (4492) of ditch [4488].

Six samples contained charred seeds of wild plants. Taxa included the aquatic species common spike-rush (*Eleocharis palustris* L.) and club-rush (*Schoenoplectus* sp.), knotweed-type ruderal plants (*Polygonum/Persicaria* sp.) and wild grasses (Poaceae). These may be present as crop weeds or be the remnants of peat used as fuel. Further evidence for the utilisation of peat as a fuel on site was present in the form of 5ml of possible charred peat fragments in fill (4783) of ditch [4782]

Sample <435>, from fill (4391) of ditch [4389], is the only sample where silicified plant macro-remains were found. Silicified material can be the remains of the rake-out deposits of hearths and ovens (Carruthers and Hunter-Dowse 2019, 11), suggesting that this assemblage could be the waste from an activity that involved exposing cereal grains to heat, such as corn drying prior to storage or milling.

Wood charcoal was recovered from all of the assessed samples, apart from sample <452>, taken from fill (34520) of ditch [4519]. This assemblage was poorly preserved and fragmentary, and a proportion of the remains are considered to be residual. The highest density of material was found in fills (4316) of ditch [4315], (4391) of ditch [4389], (4672) of ditch [4670] and (8120) of ditch [8119], which each produced at least 20 fragments >4mm. Sixteen additional samples contained specimens that may be suitable for radiocarbon dating.

Wood charcoal fragments of identifiable size were also found in eleven assemblages of hand-collected charcoal (Table 18). Fragments of round wood were present in hand-collected charcoal assemblages from contexts (4783), (4391) and (4492).

Untransformed seeds were common in the samples from SMR6. Taxa are generally those of wetland and aquatic environments, including duckweed, rush, water-plantain (*Alisma* sp.) and crowfoots (*Ranunculus* subgen. *batrachium*). Disturbed/waste ground is represented by species such as goosefoot and common nettle (*Urtica dioica*), with seeds of black-bindweed (*Fallopia convolvulus*) representing cultivated ground.

Few molluscs were recovered. Ten samples contained shells of terrestrial snails, with freshwater molluscs present in two samples. Shells of the non-native subterranean mollusc *Cecilioides acicula* were identified in fills of ditches [4289] and [4315] and are evidence for burrowing activity. Fragments of marine mollusca, including native oyster (*Ostrea edulis*) and mussel, were found in eight samples.

The retent from sample <468>, taken from fill (4672) of ditch [4670], contained material provisionally identified as 'cess material'. Microscopic examination revealed nothing to confirm this and the absence of any mineralised material in any of the samples suggests that this material is geological in origin rather than organic.

Roots were encountered throughout, frequently making up over 90% of the total flot volume.

5.2.2.4 Activity to the south-west of SMR1

A total of 21 samples were assessed from contexts in SMR1. Settlement remains in this area have been dated to the mid- to late Roman period, with pottery spot-dated from the 2nd to 4th century AD. Samples were taken from the fills of 19 ditch cuts and one pit.

Preservation of charred plant material was poor in these deposits. Charred cereal grains were recorded in four samples, taken from cuts of ditches [3008], [3060], [3147] and [3156]. The level of preservation of these was generally poor and grains were not identifiable to species. Wheat (*Triticum* sp.) and barley (*Hordeum* sp.) were present in addition to a small number of indeterminate grain fragments. Chaff was absent.

Seeds of cultivated legumes, specifically broad bean (*Vicia faba* L.), were found in one sample, from fill (3158) of ditch [3156]. A small quantity of knotweed seeds (*Polygonum/Persicaria*) were also identified in this deposit. Charred wild seeds were otherwise not recovered.

The retent from sample <312>, context (3158), contained fragments of material provisionally identified as charred peat. Seeds were not clearly visible in these fragments, and it was not possible to confirm this identification without access to reference material.

Charcoal fragments were observed in all of the assessed samples from SMR1. Fragmentation within this assemblage was significant, and none of the sampled deposits produced any specimens that are suitable for radiocarbon dating.

Untransformed seeds were identified in 12 samples. Wetland and aquatic taxa were predominant, with duckweed (*Lemna* sp.) and rush (*Juncus* sp.) present in significant quantities. These species were particularly abundant in fills of ditches [1005] and [2024]. Seeds of ruderal taxa, including goosefoot (*Chenopodium* spp.) and orache (*Atriplex* sp.) were also recorded, in addition to a small quantity of bedstraw (*Galium verum/mollugo*), which is common in dry, grassy habitats. There is no evidence for waterlogging of the sampled contexts; therefore these specimens are assumed to be recent contaminants.

Mollusca were found in 10 samples. Terrestrial molluscs were the most common type, identified in six samples, with shells of freshwater taxa recorded in three samples. A single shell of common mussel (*Mytilus edulis*) was also hand collected from fill (3158) of ditch [3156].

Modern roots were common in the samples from SMR1, often making up between 50 and 90% of the overall flot volume and are likely to be evidence for bioturbation.

5.2.2.5 Further activity to the south-west of SMR2

One sample was taken from the fill of an unphased ditch, [3152], in SMR2. Preservation of charred plant material was poor in this sample, which contained only a small quantity of abraded bread wheat grains and several small fragments of charcoal. Roots and untransformed seeds made up the bulk of the flot material.

5.2.3 Discussion

In this section the samples will be discussed by phase. Owing to the likelihood that the uncharred seeds in these samples could be intrusive, they have been excluded from discussion.

5.2.3.1 Romano British

The carbonised plant assemblages recovered from SMR1, SPE1 and SPE2 provide evidence to support the handling of cereals, including glume wheats, free-threshing wheats and barley, on these sites during the Roman period. Pottery spot-dating suggests that the main period of activity was likely to be between the 2nd to 4th centuries, with there being little evidence for cereals being utilised in these areas beyond this point. The bulk of arable activity appears to be happening in SPE1, with

SMR1 and SPE2 producing only a handful of material, likely to represent secondary scatters of settlement waste.

The main crops that were being grown during this period would appear to be free-threshing and glume wheats, notably spelt. Occasional grains of barley, emmer and oat were present in some samples, but never in substantial amounts. The scarcity of emmer in these samples suggest that specimens perhaps present a relic of earlier agriculture, with plants growing as weeds in the spelt fields. It was also not possible to determine whether oats were of the wild or cultivated varieties owing to the lack of diagnostic chaff. Oat was not generally a popular crop during the Roman period, and it may be the case that oats were being grown as fodder for livestock rather than for human consumption. This accords with trends seen in the national dataset. Throughout most of Britain spelt wheat was one of the main cereals grown during the Roman period, with bread wheat, emmer and barley appearing as secondary crops (Hillman 1981). Similar assemblages have been found at other sites in the Boston area, including Station Road, Sutterton (Dailey 2008) and Third Drove, Gosberton (Crowson *et al*. 2000).

There is some evidence to suggest that cereal processing was being undertaken in SPE1 and SPE2, in the form of infrequent glume bases of spelt. The largest quantity, between 30 and 50 specimens, was recorded in fill (1493) of ditch [1491]. The proportion of glume wheat chaff in this deposit suggests that it contains an element of the waste from late-stage processing of hulled wheat spikelets. Glumes are not removed from threshed wheat spikelets until the final stages of sieving and pounding (Stevens 2003, 63). Generally, however, grains were more common than chaff throughout the Roman samples, which could indicate that processing waste may have been disposed of elsewhere. Equally, exposure to high temperatures during combustion could have led to the under-representation of these elements in the assemblage. The poor condition of the grains in these samples is indicative of high-temperature combustion, which can lead to under-representation of more fragile elements, including chaff.

The richest cereal assemblage of Roman date was recorded in fill (1371) of ditch [1368], SPE1. This sample was dominated by charred grains of spelt. Grain-rich assemblages are thought to be an indicator of the scale of cereal production being undertaken (Van der Veen and Jones 2006 , 223), with such deposits generally created by accidents during processing or cooking. The low density of material in other deposits suggests that most are more likely to constitute secondary or tertiary scatters of general occupational waste, rather than primary deposition of remains.

Grass and cereal-type culm nodes and stem material in samples from SPE1 and SPE2 may indicate that gathered grassland vegetation or the waste by-product from the early stages of cereal processing may have been used as a fuel on site. The presence of low-growing weed species, such as clover, and twining plants (black bindweed, vetch), in some samples could support this, providing evidence that crops were being reaped low on the straw, probably using a sickle (Hillman 1981, 151). Sickle-harvesting was a common practice during the Roman period (Lodwick and Brindle 2017, 46). Harvesting crops low on the stem and bringing them back to site as un-threshed sheaves would provide an ample supply of cereal straw for use as a fuel or fodder.

Peat may also have been used as a fuel on site during this period, with fragments of charred peat found in samples from SMR1, SPE1 and SPE2. Charred seeds of club and spike-rush seeds could also be associated with peat fuel. Peat was a readily available local resource in Fenland areas at this time, although the extent to which it was explored as a fuel source is currently unknown (Lane and Morris 2001). There is some evidence, however, to support the use of peat in salt production at other Fenland sites, such as Nordelph in Norfolk (Lane and Morris 2001).

5.2.3.2 Anglo-Saxon

Arable activity in the Anglo-Saxon period appears to be centred around SMR6, with no evidence of ongoing activity in the other excavation areas. The main crops represented during this period were barley and bread wheat. This accords with patterns seen across Britain (Moffett 2011, 51). Bread wheat and barley were the foremost crops being grown in Anglo-Saxon England (Banham and Faith 2014, 30), likely as a result of the relative ease of processing such cereals in comparison to the hulled wheats favoured by the Romans. Barley and bread wheat are 'free-threshing', described as such because the grains are released from the chaff by threshing alone (Van der Veen and Jones 2006, 218).

The charred plant assemblage from SMR6 is principally composed of weeds and cereal grains, with few chaff elements recovered. The presence of weed seeds but absence of chaff could indicate the presence of fully processed cereals, or perhaps indicates that chaff was being disposed of in some manner detrimental to its preservation. One possible explanation may be its use as a fodder or fuel off-site (Van der Veen *et al*. 2013, 160).

The greatest quantity of grains was recorded in fill (4391) of ditch [4389}, which produced an abundance of barley grains. Barley may have been used for making bread and was also frequently employed in ale brewing during the medieval period.

