Late Saxon to Early Medieval Salterns on Land North of Greenpark Avenue, King's Lynn, Norfolk. Post-Excavation Assessment and Updated Project Design

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Late Saxon to Early Medieval Salterns on Land North of Greenpark Avenue, Kings Lynn, Norfolk

Post-Excavation Assessment and Updated Project Design

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Summary

Oxford Archaeology East (OA East) carried out an archaeological excavation between 4th February and 5th March 2019 at Land north of Greenpark Avenue, King's Lynn, Norfolk. This work was commissioned by NPS Property Consultants Ltd. The site comprised 3.8ha of undeveloped land, within the urban reach of King's Lynn, proposed for redevelopment as a primary school and associated grounds.

These works lie in a significant area of industrial archaeological remains relating to salt-making, during the later Anglo-Saxon and medieval periods. This industrial landscape is currently being investigated by OA as part of a wider scope of works for the adjacent Lynnsport residential development by Lovell Partnerships Ltd.

An initial phase of evaluation by OA East in February 2018, which incorporated a topographical survey of the site, uncovered mounds associated with salt-making at six locations: Salterns 1, 4-8. Two of these salterns (Salterns 5 and 8) were mapped on the NHER (NHER 27909 and 27907 respectively). A further two (Salterns 1 and 4) extended beyond the southern boundary of the site where they were previously excavated by OA East in 2017 as part of the Lynnsport 4 and 5 developments (Clarke 2017b). As well as revealing waste deposits from the salt-making process constituting the mounds, the evaluation also revealed the remains of broken-up brine boiling hearths and *in-situ* remains of clay-lined tanks.

The current excavation investigated Salterns 4-6 which were located in areas that were to be impacted upon at depth by the proposed development. Significantly, within the lower sequence of deposits excavated in Saltern 5, a burnt layer of material produced fragments of both salt slag cakes and fired clay brick supports for lead pans; diagnostic artefacts associated with brine boiling hearths. Equally significantly, a large number of salt-making features were uncovered within the upper part of Saltern 5, which included an *in-situ* brine boiling hearth and surviving elements of filtration units for concentrated brine production. Near to the hearth lay a spread of burnt material which overlay a rake-out pit, evidently excavated to store the hearth's waste. Two heavily truncated clay-lined pits were also revealed in Saltern 4. These features and their waste products provided three radiocarbon dates, an archaeomagnetic date and four sherds of pottery to provide a dating framework which suggests salt-making was carried out on this site between the 10th and 12th centuries.

The excavation of Saltern 5 also uncovered parts of the circuits of two heavily truncated curvilinear gullies that probably represent drainage channels for hayricks (Riley circles) dating from the early modern period.

Acknowledgements

OA East would like to thank NPS Property Consultants Ltd for commissioning this project. OA East is grateful to James Albone (Planning Archaeologist) who monitored the work on behalf of Norfolk County Council and provided advice and guidance.

The project was managed for OA East by Matthew Brudenell. The fieldwork was directed by Toby Knight with the assistance of Kathryn Blackbourn, Lindsey Kemp, Brian Antoni, Anne Templeton, Paul Simkins, Frankie Wildmun, William Kelly and Rory Coduri. Survey was carried out by Katie Hutton and the illustrations were produced by Séverine Bézie and Thomas Houghton. Thanks are extended to the teams of OA staff that cleaned and packaged the finds under the management of Natasha Dodwell, processed the environmental remains under the supervision of Rachel Fosberry, and prepared the archive under the direction of Katherine Hamilton. Thanks are also extended to the various specialists for their contributions.

1 INTRODUCTION

1.1 Background

1.1.1 Between the 4th February and 5th March 2019, Oxford Archaeology East (OA East) conducted the second phase of archaeological investigation on Land north of Greenpark Avenue, King's Lynn, Norfolk (TF 6278 2124; Fig. 1). This work was commissioned by NPS Property Consultants Ltd and forms part of the wider scheme of redevelopment in this area (Lynnsport etc). The site comprises 3.8ha of undeveloped land, in the northeastern part of King's Lynn, proposed for redevelopment as a primary school and associated grounds (Planning Application: Y/2/2018/2002).