The crops present may provide information regarding soil cultivation regimes during this period. Barley, being more drought-tolerant, would perhaps have been more suitable for spring-sowing and would have fared better on well-drained loams and light clay soils, while naked wheats will thrive even on clay-rich soils (McKerracher 2015, 98). Innovations in ploughing technology during this period, would have allowed farmers to cultivate these heavier soils.

Pulses, including broad bean and pea, were found in several samples, and could be the remains of economic plants. Legumes, including field pea, beans and vetch, were thought to have been cultivated by Anglo Saxon farmers as a food and fodder crop. The rise of the two- and three-field crop rotation during the Saxon period, and the adoption of equipment such as the mould-board plough, would not only have allowed for larger overall yields (Hamerow *et al*. 2020, 585) but may also have facilitated a shift towards a more diverse crop profile. Pulses may have been grown as part of a seasonal rotation. The small number of pulses present is perhaps a reflection of the way in which these remains were prepared. Legumes are less likely to come into contact with fire during preparation than cereals, and are, as a result, often considered to be under-represented in archaeobotanical assemblages (Treasure and Church 2017, 117).

Wild plants may also have been exploited for food during at this time, evidenced by the presence of a well-preserved cherry/plum/sloe type (*Prunus* sp.) fruit and endocarp in one sample. While the marine mollusc assemblage is too small to be of significant interpretive value, it indicates that marine resources were being utilised locally at this time, suggesting that the local diet may have been relatively diverse.

Silicified awn fragments in fill (4391) of ditch [4389] could represent the waste from hearths and ovens, and is perhaps evidence that heat-intensive processing activities, for example corn drying, were being carried out on site.

5.2.4 Summary

Based on the site phasing, it appears clear that in the Romano-British period hulled wheats were the dominant cereal, while during the Anglo-Saxon period barley was more frequent. This can be demonstrated with %Ubiquity (the proportion of samples from each phase that contained barley or wheat). For Romano-British phase, 12% of samples contained wheat and 3% contained barley, while in the Anglo-Saxon phases %Ubiquity increases to 25% for barley and wheat drops to 12%. The relative paucity of cereal-containing samples is noteworthy, with the low incidence of cereals likely to be indicative of the poor preservation conditions (recognised throughout the assemblage as the grains were often abraded and fragmented) and the limited occurrence of remains associated with primary use of features.

The cereals detected at the site are typical of the region and periods. The density of charred plant remains per litre of sampled soil was generally low, and the quality of preservation of these items was relatively poor. As a result, what appears to be present is a scatter of charred plant material across the excavated area that cannot be linked securely to any particular period or activity. Of note were several samples that contained hulled barley grains that were well preserved and still enclosed within their lemma and palea.

The wild taxa assemblage is limited. There is little evidence for crop-processing residue, and accordingly limited opportunity to use weed ecology to infer arable field conditions. The presence of several taxa adapted to waterlogged environments suggests that wetland habitats were local to the site. This could be a nearby area exploited for reeds or peat fuel, or, just as likely, that ditches were left undisturbed, which allowed wetland species to establish on and around the site.

6. Bayesian Chronological Modelling *by Derek Hamilton*

A total of 17 samples of charcoal, charred cereal remains, and animal remains from 15 contexts were radiocarbon dated. The samples were processed following methods outlined in Dunbar *et al*. (2016). A Bayesian approach (Buck *et al*. 1996) has been applied to the interpretation of the chronology of some of the archaeological activity revealed through the Viking Link excavations.

The results are presented (Table 1) as conventional radiocarbon ages (Stuiver and Polach 1977). They have been calibrated (Figure 43) using the internationally agreed terrestrial calibration curve (IntCal20) of Reimer *et al*. (2020) and the OxCal v4.4 computer program (Bronk Ramsey 2009). Simple calibrated results are presented as single ranges at 95% probability intervals (unless otherwise noted) in plain text and rounded outward to 10 years. The italicised dates presented in the text below are posterior density estimates derived from mathematical modelling of archaeological problems and have been rounded outward to five years. These dates can change with the addition of new data or when the modelling choices are varied.

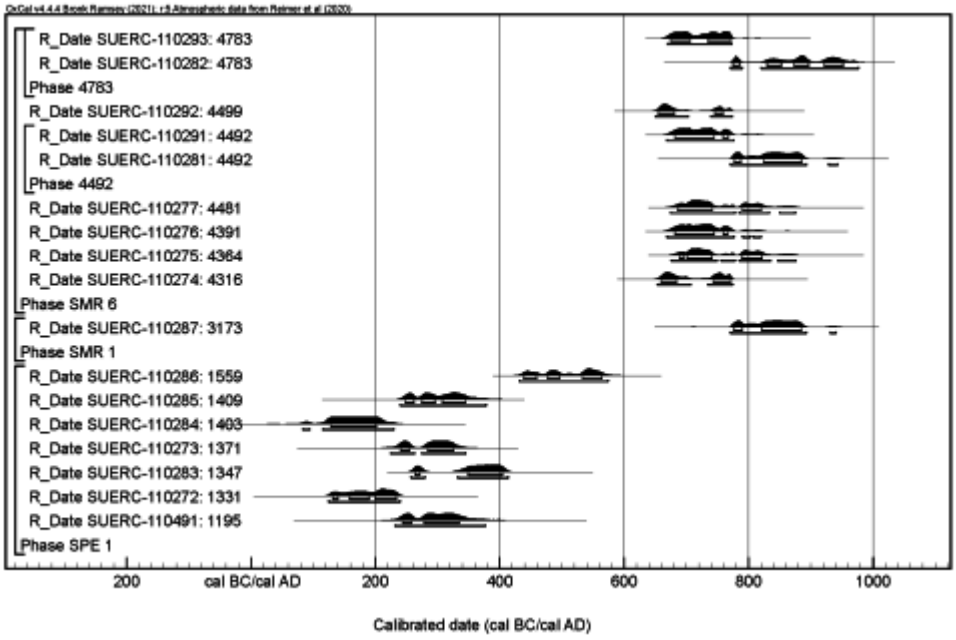

Figure 43: Calibrated radiocarbon results from Viking Link, Lincolnshire. Image credit: Headland Archaeology (UK)

6.1 The samples and the models

The radiocarbon dating from Viking Link is primarily focused on two areas - SPE1 and SMR6 - that date to the Roman and early medieval periods, respectively. There is a single radiocarbon result from an early medieval feature in SMR1. Most samples come from ditch fills across the three areas. In two cases there are multiple dates from a single context and the paired measurements have been compared using a t-test (Ward and Wilson 1978) to check for consistency. Where multiple measurements are consistent there generally is greater security in the material dating the feature formation. In both cases, the paired measurements are not statistically consistent (T'(4783)=15.8 and T'(4492)=7.4; df=1; T'(5%)=3.8). In both cases, one result is 7th-8th century cal AD and the other is 9th-10th century cal AD. No results have been excluded from the modelling as the chronological model is only being used here to provide a general idea of when the activity occurred. It is important to note that these statistical tests suggest reworking of deposits, either at the point of deposition or after.

The dates in the primary model are grouped by the excavation area from which the samples were derived. SPE1 and SMR6 have seven and nine dates, respectively, and in this initial model follow the simple bounded phase structure as described in Hamilton and Kenney (2015), with the two areas modelled independently. A second model was produced that used stratigraphic relationships between dated features in SPE1, whereby the dates from (1403) and (1371) are earlier than (1347) and later than (1409).

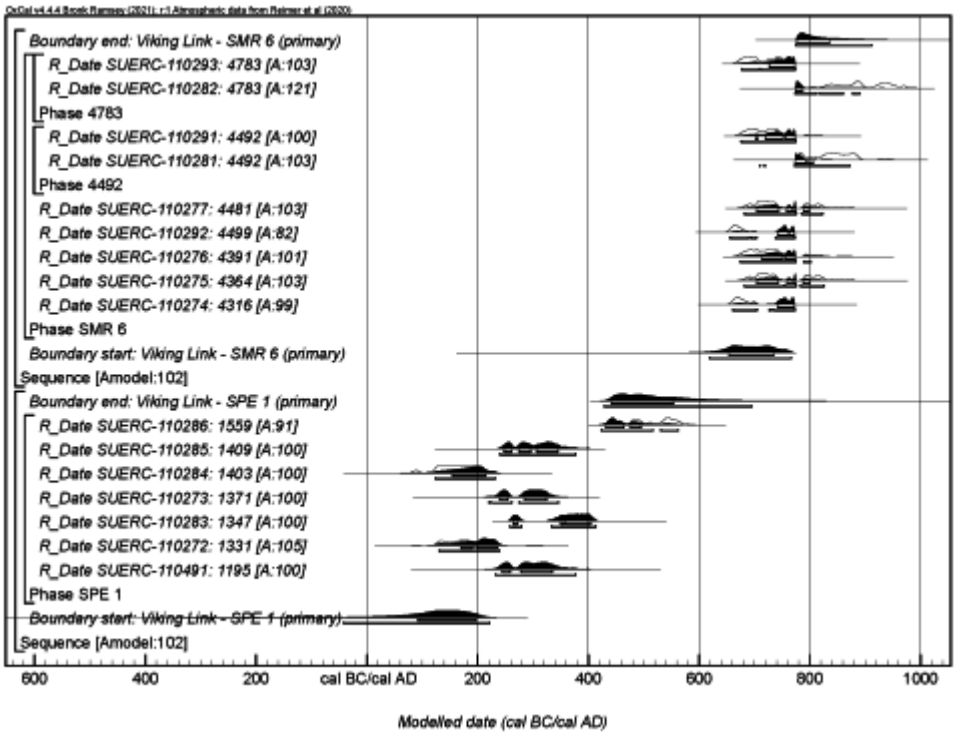

Figure 44: Chronological model for the dated activity from SPE1 and SMR6 from the Viking Link excavations. Each distribution represents the relative probability that an event occurred at some particular time. For each of the radiocarbon measurements two distributions have been plotted, one in outline, which is the result of simple radiocarbon calibration, and a solid one, which is based on the chronological model use. The other distributions correspond to aspects of the model. For example, 'start: Viking Link - SPE1' is the estimated date that activity began at SPE1, based on the radiocarbon dating results. The large square 'brackets' along with the OxCal keywords define the overall model. Image credit: Headland Archaeology (UK)

The primary model has good agreement between the radiocarbon dates and the archaeology (Amodel=102). It estimates the Roman period activity in SPE1 began in *45 cal BC-cal AD 225 (95% probability; Figure 44; start: Viking Link - SPE1 (primary))*, or *cal AD 90-200 (68% probability)*. The dated activity in SPE1 ended in *cal AD 425-700 (95% probability; Figure 44; end: Viking Link - SPE1 (primary))*, or *cal AD 440-555 (68% probability)*. The dating estimates the dated SPE1 activity spanned *235-675 years (95% probability; Figure 45; span: Viking Link - SPE1 (primary))*, or *275-465 years (68% probability)*.

The early medieval period activity in SMR6 is estimated to have begun in *cal AD 615-770 (95% probability; Figure 44; start: Viking Link - SMR6 (primary))*, or *cal AD 650-735 (68% probability)*. The dated activity is SMR6 ended in *cal AD 775-915 (95% probability; Figure 44; end: Viking Link - SMR6 (primary))*, or *cal AD 775-840 (68% probability)*. The dating estimates the dated SMR6 activity spanned *10-275 years (95% probability; Figure 45; span: Viking Link - SMR6 (primary)), or 45-180 years (68% probability)*.

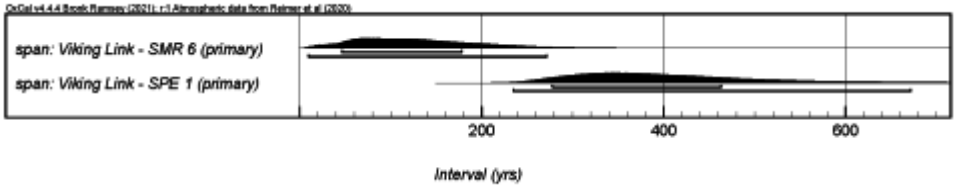

Figure 45: Span of dated activity in SPE1 and SMR6 at Viking Link, Lincolnshire. The span is derived from the modelling shown in Figure 44. Image credit: Headland Archaeology (UK)

The alternative model for Viking Link only changed the structure for the dates from SPE1. This model has poor agreement (Amodel=9) with the result (SUERC-110284) from (1403) clearly earlier than the material from the underlying (1409). After excluding SUERC-110284 as being residual, the model has good agreement (Amodel=101) and estimates the Roman period activity in SME1 began in *50 cal BC-cal AD 290 (95% probability; Figure 46; start: Viking Link - SPE1), or cal AD 115-230 (68% probability)*. The dated activity in SPE1 ended in *cal AD 425-730 (95% probability; Figure 46; end: Viking Link - SPE1)*, or *cal AD 440-565 (68% probability)*. The dating estimates the dated SPE1 activity spanned *185-715 years (95% probability; span: Viking Link - SPE1)*, or *240-445 years (68% probability)*.

The inclusion of the stratigraphy between dated features has had little effect on the precision for the dating framework for SPE1, but has highlighted that, just like SMR6, there are potential taphonomic issues that have resulted in reworked material being in dated contexts. Therefore, the more conservative primary model is preferred.

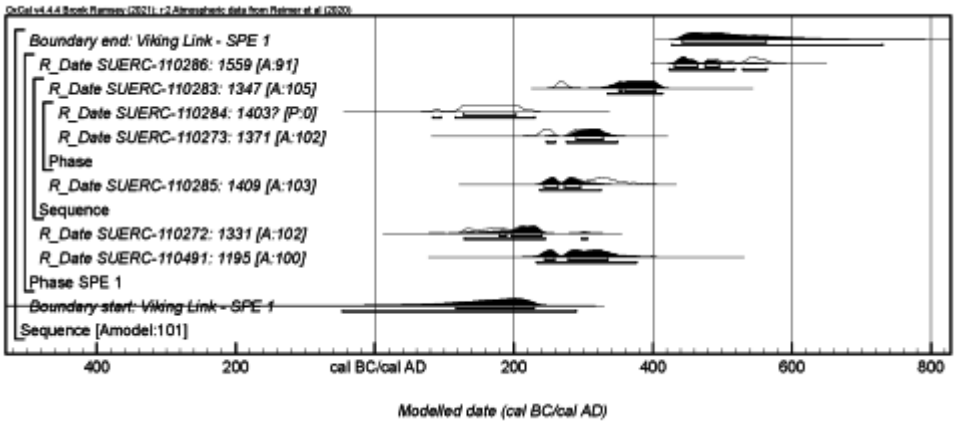

Figure 46: Chronological model using the alternative prior information for SPE1 at Viking Link. The model is as described in Figure 44. Image credit: Headland Archaeology (UK)

7. Fenland Settlement and Fields

The excavations at Viking Link revealed evidence for Roman settlement and Anglo-Saxon enclosure and agriculture. The results provide insight into the creation, development and maintenance of a Roman enclosure system on the edge of one of the characteristic roddons in the Lincolnshire Fenland. The evidence is inconclusive when addressing the possibility of continuous site use during the transition period from Roman to Anglo-Saxon influence. It is clear, however, that the site was used again for agricultural purposes during the mid-Anglo-Saxon period. The enclosures created during the Roman and Saxon periods are geographically separate and both have a distinctive layout with varied characteristics.

During the mid-2nd century AD, the site would have been surrounded by a marshy Fenland landscape influenced by high groundwater levels and under a certain amount of threat from fluctuating sea levels. To mitigate these challenges, the Roman enclosures were situated on a relatively high point in the landscape. It is possible that they were guided in their choice by the remains of small curvilinear gullies, which potentially belong to a previous phase of land use that is now virtually archaeologically invisible. While protection from flooding was of importance, it is likely that access to fresh water for agricultural purposes also played a role. As the Roman enclosure system developed the ditches were maintained and kept open at considerable effort, as evidenced by the multiple recuts. The ditches may have been subject to flooding or used to channel water, with the presence of frog or toad remains, including juveniles, indicating periods of fresh standing water.

The Saxon enclosure system is more temporary than its Roman counterpart and includes many more recut phases. It is likely that the land divisions were used on a seasonal or otherwise ad hoc basis. This is in line with the suggestion that the Anglo-Saxons, in many areas at least, were likely more focused on pastoralism than crop growing during the period up to *c*. AD 700 (Banham and Faith. 2014, 73-75). It is possible that Anglo-Saxon farming on the roddon was seasonal owing to the risk of flooding at certain times of year. However, it is equally possible that the roddon provided the

best pastures in the otherwise marshy Fenland and that seasonality was just part of the standard practice in the region.

7.1 Roman enclosures: a complex farmstead

It is clear from the material culture, as well as from the radiocarbon dates, that the Roman site was likely established during the 2nd century AD and consisted of twelve initial enclosures. The core of activity during this phase of establishment seems to focus on the northern part of the excavation. The size of the enclosed areas increases from north to south and therefore towards the edge of the roddon. A similar pattern of smaller and larger enclosures is present around Straw Hall Farm in Downham West (Norfolk) and in other places along the Fen Causeway (Silvester 1991, 105, 111). A droveway leading from the enclosures may have connected the area to other settlement and resources. Overall, the chronological evidence suggests that the core period of occupation in this part of the site fell between the mid-2nd century and the 4th century AD, although a couple of radiocarbon dates hint at continued activity into the 5th century. Within this time period, the enclosures were altered, expanded and maintained in order to keep functioning under the potentially changing needs of the population. In some cases, it seems as if maintenance and clearing of ditches was a regular occurrence, potentially as a result of damage through flooding. The re-digging of ditches may have led to the loss of material culture from earlier phases and therefore may alter the chronological picture of the site to some extent.

The enclosures, structures and pits likely formed part of a larger farmstead potentially extending to the north. The case for further Roman settlement to the north of the current excavation site is strengthened by the high density of artefacts, including querns, animal bone and metalworking waste, located at the northern extent of the site (Figure 4). While the economic focus seems to be on agriculture, this may have been supplemented on a small scale by craft production such as metalworking and bone working. The metalworking waste was characteristic of that deposited during or directly after the process of iron smithing, suggesting that this was taking place in the immediate surroundings. As no clear evidence for this process was found on site, it is most probable that the activity took place somewhat to the north of the excavation. The evdience for animal bone working was also concentraited in this area, with activity appearing to be small in scale (MacGregor 1985, 44). A key portion of the ceramic assemblage was recovered from the same area as the bone and metalworking including the sherds of the tazze, reinforcing links to a wider farmstead.

The combination of enclosures and different zones of activity is indicative of complex farmsteads, as defined by Allen and Smith (Smith *et al*. 2016, 28). This settlement type is characterised by a cluster of distinctively separate yet conjoining zones which were used for a variety of different activities (e.g. domestic, industrial, storage, livestock enclosures, etc.). This type represents the majority of all classified Roman farmsteads in the Fenlands and numbers rose sharply during the late 1st to mid 2nd century AD (Smith *et al*. 2016, 151-2). This date is contemporary with the expected start date of the Viking Link complex. It is likely that the current excavations revealed the fringes of a complex farmstead settlement representing agricultural enclosures, structures and craftworking areas. In this scenario, it is probable that a zone of further industrial activity was directly adjacent, and a zone for habitation in the near vicinity too.

As it becomes increasingly clear that the excavated remains represent part of a larger farmstead, it is interesting to note how the suspected main activity of cattle herding is translated into the creation of economic surplus. The zoological assemblage was dominated by cattle, with the very low occurrence of butchery marks suggesting that butchery may have taken place elsewhere. The majority of the remains with evidence of butchery were recovered from the northern part of the site, which suggests that this may have taken place in the core of the settlement or the industrial zone to the north of the excavation. This idea is strengthened by the discovery of articulated lower limbs of cattle and horse, likely representing the dumping of low-utility body parts after initial butchering. Among the assemblage of cattle remains were bones from older animals as well as juveniles. This suggests that on-site breeding took place to some extent with evidence for the use of cattle for traction in agricultural processes. In addition to cattle, the Roman-period assemblage returned a relatively small number of caprine remains with the age profile suggesting a flock bred in the vicinity. Organic residue analysis showed a split of Roman pottery usage between ruminant adipose and dairy, with a majority of vessels used for processing/cooking of cattle or sheep/goat carcass products. The outcomes, which suggest that dairying was less important than carcass processing, represent a contrast with the site at Stanwick, Northants, where dairy was shown to be of greater importance (Copley *et al*. 2005). In Faverdale, Darlington, however, carcass processing was the more important form (Cramp *et*

al. 2011; 2012). This indicates that the economic importance of dairying and butchery is highly variable, presumably dictated by local requirements and/or the needs of other settlements and production centres nearby.