1.1.2 An archaeological evaluation was carried out in February 2018, prior to the excavation, in order to establish the presence/absence of archaeological features and deposits (Clarke 2018c). The evaluation, which included a topographical survey of the site, identified six mounds of deposits associated with salt-making on the site (Salterns 1, 4-8; Fig. 3a), including two previously recorded by the Norfolk Historic Environment Record (NHER 27907 and 27909; Fig. 2). These remains are typical of the known later Saxon and medieval salt-making evidence previously excavated by OA East on the adjacent Lynnsport residential development (Clarke 2017a-b).

1.1.3 A Written Scheme of Investigation (WSI) was prepared by OA East (and approved by Norfolk County Council Historic Environment Service (NCC/HES)) detailing the further programme of four excavation areas required on the site; each designed to mitigate the impact of the proposed development on Salterns 4-6 in the eastern part of the site (Clarke 2018d). Together, these four separate areas (Areas J, K, L and M) totalled an area of *c*.0.38ha.

1.1.4 This assessment has been conducted in accordance with the principles identified in Historic England's guidance documents *Management of Research Projects in the Historic Environment*, specifically *The MoRPHE Project Manager's Guide (2006) and PPN3 Archaeological Excavation* (2008).

1.2 Geology and topography

1.2.1 The site is located on former marshland, *c*. 1.5km east of the River Great Ouse. The site covers 3.8ha on a flat area of ground at a height of approximately 4-5m OD. The site is bounded by land adjacent to Greenpark Road (formerly Salter's Way) to the south (currently under redevelopment for housing), allotment gardens to the north, recreation fields to the east, and residential development along Columbia Way to the west. The central part of the site comprises a children's playpark, with the periphery of the site, until recently, covered by scrub and copses of woodland that have since been cleared.

1.2.2 The underlying geology of the site comprises Jurassic Kimmeridge Clay Formation mudstone overlain by layers of clay and silt, which were deposited by tidal action during the Quaternary period. British Geological Survey borehole data from the site (TF 62900 20900 and TF 63060 20890) revealed a typical Flandrian sequence of deposits, with an amorphous peat horizon (1.60/1.88m-3.10/3.35m below the ground surface) overlain by saltmarsh deposits of brown fine-grained silts and sands of the Terrington Beds. An archaeological evaluation carried out by OA East to the north of the site at Marsh Lane (Webster 2015; Fig. 2, MNF42716), uncovered peat which was radiocarbon dated to 790-540 cal BC (2499 BP ±29 at 95.4% probability; SUERC-61520). The archaeological evaluation of the site carried out by OA East in February 2018 revealed natural saltmarsh deposits at a height of between 1.19-1.71m OD (Clarke 2018c).

1.2.3 Previous archaeological excavation work by OA East as part of the adjacent Lynnsport and Marsh Lane projects has demonstrated that the upper horizon of the natural saltmarsh deposits upon which the Gaywood salterns were placed lay at slightly differing heights across this landscape: Marsh Lane – 1.5-2m OD (Clarke 2016); Lynnsport 4 and 5 – 2m OD (Clarke 2017b); Lynnsport 3 – 1.57-1.75m OD (Clarke 2018b); Lynnsport 1 – 1.91-2.29m OD (Clarke 2018a).

1.3 Archaeological background

1.3.1 The site has been subject to an Archaeological Desk-based Assessment (DBA) by NPS Archaeology in 2016 (Copsey and Hobbs 2016). The following sections summarise the findings from the DBA report, data obtained from the NHER, along with the results of the previous phases of archaeological investigation at the site and those of recent archaeological investigations immediately south of the site (Clarke 2017a-b; OA East Reports 2059 and 2078; ENF 139746 and ENF141949). Pertinent records are shown on Figure 2.

1.3.2 Although the surrounding landscape provides evidence of prehistoric and Roman activity in the vicinity of the site (with stray finds of a Roman coin, c.350m to the northeast (NHER 11990), and a Late Neolithic/Early Bronze Age arrowhead c.380m to the southwest (NHER 5494)), much of this area was unsuitable for occupation during the later prehistoric and Romano-British periods, with any earlier traces of activity sealed beneath thick marine and freshwater Flandrian deposits (the arrowhead was recovered from a drain cutting these deposits). Whilst not discounting the importance of these deposits, and the potential buried prehistoric land surfaces/shore-lines they protect, the immediate archaeological significance of the area falls largely within the Anglo-Saxon, medieval and post-medieval periods when the area was a saltmarsh environment.