One of these production centres is the salt extraction site at Helpringham, some 8km away from Viking Link. Excavations show activity during the 3rd century AD, but it is likely that salt extraction started earlier, potentially even continuing from the Iron Age (Healey 1999, 19). Viking Link itself did not return evidence for salt extraction, but it is likely that interaction took place between those who lived and worked near the site and other communities nearby. As salt is used for the preservation of food, including meat, it is possible that there was a link between the nearby salt production in places like Helpringham and the focus on carcass processing and butchery near Viking Link. In the introductory sections of this publication, a brief summary was provided of the Roman period infrastructure that was created in and around the Fenland and that may have impacted life and economy at Viking Link. The main roads and waterways would have provided access to local and regional products, resources and communications. The ceramic assemablage recovered from the site supports this, as while it was manufactured by local industries, the small assmeblage of samian along with regionally traded colour-coated fine wares and mortaria suggests access to more refined wares. The Roman road 'Salters Way' runs to the south of Viking link and was likely used for the transport of salt between the Fens and larger inland settlements further west (MLI33293). With Car Dyke being located a few miles west of Donington, it is possible that this waterway was also used to move goods to the Peterborough or Lincoln areas (Bond 2007). The site is also surrounded by ironworking sites clustered around the area of a possible crossing point of two Roman roads, one of which potentially extended eastwards in the direction of Viking Link (Schrüfer-Kolb 2004). The enclosures uncovered at Viking Link likely formed part of a well-connected farmstead, participating in activities and trade locally with access to wider regional networks.

7.2 Roman to Saxon transition

Evidence for changing land use during the transition period between Roman and Anglo-Saxon cultural influence in England is often sought after but remains scarce. Unfortunately, the same applies to the Viking Link site, where there is strong evidence for Roman and mid-Anglo-Saxon land use, but very little for the 5th century AD, except for a single radiocarbon date of cal AD 430-580 (SUERC-110286) from the area of the Roman settlement. The paucity of datable evidence may be an indicator that there was little or no activity, but this is an unlikely scenario. While many changes occurred during this transition, it is likely that these formed a gradual process rather than an abrupt revolution and life in the countryside initially remained the same for many. The stratigraphically earliest phases of the mid-Anglo-Saxon enclosure system did not produce datable evidence. Anglo-Saxon Enclosure 1 is located in between the field systems from the Roman and mid-Anglo-Saxon periods and does not seem to be connected to either. The enclosure is rectilinear but much narrower than its Roman counterparts. It may be that this enclosure, which does not contain any datable material, represents the transition period between two systems. This would suggest a low-level continuation of activity on site and a gradual system change. The narrowness of this potential transition period enclosure ties in with the theory that Anglo-Saxon agriculture shifted from rectangular fields to strip cultivation and more irregular fields around AD 650 (Carver 2019, 18). This change likely happened under the influence of an economic downturn after the decline of Roman rule, as well as climatic deterioration. It is likely that crop-based agriculture reversed to more pastoral land use throughout the country (Payne 2007). The increased use of pastures at the expense of arable fields can be seen in Haddon and other sites near Peterborough (Cambridgeshire), Mucking and Springfield Lyons (Essex), Barton Bendish, Witton, and Hales and Loddon (Norfolk) and West Stow (Suffolk) (Lawson 1983, 75; Davison 1990, 18-19; Murphy 1994, 37; Rogerson *et al*. 1997, 20 and 23; Upex 2002, 89). For Viking Link, where arable land use was probably already very small, it is likely that animal husbandry remained dominant, albeit on a very small scale. This low-level pastoralism is unlikely to have left many traces. Moving into the mid-Saxon period, it is suggested that crop growing increases again as a percentage of the total agricultural practice during the 7th and 8th centuries (Carver 2019, 19). This increase in crop cultivation may subsequently result in the creation of the second field system on site. However, for the mid-Anglo-Saxon period it also appears that there is very little ecological evidence for arable field use.

7.3 Anglo-Saxon field/enclosure system

The aforementioned shift from rectilinear enclosures to strip cultivation goes hand in hand with a closer association between livestock and settlement. In addition to meat production, dung was used

for manuring, oxen were used for ploughing and wool became a saleable commodity (Carver 2019, 18). The layout of the Anglo-Saxon field system at Viking Link comprises smaller enclosures than its Roman counterpart, with much more curvilinear boundaries and irregular enclosure shapes. The ditches seem more short-lived, suggesting that the field system was less rigid. It could have been used seasonally and extended or altered on an ad hoc basis, as evidenced by the many repair or maintenance cuts. It is notable that Anglo-Saxon features are found to the west and, to a greater extent, to the east of the Roman enclosure system, but that features from both periods do not connect or overlap. This indicates that the Roman enclosure system may have still been visible at the start of the mid-Anglo-Saxon phase and could therefore be avoided. It prompts the question why the Anglo-Saxons did not just use the existing Roman enclosures. A potential explanation is that the Roman system was unsuitable owing to changed natural circumstances, for example flooding. Another possibility is that the Roman system, which was part of a wider domestic settlement, did not suit the particular agricultural practices being deployed. Given the suggestion that livestock was more closely associated with settlement, this could mean that a potential Anglo-Saxon settlement should be sought to the east or north-east of the existing excavation site. It is possible that the Anglo-Saxon field/enclosure system was only used during a certain time of year, when the roddon in the Fenland was the most suitable location, and at other times the animals were grazed elsewhere. The suspected proximity to a settlement is reflected in the presence of evidence for some industrial activity as well as more luxurious pottery or ceramic items related to ritual practice. However, the Anglo-Saxon pottery is mainly utilitarian ware which may indicate more transient occupation of the site, possibly seasonal.

7.3.1 Animal husbandry in the Anglo-Saxon period

Research into the size of animal bones suggests that cattle were likely smaller during the mid-Anglo-Saxon period than during the Roman period. This is in line with evidence from other Anglo-Saxon sites including West Stow (Suffolk), Higham Ferrers (Northamptonshire) and Mucking in Essex (Crabtree 1989; Done 1993; Albarella 2000). The general suggestion is that the size of cattle increases significantly after the Iron Age, to subsequently decrease somewhat in the first centuries of the Anglo-Saxon period. Relative to the Roman period, it seems that the number of cattle on site has also declined somewhat. Cattle, however, remains the most important animal, followed by caprine - most likely sheep. The number of pigs and equid remains is relatively small. Sheep were kept for breeding, as evidenced by remains of juveniles, and most pig remains indicate slaughter around the optimal age of 18-24 months (Albarella 2006). The assemblage of equid remains is very small and includes no recognisable evidence for juvenile individuals. The only avian remains from an Anglo-Saxon context consist of a bone from a relatively young goose. It can be suggested that geese were kept on a very small scale and probably not in relation to economic activity. Similar to the evidence from the Roman period, only a very small number of animal remains from the Anglo-Saxon era show traces of butchery. Together with the discovery of some articulated limbs, these findings suggest off-site butchering, potentially in the vicinity, and the dumping of some butchered remains or low-utility body parts. The conclusion that can be drawn from the Anglo-Saxon evidence is that animal husbandry was practised on a relatively small scale and with little focus or specialisation. The same suggestion of unspecialised animal husbandry arises from other contemporary and somewhat earlier assemblages, for example from West Stow, Highham Ferrers and Mucking (Crabtree 1989; Done 1993; Albarella 2000).

7.3.2 Settlement and economic activities

There is no clear indication as to where a potential contemporary Saxon settlement was located. The Domesday book lists settlements, established around AD 900, in nearby Donington, Swaton, Bicker, Quadring, Drayton and Steyning. It may be possible to suggest that any settlement related to the activity at Viking Link was a predecessor of one of these later settlements. It is possible that the agriculture at Viking Link was used to support mid-Anglo-Saxon settlements further afield, or communities from more than one settlement. If the site is considered to represent a seasonal field system, a settlement can be relatively far away, although the balance of evidence as just discussed indicates it is more likely to be located close by. The mid-Anglo-Saxon site use seems completely focused on agriculture as the main economic component, with again meat production as a dominant factor. The Domesday book lists 16 salt houses in Donington, which may suggest that salt extraction in the surrounding areas coninued from the Roman into the Anglo-Saxon period and had some impact on the region's economy. However, no evidence of salt extraction was found in relation to the site.

The pottery assemblage does indicate that wider connections existed and it is notable that no Ipswich ware was discovered. This goes against expectations for a site from this period. A selection of

vessels, however, have tempers more common north and east of Lincoln. This may suggest that during the Anglo-Saxon period there was more contact with the north, potentially through better developed trade routes, than with the south and east. The fish bones also indicate a connection to the coast. The remains of a wide variety of fish were dumped on site, evidencing the use of natural local food resources and processing and/or consumption on site. The presence of eel, for example, is common for the period, but the absence of herring is noteworthy. Key indicators of fish cess deposits such as crushed/chewed eel vertebrae are also absent. The number of cod remains is commensurate with the idea that the species was not widely exploited at this time, except in coastal areas. However, the size of the remains from Viking Link indicates the consumption of large cod found deeper offshore. If more advanced fishing methods were used to catch these larger cod, it is possible to suggest that there was a potential link between the site and a more organised fishing industry closer to the Wash. Among the assemblage are also horse mackerel and garfish, which are found in high numbers in the Wash; the presence of flat fish is a further indication of sea fishing.

8. Conclusion

The archaeological investigations at the Viking Link Convertor Station, Bicker Fen, Lincolnshire, uncovered Roman and Saxon activity at varying scales. The excavations have provided insights into the development and changing use of the Fenland landscape. The Roman enclosures appear to form the southern edge of a more complex farmstead. The site was established as a set of defined rectilinear enclosures that were expanded and routinely maintained. The primary focus appears to have been cattle husbandry, with the artefactual evidence indicating small-scale craft production at the site's northern edge. The ceramic assemblage, supported by the radiocarbon dating, suggests a focus of activity in the later Roman period, dating from the mid-2nd century AD onwards extending into the 4th century, with hints of continuity into the 5th century. The assemblage is largely utilitarian in nature although the presence of samian, along with regionally traded colour-coated fine wares and mortaria, suggests access to wider trading networks. The Saxon enclosures are strikingly different in form, potentially resulting from repeated ad hoc or seasonal use of the site. The focus again appears to have been animal husbandry with the site potentially linked to a neighbouring settlement or activity further afield. The identification of these remains as Saxon relied heavily on the radiocarbon dating, with their less substantial nature when compared to the earlier settlement. The identification of potentially seasonal Saxon activity adds to the picture of Saxon life so often dominated by discussions of later settlement centres.

Acknowledgements

The archaeological works were commissioned by Ian Farmer Associates (IFA) for the Viking Link Interconnector and Converter Station a joint venture between National Grid and Energinet. Thank you to National Grid and Siemens Energy for their support throughout the project. We are grateful to South Holland District Council (SHDC), Boston Borough Council (BBC) and Lincolnshire Council for their curatorial support.

Thanks must first be given to the fieldwork teams who worked tirelessly to complete the archaeological program. The field team comprised: David Bennison, Ellinor Berggren, Rachael Doyle, Andrew Failes, Aisling Fitzpatrick, Francis Frassine, Dana Gaskell, Josh Gaunt, Verity Landrock, Jeanine Lewis, Kimberley Gaunt, Tereza Nesnidalova, Sesilia Niehaus, Robert Pass, Megan Roberts, Phil Roberts, Rachel Robertson, Alex Rodzinka, Joseph Sleight, Kirsty Stanton, Anthony Taylor, Alexis Thouki and Tom Watson. The excavations were directed by Josh Gaunt who along with Kim Gaunt authored the Assessment Report. Candy Hatherley was the Project Manager throughout.

A number of individuals contributed to the project during post-excavation beyond the named specialists. Thanks must go to the entire post-excavation team from initial processing to archiving, including Amy Koonce, Charlotte Self, Steve Roe and Megan Roberts. Special thanks to the specialists who contributed at various stages including Julie Franklin, Michael Wallace and Anna Rebisz-Niziolek. The post-excavation analysis was managed by Claire Christie. The Illustrations were created by Tom Watson (flyover and site plans), Marc Zubia-Pons (pottery reconstruction) and Beata Wieczorek-Oleksy (finds illustration and management).

Bibliography

Addyman, P. 1964 'A Dark-Age settlement at Maxey, Northants', *Medieval Archaeology* **8**, 20-73. https://doi.org/10.1080/00766097.1964.11735674

Albarella, U. 2000 *The Early to Late Saxon Animal Bones Excavated in 1995 from Kings Meadow Lane, Higham Ferrers, Northamptonshire*, Ancient Monument Laboratory Report 79/2000.

Albarella, U. 2006 'Pig Husbandry and Pork Consumption in Medieval England' in Woolgar, C., Serjeantson, D. and Waldron, T. (eds) 2006 *Food In Medieval England: Diet and Nutrition*, Oxford: Oxford Academic. 72-87. https://doi.org/10.1093/oso/9780199273492.003.0006

Albarella, U. and Pirnie, T. 2019 *A Review of Animal Bone Evidence from Central England*, Portsmouth: Historic England.

Allen, M. and Smith, A. 2016 'Rural settlement in Roman Britain: morphological classification and overview' in A. Smith, M. Allen, T. Brindle and M. Fulford (eds) *New Visions of the Countryside of Roman Britain, Volume 1: The Rural Settlement of Roman Britain*, Britannia Monograph Series **29**. 17-43.

Ameen, C., Benkert, H., Fraser, T., Gordon, R., Holmes, M., Johnson, W., Lauritsen, M., Maltby, M., Rapp, K., Townend, T. and Baker, G. 2021 'In search of the 'great horse': a zooarchaeological assessment of horses from England (AD 300-1650)', *International Journal of Osteoarchaeology* **31**(6), 1247-57. https://doi.org/10.1002/oa.3038

Andrews, A. and Noddle, B. 1975 'Absence of premolar teeth from ruminant mandibles found at archaeological sites', *Journal of Archaeological Science* **2**(2), 137-44. https://doi.org/10.1016/0305-4403(75)90032-1

Arcadis Consulting (UK) Ltd 2017a 'Viking Link UK Onshore Scheme, Desk Based Assessment' Volume 4: Appendix 23.1, Archaeology and Cultural Heritage Desk Based Assessment (Proposed Converter Station), Document Ref. ES-4-C.07

Arcadis Consulting (UK) Ltd 2017b 'Viking Link UK Onshore Scheme, Environmental Statement', Volume 2: Chapter 23 Archaeology and Cultural Heritage (Proposed Converter Station), Document Ref. ES-2-C.07

Arnold, E. and Ovenden, D. 2004 *A Field Guide to the Reptiles and Amphibians of Britain and Europe*, 2nd edition, London: Harper Collins.

Banham, D. and Faith, R. 2014 *Anglo-Saxon Farms and Farming*, Oxford: Oxford University Press. https://doi.org/10.1093/acprof:oso/9780199207947.001.0001

Barrett, J., Locker, A. and Roberts, C. 2004a "Dark Age Economics' revisited: the English fish bone evidence AD 600-1600', *Antiquity* **78**(301), 618-36. https://doi.org/10.1017/S0003598X00113262

Barrett, J., Locker, A. and Roberts, C. 2004b 'The origins of intensive marine fishing in medieval Europe: the English evidence', *Proceedings of the Royal Society of London. Series B: Biological Sciences* **271**(1556), 2417-21. https://doi.org/10.1098/rspb.2004.2885

Barrett, J., Johnstone, C., Harland, J., van Neer, W., Ervynck, A., Makowiecki, D., Heinrich, D., Hufthammer, A., Enghoff, I., Amundsen C. and Christiansen, J. 2008 'Detecting the medieval cod trade: a new method and first results', *Journal of Archaeological Science* **35**(4), 850-61. https://doi.org/10.1016/j.jas.2007.06.004

Bartosiewicz, L., van Neer, W. and Lentacker, A. 1993 'Metapodial asymmetry in draft cattle', *International Journal of Osteoarchaeology* **3**(2), 69-75. https://doi.org/10.1002/oa.1390030203

Bell, A., Gurney, D. and Healey, H. 1999 *Lincolnshire Salterns, Excavations at Helpringham, Holbeach St Johns and Bicker Haven*, East Anglian Archaeology Report **89**, Dereham: East Anglian Archaeology.

Bendrey, R. 2007 'Ossification of the interosseous ligaments between the metapodials in horses: a new recording methodology and preliminary study', *International Journal of Osteoarchaeology* **17**(2), 207-13.

Berstan, R., Stott, A., Minnitt, S., Ramsey, C., Hedges, R. and Evershed, R. 2008 'Direct dating of pottery from its organic residues: new precision using compound-specific carbon isotopes', *Antiquity* **82**(317), 702-13. https://doi.org/10.1017/S0003598X00097325

Biddulph, E., Compton, J. and Martin, T. 2015 'The Late Iron Age and Roman pottery' in M. Atkinson and S. Preston 'Heybridge: A Late Iron Age and Roman Settlement, Excavations at Elms Farm 1993-5', *Internet Archaeology* **40**. https://doi.org/10.11141/ia.40.1.compton6

Blinkhorn, P. 2012 *The Ipswich Ware Project: ceramics, trade and society in Middle Saxon England*, Medieval Pottery Research Group Occasional Paper **7**.

Bond, J., 2007 'Canal construction, an introductory review' in J. Blair (ed) *Waterways and Canal Building in Medieval England*, Oxford: Oxford University Press. 153-206. https://doi.org/10.1093/acprof:osobl/9780198723134.001.0001

Bronk Ramsey, C. 2009 'Bayesian analysis of radiocarbon dates', *Radiocarbon* **51**, 337-60. https://doi.org/10.1017/S0033822200033865

Buck, C., Cavanagh, W. and Litton, C.1996 *Bayesian Approach to Interpreting Archaeological Data*, Chichester: John Wiley and Sons, Ltd.

Carruthers, W. and Hunter-Dowse, K. 2019 *A Review of Macroscopic Plant Remains from the Midland Counties*, Research Report Series **47**, Historic England.

Carver, M. 2019 *Formative Britain: An Archaeology of Britain, Fifth to Eleventh Century AD*, 1st edition, London: Routledge. https://doi.org/10.4324/9780429449130

Colonese, A.C., Lucquin, A., Guedes, E.P., Thomas, R., Best, J., Fothergill, B.T., Sykes, N., Foster, A., Miller, H., Poole, K., Maltby, M., Von Tersch, M., Craig, O.E. 2017 'The identification of poultry processing in archaeological ceramic vessels using in-situ isotope references for organic residue analysis', *Journal of Archaeological Science* **78**, 179-192. https://doi.org/10.1016/j.jas.2016.12.006

Copley, M., Berstan, R., Dudd, S., Docherty, G., Mukherjee, A., Straker, V., Payne S. and Evershed, R. 2003 'Direct chemical evidence for widespread dairying in Prehistoric Britain', *Proceedings of the National Academy of Sciences of the United States of America* **100**(4), 1524-29. https://doi.org/10.1073/pnas.0335955100

Copley, M., Berstan, R., Dudd, S., Straker, V., Payne, S. and Evershed, R. 2005 'Dairying in antiquity. I. Evidence from absorbed lipid residues dating to the British Iron Age', *Journal of Archaeological Science* **32**(4), 485-503. https://doi.org/10.1016/j.jas.2004.07.004

Corder, P. 1950 *A Romano-British Pottery Kiln on the Lincoln Racecourse*, Nottingham: University of Nottingham, Dept. of Adult Education.

Correa-Ascencio , M. and Evershed, R. 2014 'High throughput screening of organic residues in archaeological potsherds using direct acidified methanol extraction', *Analytical Methods* **6**(5), 1330-40. https://doi.org/10.1039/c3ay41678j

Crabtree, P. 1989 *West Stow, Suffolk: Early Anglo-Saxon Animal Husbandry*, Ipswich: Suffolk County Planning Department.