1.3.3 Of particular significance are the traces of a former salt-making industry that flourished between the Anglo-Saxon and post-medieval periods around the Wash coastline. The remains of this industry are primarily revealed in the form of saltern mounds, some of which still survive as earthworks, or are visible as pale oval or floriform soilmarks. The mounds, which can be up to 200m across, were formed by the piling up of waste sand from salt filtration in the 'sand washing' or ‘sleeching’ process of salt extraction.

1.3.4 An extensive swathe of saltern mounds is recorded around North Lynn, first identified by the National Mapping Programme (NMP) survey (Albone *et al.* 2007, 116). These not only reflect the importance of the salt industry, but the location and progressive land reclamation along the Anglo-Saxon and medieval coast line. Until recently, most of the saltern mounds were thought to be medieval or later in origin, particularly the western examples towards the current line of the Great Ouse. However, radiocarbon dates recovered from recent excavations immediately south of the site have revealed that some of the mounds in this area have a Middle Saxon origin, pushing the date of the salt industry in this landscape back by several hundred years (Clarke 2017a-b; Fig. 2, ENF139746 and ENF141949). Mid to Late Saxon radiocarbon dates were also achieved for a saltern excavated at Marsh Lane, c. 650m to the northeast (Fig. 2, NHER 27899; Clarke and Clarke forthcoming; Clarke 2016), demonstrating that this was not a one-off, but evidence of a developed Anglo-Saxon saltworking landscape.

1.3.5 Clay-lined pits, filtration units and brine boiling hearths of various forms were found at both these sites, with differences in the size and shape of these features possibly indicating changes in the manner and scale of production over time.

1.3.6 A sense of the extent of this industry is revealed by the fact that most records in the NHER recorded within a 500m radius of the site, relate to saltern mounds or salt-making activity (e.g. NHER 5524, 27886, 27893-6, 27899-902, 27906-912 and 38265). Saltern mounds are recorded on all sides of the site, and most significantly, three have been identified on the site itself from aerial photographs (NHER 27907; 27909 x 2) and a further two are suspected to encroach on the southern end of the site, based on the results of recent investigations immediately adjacent (Clarke 2017a-b; Fig. 2, ENF139746 and ENF141949).

1.3.7 All of the mounds recorded from 1946 RAF vertical aerial photographs partially lie within the site, around the north-west (NHER 27907), north-east and eastern edges of the proposed development area (NHER 27909). The mounds are recorded as being between 65-88m in diameter and lie between the drainage ditches which bisect the site - the curves in the ditches appearing to skirt them. Mounds revealed in recent excavations to the south survived to over 1m in thickness.

1.3.8 The salt-making industry declined during the post-medieval period, however, several of the saltern mounds were put to other uses during this time, some being incorporated into the King's Lynn siege defences during the Civil War (e.g. NHER 13785).

1.3.9 The subsequent drainage of the Fens during the 17th century exposed a large area of land in the environs of the site and made it available for cultivation and extended permanent grazing pastures. Remnant ridge and furrow or 'lazybedding' agricultural features are recorded *c*.200m to the south-east site (Fig. 2, NHER 27890), with further examples further south (Fig. 2, NHER 27865). Earthworks of possible medieval banks, ditches and drains in the area also attest to the process of land reclamation which made the area habitable (Fig. 2, e.g. NHER 13785 and 27891). Aerial photographs and LIDAR (Light Detection and Ranging) images of the sites itself show a series of at least five east-west aligned linear earthwork features, presumed to be post-medieval or earlier drainage ditches. These are still visible on the site today. Excavation immediately south of the site also revealed two circular gullies representing drainage channels for hayricks/ Riley circles (Clarke 2017a-b; Fig. 2, ENF139746 and ENF141949).

1.3.10 Faden's map of 1797 (not illustrated) shows the site located on the Gaywood Marsh north of Salter's Way. Drainage ditches crossing the site are subsequently shown on the 1820 Inclosure map and 1916 Tithe Map (not illustrated). These are also depicted on the OS first edition series maps from 1884 (not illustrated) and are still visible today at the site.