Cramp, L.J.E., Evershed, R.P. and Eckardt, H. 2011 'What was a mortarium used for? Organic residues and cultural change in Iron Age and Roman Britain', *Antiquity* **85**, 1339-52. https://doi.org/10.1017/S0003598X00062098

Cramp, L.J.E., Evershed, R.P. and Eckardt, H. 2012 'Are you what you grind? A comparison of organic residues from ceramics at two Roman British sites' in I. Schruefer-Kolb (ed) *More Than Just Numbers? The role of science in Roman Archaeology*, Journal of Roman Archaeology Supplement **91**. 93-110.

Cranfield University 2020 *The Soils Guide*, https://www.landis.org.uk, Cranfield University, UK.

Crowson, A., Lane, T. and Reece, J. 2000 *Fenland Management Project Excavations 1991-1995*, Lincolnshire Archaeology and Heritage Reports Series **3**, Heritage Trust of Lincolnshire.

Crummy, N. 1983 *The Roman small finds from excavations in Colchester 1971-9*, Colchester Archaeological Report **2**, Colchester: Colchester Archaeological Trust.

Cumberlidge, J. 2009 *Inland Waterways of Great Britain*, St Ives: Imray.

Dailey, M. 2008 'Archaeological Evaluation Report: Trial Trenching of Land Adjacent to Sutterton Enterprise Park, Station Road, Sutterton, Lincolnshire', Lincoln: Allen Archaeology Ltd.

Darling, M. 2005 'Report 63 on the pottery from Linwood Road, Market Rasen, MRL99 in Linwood Road, Market Rasen, Lincolnshire', Archaeological Excavation and Watching Brief, Lindsey Archaeological Services https://doi.org/10.5284/1015664 Accessed 05/05/2023.

Darling, M. and Precious, B. 2014 *A Corpus of Roman Pottery from Lincoln*, Oxford: Oxbow Books.https://doi.org/10.2307/j.ctvh1dq62

Davies, B. 1996 'Preliminary pottery analysis in archaeological evaluation on land south of the cemetery, Station Road, Sutterton, Lincolnshire', Sleaford: Archaeological Project Services https://doi.org/10.5284/1015951 [Last accessed: 5 May2023].

Davies, B., Richardson, B. and Tomber, R. 1994 *A Dated Corpus of Early Roman Pottery from the City of London*, CBA Research Report **98**, York: Council for British Archaeology.

Davis, S.J. 1996 'Measurements of a group of adult female Shetland sheep skeletons from a single flock: a baseline for zooarchaeologists', *Journal of Archaeological Science* **23**(4), 593-612. https://doi.org/10.1006/jasc.1996.0056

Davis, S. 2001 'The animal bones' in D.F. Mackreth (ed) *Monument 97, Orton Longueville, Cambridgeshire: A Late Pre-Roman Iron Age and Early Roman Farmstead*, East Anglian Archaeology Report **97**. 82.

Davison, A. 1990 *The Evolution of Settlement in Three Parishes in South-East Norfolk*, East Anglian Archaeology Report **49**.

De Cupere, B., Lentacker, A., Van Neer, W., Waelkens, M. and Verslype, L. 2000 'Osteological evidence for the draught exploitation of cattle: first applications of a new methodology', *International Journal of Osteoarchaeology* **10**(4), 254-67. https://doi.org/10.1002/1099-1212(200007/08)10:4%3C254::AID-OA528%3E3.0.CO;2-#

Dobney, K. and Rielly, K. 1988 'A method for recording archaeological animal bones: the use of diagnostic zones', *Circaea* **5**, 79-96.

Dobney, K. and Ervynck, A. 2007 'To fish or not to fish? Evidence for the possible avoidance of fish consumption during the Iron Age around the North Sea' in C. Haselgrove and T. Moore (eds) *The Later Iron Age in Britain and Beyond*, Oxford: Oxbow Books. 403-18. https://doi.org/10.2307/j.ctvh1dsh9.25

Dobney, K., Jaques, D. and Irving, B.G. 1996 *Of Butchers and Breeds: report on vertebrate remains from various sites in the city of Lincoln (Vol. 7)*, Lincoln: City of Lincoln Council.

Done, G. 1993 'Animal bone from Anglo-Saxon contexts' in H. Hamerow (ed) *Excavations at Mucking, Vol. 2: The Anglo-Saxon Settlement*, English Heritage Archaeological Report **21**, London: English Heritage and British Museum Press. 74-79.

Dudd, S.N. and Evershed, R.P. 1998 'Direct demonstration of milk as an element of archaeological economies', *Science* **282**(5393), 1478-81. https://doi.org/10.1126/science.282.5393.1478

Dunbar, E., Cook, G.T., Naysmith, P., Tripney, B.G. and Xu, S. 2016 'AMS 14C dating at the Scottish Universities Environmental Research Centre (SUERC) Radiocarbon Dating Laboratory', *Radiocarbon* **58**, 9-23. https://doi.org/10.1017/RDC.2015.2

Dunne, J., Evershed, R.P., Salque, M., Cramp, L., Bruni, S., Ryan, K., Biagetti, S. and di Lernia S. 2012 'First dairying in green Saharan Africa in the fifth millennium BC', *Nature* **486**(7403), 390-94. https://doi.org/10.1038/nature11186

Elsdon, S.M., Leary, R.S. and Oetgen, J.M. 1997 'The late Iron Age and Romano-British pottery' in S.M. Elsdon *Old Sleaford Revealed. A Lincolnshire settlement in Iron Age, Roman Saxon, and Medieval times: excavations 1882-1995*, Oxbow Monograph **78**, Oxford: Oxbow Books. 103-74

Evershed, R.P. 1993 'Biomolecular archaeology and lipids', *World Archaeology* **25**(1), 74-93. https://doi.org/10.1080/00438243.1993.9980229

Ferris, I. 2001 'Bone and metalworking' in P. Leach with C. Jane Evans *Excavation of a Romano-British Roadside Settlement in Somerset: Fosse Lane, Shepton Mallet 1990*, Britannia Monograph Series **18**, London: English Heritage. 247-49. https://doi.org/10.5284/1090318

Foreman, M. 2009 'Combs' in D.H. Evans and C. Loveluck *Life and Economy at Early Medieval Flixborough, c. AD600-1000: The Artefact Evidence*, Oxford: Oxbow Books. 82-102.

Foster, A. 2018 *Identifying chicken breeds in the archaeological record: a geometric and linear morphometric approach*, PhD thesis, University of Leicester.

Froese, R. and Pauly, D. (eds) 2023 http://www.fishbase.org [Last accessed: 1 May 2023].

Fulford, M.G. 1975 *New Forest Pottery: Manufacture and distribution, with a corpus of pottery types*, British Archaeological Reports, British Series **17**, Oxford: BAR Publishing. https://doi.org/10.30861/9781841710839

Gillam, J.P. 1951 'Dales Ware: a distinctive Romano-British cooking-pot', *Antiquaries Journal* **31**, 154-64. https://doi.org/10.1017/S0003581500076332

Grant, A. 1982 'The use of tooth wear as a guide to the age of domestic ungulates' in B. Wilson, C. Grigson and S. Payne (eds) *Ageing and Sexing Animal Bones from Archaeological Sites*, Oxford: British Archaeological Reports, British Series **109**, Oxford: BAR Publishing. 91-108.

Gregg, M.W., Banning, E.B., Gibbs, K. and Slater G.F. 2009 'Subsistence practices and pottery use in Neolithic Jordan: molecular and isotopic evidence', *Journal of Archaeological Science* **36**(4),937-46. https://doi.org/10.1016/j.jas.2008.09.009

Grimes, W.F. 1930 'Holt: the works depot of the Twentieth Legion at Castle Lyons', *Y Cymmrodor* **LXI**, 1-235.

Grimm, J.M. 2009 'Kentish Sites and Sites of Kent. A miscellany of four archaeological excavations: Animal bone from the route of the Weatherlees-Margate-Broadstairs wastewater pipeline. Wessex Archaeology'. https://www.wessexarch.co.uk/sites/default/files/field_file/4_margate%20animal%20bone%20analysis.pdf

Guido, M. 1978 *The Glass Beads of the Prehistoric and Roman Periods in Britain and Ireland*, Reports of the Research Committee of the Society of Antiquaries of London **35**, London: Society of Antiquaries of London. https://doi.org/10.26530/20.500.12657/50812

Hall, D. and Coles, J. 1994 *Fenland Survey - An Essay in Landscape and Persistence*, Swindon: English Heritage. https://archaeologydataservice.ac.uk/archives/view/eh_monographs_2014/contents.cfm?mono=1089028

Hamerow, H., Bogaard, A., Charles, M., Forster, E., Holmes, M., McKerracher, M., Neil, S., Bronk-Ramsey, C., Stroud, E. and Thomas, R. 2020 'An integrated bioarchaeological approach to the medieval 'agricultural revolution': A case study from Stafford, England, c. AD 800-120', *European Journal of Archaeology* **23**(4),585-609. https://doi.org/10.1017/eaa.2020.6

Hamilton, D. and Kenney, J. 2015 'Multiple Bayesian modelling approaches to a suite of radiocarbon dates from ovens excavated at Ysgol yrHendre, Caernarfon, North Wales', *Quaternary Geochronology* **25**, 72-82. https://doi.org/10.1016/j.quageo.2014.10.001

Hanot, P. and Bochaton, C. 2018 'New osteological criteria for the identification of domestic horses, donkeys and their hybrids in archaeological contexts', *Journal of Archaeological Science* **94**, 12-20. https://doi.org/10.1016/j.jas.2018.03.012

Harris, S. and Yalden, D.W.Y. (eds) 2008 *Mammals of the British Isles: Handbook*, Southampton: Mammal Society.

Headland Archaeology 2017a 'Viking Link Proposed Converter Station Sites, Lincolnshire Geophysical Survey Report No VLCS/01'.

Headland Archaeology 2017b 'Viking Link Proposed Converter Station, North Ing Drove, South Holland. Trial Trench Evaluation Report No VLCS/02'.

Headland Archaeology forthcoming *Viking Link UK Onshore Scheme: Trial Trenching, Excavation*, York: Archaeology Data Service [DOI pending].

Healey, H. 1999 'An Iron Age salt-making site at Helpringham Fen, Lincolnshire: excavations by the Car Dyke Research Group, 1972-7' in A. Bell, D. Gurney and H. Healey *Lincolnshire Salterns: Excavations at Helpringham, HoIbeach St Johns and Bicker Haven*, Heckington: Heritage Trust of Lincolnshire. 1-19.

Higham, N. and Ryan, M. 2013 *The Anglo-Saxon World*, New Haven and London: Yale Universiry Press.

Hillman, G. 1981 'Reconstructing crop husbandry practices from charred remains of crops' in Mercer, R. (ed) *Farming Practice in British Prehistory*, Edinburgh: Edinburgh University Press. 123-162.

Hylton, T. 1995 'Objects of worked bone and antler' in R. Williams, P. Hart and A. Williams *Wavendon Gate: A Late Iron Age and Roman Settlement in Milton Keynes*, Buckinghamshire Archaeological Society Monograph **10**. 128-36.

Ian Farmer Associates Ltd 2020 'Viking Link Converter Station Access Road. Factual Report on Ground Investigations. Report Reference: 42368 (00)'.

Johnstone, C. 2010 'Donkeys and mules' in T. O'Connor and N. Sykes (eds) *Extinctions and Invasions: a social history of British fauna*, Oxbow Books/Windgather Press. 17-25. https://doi.org/10.2307/j.ctv13gvg6k.9

Johnstone, C.J. 2004 *A Biometric Study of Equids in the Roman World*, PhD thesis, University of York.

Jones, M. 2002 *Roman Lincoln: Conquest, Colony and Capital*, Stroud: History Press.

Keys, L. 2012 'Specialist Report 6: slag and high temperature debris' in E. Biddulph, E. Stafford, S. Foreman, D. Stansbie and S. Nicholson (eds) *London Gateway: Iron Age and Roman Salt Making in the Thames Estuary, Excavation at Stanford Wharf Nature Reserve, Essex*, Oxford Archaeology Monograph **18**. https://knowledge.oxfordarchaeology.com/909

King, J.M. 1987 'The animal bones' in G.B. Dannell and J.P. Wild (eds) *Longthorpe II. The Military Works-Depot: An Episode in Landscape History*, Britannia Monograph Series **8**, London: Society for the Promotion of Roman Studies. 184-94. https://doi.org/10.5284/1090327

King, J. 1996 'The animal bones' in D.F. Mackreth (ed) *Orton Hall Farm: A Roman and Early Anglo Saxon Farmstead*, East Anglian Archaeology Report **76**. 216-18.

Lane, T. and Morris, E.L. (eds) 2001 *A Millennium of Saltmaking: prehistoric and Romano-British salt production in the Fenland*, Sleaford: Heritage Trust of Lincolnshire. https://archive.org/details/millenniumofsalt0000unse/page/n1/mode/1up

Lawrence, M.J. and Brown, R.W. 1973 *Mammals of Britain: their tracks, trails and signs*, London: Blandford Press.

Lawson, A. 1983 *The Archaeology of Witton, near North Walsham, Norfolk*, East Anglian Archaeology Report **18**.

Leary, R.S. 2008 'Romano-British pottery assessment' in M. Dailey 'Archaeological Evaluation Report: Trial Trenching of Land Adjacent to Sutterton Enterprise Park, Station Road, Sutterton, Lincolnshire', Allen Archaeology Ltd. Report Number 2008/010 https://doi.org/10.5284/1023716.

Leary, R.S. 1994 *Excavations at the Romano-British settlement at Pasture Lodge Farm, Long Bennington, Lincs, 1975-1977 by H.M. Wheeler*, Lincolnshire History and Archaeology Occasional Paper **10**, Society for Lincolnshire History and Archaeology.

Lee, F., Lindquist, G. and Evans, J. 1994 'Romano-British coarse pottery' in C. Cracknell and S. Mahaney (eds) *Roman Alcester: south extramural area, 1964-1966 excavations, Part 2: Finds and discussion*, Council for British Archaeology Research Report **97**. 3-92. https://doi.org/10.5284/1081686

Locker, A. 2007 'In piscibus diversis; the bone evidence for fish consumption in Roman Britain', *Britannia* **38**, 141-80. https://doi.org/10.3815/000000007784016520

Locker, A. 2012 'The fish assemblage' in P. Cope-Faulkner *Clampgate Road, Fishtoft. Archaeology of a Middle Saxon Island Settlement in the Lincolnshire Fens*, Lincolnshire Archaeology and Heritage Report Series **10**. 98-102.

Lodwick, L. and Brindle, T. 2017 'Arable Farming, Plant Foods and Resources' in T. Brindle, M.J. Allen, M. Fulford and L. Lodwick (eds) *The Rural Economy of Roman Britain*, Britannia Monograph Series **30**, Society for the Promotion of Roman Studies. 11-84. https://doi.org/10.5284/1090307

MacGregor, A. 1985 *Bone, Antler, Ivory and Horn: The Technology of Skeletal Materials Since the Roman Period*, London: Routledge.

Maltby, M. 2007 'Chop and change: specialist cattle carcass processing in Roman Britain', in B. Croxford, N. Ray, R. Roth and N. White (eds) *TRAC 2006: Proceedings of the 16th Annual Theoretical Roman Archaeology Conference, Cambridge 2006*. 59-76. https://doi.org/10.16995/TRAC2006_59_76

Mann, J. 2003 'Appendix 8: The bulk and registered finds' in Network Archaeology Ltd 'Hatton to Silk Willoughby Gas Pipeline. Archaeological Evaluation, Excavation and Watching Brief 2001'. https://doi.org/10.5284/1015093

Margary, I.D. 1967 *Roman Roads in Britain*, London: Phoenix House Ltd. https://archive.org/details/in.gov.ignca.6845/page/7/mode/1up

Matolcsi, J. 1970 'Historische Eforschung der Korpergrosse des Rindes auf Grund von ungarischem Knochematerial', *Zeitschrift für Tierzüchtung und Züchtungsbiologie* **87**, 89-137. https://doi.org/10.1111/j.1439-0388.1970.tb01330.x

McKerracher, M. 2015 'Bread and surpluses: the Anglo-Saxon 'bread wheat thesis' reconsidered', *Environmental Archaeology* **21**(1), 88-102. https://doi.org/10.1179/1749631414Y.0000000054

Meadow, R.H. 1999 'The use of size-index scaling techniques for research on archaeozoological collections from the Middle East' in C. Becker, H. Manhart, J. Peters and J. Schiblereds (eds) *Historiae Animalium ex Ossibus: Beiträge zur Paläoanatomie, Archäologie, Ägyptologie, Ethnologie und Geschichte der Tiermedizin*, Rahden: Marie Leidorf Verlag. 285-300.

Miles, A.E.W. and Grigson, C. 1990 *Colyer's Variations and Diseases of the Teeth of Animals*, Cambridge: Cambridge University Press. https://doi.org/10.1017/CBO9780511565298

Moffett, L. 2011 'Food plants on archaeological sites' in H. Hamerow, D. Hinton and S. Crawford (eds) *The Oxford Handbook of Anglo-Saxon Archaeology*, OUP Oxford, 346-360. https://doi.org/10.1093/oxfordhb/9780199212149.013.0019

Murphy, P. 1994 'The Anglo-Saxon landscape and rural economy: some results from sites in East Anglia and Essex' in J. Rackham (ed) *Environment and Economy in Anglo-Saxon England*, CBA Research Report **89**, York: Council for British Archaeology. 25-37. https://doi.org/10.5284/1081811

Myres, J. 1977 *A Corpus of Anglo-Saxon Pottery of the Pagan Period*, Cambridge: Cambridge University Press.

O'Connor, T. 1988 *Bones from the General Accident Site, Tanner Row*, Archaeology of York, The Animal Bones **15**(2), York: Council for British Archaeology for York Archaeological Trust.

O'Connor, T.P. 2003 *The Analysis of Urban Animal Bone Assemblages*, Archaeology of York **19**(2). York: Council for British Archaeology for York Archaeological Trust.

Outram, A.K., Stear, N.A., Bendrey, R., Olsen, S., Kasparov, A., Zaibert, V., Thorpe, N. and Evershed, R.P. 2009 'The earliest horse harnessing and milking, *Science* **323**(5919), 1332-35. https://doi.org/10.1126/science.1168594

Perrin, J.R. 1999 *Roman Pottery from Excavations at and near to the Roman small town of Durobrivae, Water Newton, Cambridgeshire, 1956-58*, Journal of Roman Pottery Studies **8**, Oxford: Oxbow Books.

Payne, S. 2007 'New insights into climate history', *British Archaeology* **92**, 54.

Precious, B. 1996 'Report on the Roman pottery from SSR95E, SSR95 and SSR96' in N. Herbert 'Archaeological Watching Brief at Land south of the cemetery Station Road, Sutterton, Lincolnshire', Archaeological Project Services. https://doi.org/10.5284/1013518

Price, J. and Cottam, S. 1998 *Romano-British Glass Vessels: A Handbook*, CBA Practical Handbook in Archaeology **14**, York: Council for British Archaeology.

Prummel, W. and Frisch, H.J. 1986 'A guide for the distinction of species, sex and body side in bones of sheep and goat', *Journal of Archaeological Science* **13**(6), 567-77. https://doi.org/10.1016/0305-4403(86)90041-5

Rackham, J. 2003 'Animal bones' in G. Taylor, with C. Allen, J. Bayley, J. Cowgill, V. Fryer, C. Palmer, B. Precious, J. Rackham, T. Roper and J. Young 'An Early to Middle Saxon settlement at Quarrington, Lincolnshire', *Antiquaries Journal* **83**, 258-73. https://doi.org/10.1017/S0003581500077702

Ratnikov, V.R. 2001 'Osteology of Russian toads and frogs for paleontological researches', *Acta Zoologica Cracovensia* **44**(1), 1-23.

Reimer, P.J., Austin, W.E.N., Bard, E., Bayliss, A., Blackwell, P.G., Ramsey, C.B., Butzin, M., Cheng, H., Edwards, R.L., Friedrich, M., Grootes, P.M., Guilderson, T.P., Hajdas, I., Heaton, T.J., Hogg, A.G., Hughen, K.A., Kromer, B., Manning, S.W., Muscheler, R., Palmer, J.G., Pearson, C., Plicht, J.v.d., Reimer, R.W., Richards, D.A., Scott, E.M., Southon, J.R., Turney, C.S.M., Wacker, L., Adolphi, F., Büntgen, U., Capano, M., Fahrni, S.M., Fogtmann-Schulz, A., Friedrich, R., Köhler, P., Kudsk, S., Miyake, F., Olsen, J., Reinig, F., Sakamoto, M., Sookdeo, A. and Talamo, S. 2020 'The IntCal20 Northern Hemisphere Radiocarbon Age Calibration Curve (0-55 calkBP)', *Radiocarbon* **62**, 725-57. https://doi.org/10.1017/RDC.2020.41

Reynolds, R.V. 2009 *Surf 'n' Turf: The Components and Influences of a Middle Anglo-Saxon Diet from Lyminge, Kent*, MSc Dissertation, University of Nottingham.

Reynolds, R.V. 2015 *Food for the Soul: The Dynamics of Fishing and Fish Consumption in Anglo-Saxon England, c.AD 410-1066*, PhD thesis, University of Nottingham.

Rogers, N.S.H. 1993 *Anglian and Other Finds from 46-54 Fishergate*, Archaeology of York **17**(9), York: Council for British Archaeology for York Archaeological Trust.

Rogerson, A., Davison, A., Pritchard, D. and Silvester, R. 1997 *Barton Bendish and Caldecote: Fieldwork in South-West Norfolk*, East Anglian Archaeology Report **80**.

Rowlandson, I.M. 2020 'The Iron Age and Roman pottery' in Headland Archaeology (UK) Ltd 'Volume 2: Environmental and artefact assessment , Triton Knoll Electrical System: Lot 1 and Lot 2 (SMR 14, 15 and 16) Mitigation'.

Rowlandson, I.M. 2011 'The Roman pottery' in N. Field and M. McDaid 'Biomass Generating Station, Hobson Way, Stallingborough, North-East Lincolnshire Archaeological Excavation. Naomi Field Archaeological Consultancy'.

Salter, C. 2005 'Specialist report: the slag-like material' in G. Lock, C. Gosden and P. Daly (eds) *Segsbury Camp: excavations in 1996 and 1997 at an Iron Age hillfort on the Oxfordshire Ridgeway*, Oxford University School of Archaeology Monographs **61**. https://www.arch.ox.ac.uk/segsbury-camp

Schmid, E. 1972 *Atlas of Animal Bones for Prehistorians, Archaeologists and Quaternary Geologists*, Amsterdam: Elsevier.

Schrüfer-Kolb, I. 2004 *Roman Iron Production in Britain. Technological and Socio-Economic Landscape Development along the Jurassic ridge*, British Archaeological Reports **380**, Oxford: BAR Publishing. https://doi.org/10.30861/9781841716695

Silver, I.A. 1969 'The ageing of domestic animals' in D. Brothwell and E.S. Higgs (eds) *Science in Archaeology*, London: Thames and Hudson. 250-68.

Silvester, R.J. 1991 *The Fenland Project Number 4: The Wissey Embayment and the Fen Causeway*, East Anglian Archaeology Report **52**.

Smith, A. 2016 'The East' in A. Smith, M. Allen, T. Brindle and M. Fulford (eds) *New Visions of the Countryside of Roman Britain, Volume 1: The Rural Settlement of Roman Britain*, Britannia Monograph Series **29**. 208-41.

Smith, A., Allen, M., Brindle, T. and Fulford, M. (eds) 2016 *New Visions of the Countryside of Roman Britain, Volume 1: The Rural Settlement of Roman Britain*, Britannia Monograph Series **29**.

Smith, D., Zalasiewicz, J., Williams, M., Wilkinson, I., Redding, M. and Begg, C. 2010 'Holocene drainage systems of the English Fenland: roddons and their environmental significance', *Proceedings of the Geologists Association* **121**(3), 256-69. https://doi.org/10.1016/j.pgeola.2010.06.002

Spangenberg, J.E., Jacomet, S. and Schibler, J. 2006 'Chemical analyses of organic residues in archaeological pottery from Arbon Bleiche 3, Switzerland - evidence for dairying in the late Neolithic', *Journal of Archaeological Science* **33**(1), 1-13. https://doi.org/10.1016/j.jas.2005.05.013

Spoerry, P. 2016 *The Production and Distribution of Medieval Pottery in Cambridgeshire*, East Anglian Archaeology Report **159**.

Stallibrass, S. 1996 'Animal bones' in R.P.J. Jackson and T.W. Potter (eds) *Excavations at Stonea, Cambridgeshire 1980-5*, London: British Museum Press. 587-612 and pl. XXXI.

Stevens, C. J. 2003 'An Investigation of Agricultural Consumption and Production Models for Prehistoric and Roman Britain', *Environmental Archaeology* **8**(1), 61-76. https://doi.org/10.1179/env.2003.8.1.61

Stuiver, M. and Polach, H.A. 1977 'Reporting of 14C data', *Radiocarbon* **19**, 355-63. https://doi.org/10.1017/S0033822200003672

Svensson, L., Mullarney, K. and Zetterström, D. 2009 *Collins Bird Guide*, 2nd edition, London: Harper Collins.

Symonds, R.P. and Wade, S. 1999 *Roman pottery from Excavations in Colchester, 1971-86*, Colchester Archaeological Report **10**, Colchester: Colchester Archaeological Trust.

Taylor, G., Allen, C., Bayley, J., Cowgill, J., Fryer, V., Palmer, C., Precious, B., Rackham, J., Roper, T. and Young, J. 2003 'An Early to Middle Saxon Settlement at Quarrington, Lincolnshire', *Antiquaries Journal* **83**, 231-80. https://doi.org/10.1017/S0003581500077702

Thomas, R., Bellis, L., Gordon, R., Holmes, M., Johannsen, N.N., Mahoney, M. and Smith, D. 2021 'Refining the methods for identifying draught cattle in the archaeological record: lessons from the semi-feral herd at Chillingham Park', *International Journal of Paleopathology* **33**, 84-93. https://doi.org/10.1016/j.ijpp.2021.02.003

Thompson, F.H. 1958 'A Romano-British pottery kiln at North Hykeham, Lincolnshire: with an appendix on the typology, dating and distribution of 'Rustic' ware in Great Britain', *Antiquaries Journal* **38**(1-2), 15-51. https://doi.org/10.1017/S0003581500082457

Treasure, E.R. and Church, M.J. 2017 'Can't find a pulse? Celtic bean (Vicia faba L.) in British prehistory', *Environmental Archaeology*, **22**(2), 113-127. https://doi.org/10.1080/14614103.2016.1153769

Trent and Peak Archaeology 2017 'Viking Link: Boygrift to North Ing Drove, Lincolnshire, Onshore Cable Route: Air-Photographic and Lidar Assessment Report No 019/2017'.

Upex, S. 2002 'Landscape continuity and fossilisation of Roman fields', *Archaeological Journal* **159**, 77-108. https://doi.org/10.1080/00665983.2002.11020516

Van der Veen, M. and Jones, G. 2006 'A re-analysis of agricultural production and consumption: Implications for understanding the British Iron Age', *Vegetation History and Archaeobotany* **15**, 217-228. https://doi.org/10.1007/s00334-006-0040-3

Van der Veen, M., Hill, A. and Livarda, A. 2013 'The Archaeobotany of Medieval Britain (c.AD 450-1500): Identifying Research Priorities for the 21st Century', *Medieval Archaeology* **57**, 151-182. https://doi.org/10.1179/0076609713Z.00000000018n/a

Von den Driesch, A. 1976 *A Guide to the Measurement of Animal Bones from Archaeological Sites*, Peabody Museum Bulletin 1, Cambridge Mass: Harvard University.

Von den Driesch, A. and Boessneck, J. 1974 'Kritische Anmerkungen zur Widerristhöhenberechnung aus Längenmassen vor- und frühgeschichtlicher Tierknochen', *Säugetierkundliche Mitteilungen* **22**(4), 325-48.

Ward, G.K. and Wilson, S.R. 1978 'Procedures for comparing and combining radiocarbon age determinations: a critique', *Archaeometry* **20**, 19-32. https://doi.org/10.1111/j.1475-4754.1978.tb00208.x

Webster, G. 1960 'A Romano-British pottery kiln at rookery Lane, Lincoln', *Antiquaries Journal* **40**, 214-40. https://doi.org/10.1017/S0003581500061977

Webster, G. and Booth, N. 1947 'A Romano-British pottery kiln at Swanpool, near Lincoln', *Antiquaries Journal* **27**, 61-79. https://doi.org/10.1017/S0003581500017583

Webster, G. and Chadderton, J. (eds) 2002 *The Legionary Fortress at Wroxeter: Excavations by Graham Webster 1955-85*, English Heritage Archaeological Report **19**, London.

Webster, P. 1996 *Roman Samian Pottery in Britain*, CBA Practical Handbook in Archaeology **13**, York: Council for British Archaeology.

Whitwell, J. 1970 *Roman Lincolnshire. Lincoln: History of Lincolnshire Vol. 2*, Lincoln: History of Lincolnshire Committee.

Wilson, J. 1975 'The animal remains' in R. Jones 'The Romano-British Farmstead and its Cemetery at Lynch Farm, near Peterborough', *Northamptonshire Archaeology* **10**, 125-8. https://doi.org/10.5284/1083029

Young, C.J. 1977 *The Roman Pottery Industry of the Oxford Region*, Oxford: British Archaeological Report (British Series) **43**, Oxford: BAR Publishing.

Young, J. 2003 'The Early Saxon Pottery' in G. Taylor, C. Allen, J. Bayley, J. Cowgill, V. Fryer, C. Palmer, B. Precious, J. Rackham, T. Roper and J. Young 2003 'An Early to Middle Saxon Settlement at Quarrington, Lincolnshire', *Antiquaries Journal* **83**, 243. https://doi.org/10.1017/S0003581500077702

Zeder, M.A. and Lapham, H.A. 2010 'Assessing the reliability of criteria used to identify postcranial bones in sheep, Ovis, and goats, Capra', *Journal of Archaeological Science* **37**(11), 2887-290. https://doi.org/10.1016/j.jas.2010.06.032