1.4 Previous work

1.4.1 The topographical survey of the site conducted by OA East in February 2018 (Fig. 3a), combined with NHER data, indicated that the remains of six saltern mounds - resulting from salt-making activities (including NHER 27907 and 27909) - partially or wholly lie within the bounds of the proposed development. The evaluation in February 2018 confirmed the presence of the salterns (Clarke 2018c). Two of these (Salterns 1 and 4) extended beyond the southern boundary of the site where they were previously excavated by OA East in 2017 as part of the Lynnsport 4 and 5 developments. The remains of a further saltern (Saltern 7) were located wholly within the development. However, the remaining salterns (Salterns 5, 6 and 8) lay on the periphery of the site, where they extended beyond the proposed development area into neighbouring plots of land. As well as revealing waste deposits from the salt-making process constituting the mounds, the evaluation also revealed the remains of broken-up brine boiling hearths and *in-situ* remains of clay-lined tanks. With a direct bearing on the current excavations, the northeastern end of Trench 27 (Saltern 6) contained concentrations of burnt material along with fragments of hearth lining, indicative of broken-up brine boiling hearths. These remains are typical of the known later Saxon and medieval salt-making evidence previously excavated in the area by OA East.

1.4.2 The evaluation also revealed a network of ditches across the lower-lying areas of the site, probably representing drainage channels of either later medieval or post-medieval origin when the site would have comprised part of a landscape predominantly utilised for pasture. The later date for these drainage features was reinforced with the recovery from the fills of artefacts spanning both these periods. However, the possibility remains that the larger extant (unexcavated) channel observed to extend broadly north to south across the site (skirting Salterns 5 and 7) may delineate the path of a historical creek.

1.4.3 There was evidence for recent truncation of the deposits comprising Saltern 1 in the southern part of the site, with associated dumps of saltern mound material found to overly the topsoil intermittently across the southern part of the site.

1.5 Original research aims and objectives

Introduction – the emerging historical salt-making landscape of Gaywood, King's Lynn, Norfolk

1.5.1 Whilst the general aim of the investigation is to preserve by record the archaeological evidence contained within the footprint of the mitigatory area, this project will take place within a wider context of research into the salt-making industry of Gaywood, King's Lynn, which is being undertaken by OA East through a series of investigations in the vicinity of the site (Lynnsport 1-5; ENF141949 (4 & 5), ENF145065 (3), ENF145343 (1)).

1.5.2 The overarching objectives are:

i. To establish the date of the industry. Both the overall date range of the salt-making industry at Lynn and the date that it was functioning at specific locations; and
ii. To obtain a better understanding of the salt-making process and identify any methodological or technological changes over time.

Site specific research aims

1.5.3 The specific goals of this wider investigation have been set out in the document 'Lynnsport 1-5: The emerging historical salt-making landscape of Gaywood, King's Lynn, Norfolk. Overarching Written Scheme of Investigation' (Brudenell and Clarke 2017). These goals are directly relevant to the current investigation at this site and will contribute to addressing the wider research themes/questions outlined below.

Saltern mounds and mound formation

1.5.4 What period did the mounds develop over? Can we retrieve sufficient material to date mound sequences and bracket their chronology?

1.5.5 Were there periods of hiatus in mound formation, and can this be identified from soil stabilisation horizons?

1.5.6 Is there any evidence to support the hypothesis that mounds further east (landward) are earlier than those to the west (seaward)? In particular, are there further Mid-Late Saxon dates on eastern/landward salterns?

1.5.7 What evidence is there for the secondary use of the salt mounds and surrounding marsh after the salt industry declined?

Saltern fixtures and fittings

1.5.8 What structures were associated with the salterns (salt-cotes) and what activities were conducted in them?

1.5.9 What are the forms of the brine boiling hearths and how did hearth technology change over time? Were different hearth forms linked to the production of different grades of salt? Can such variation be measured from the chemical composition of the salt slags?

1.5.10 Is there patterning in the layout of tanks and filtration units? Is there any evidence that they changed in form and size over time?

1.5.11 What clay was used for lining the filtration units and constructing the hearths? What fuel was being burnt in the hearths? What were the sources?

1.5.12 Is there any evidence that channels and creeks were being modified or lagoons created to improve the efficiency of the salt-making process?

Salt makers and social context

1.5.13 Can we gauge anything about the scale and duration of episodes of salt-making from the refuse left behind by the salt makers (pottery, animal bone etc.)? Is there any associated settlement activity?

1.5.14 Is there any evidence to support the hypothesis that salt-making was only a seasonal activity?

1.5.15 What other activities were taking place on the salt mound? Evidence for iron smithing was found at Marsh Lane, but how widespread was this?

1.5.16 Can historical sources help us to better understand the scale and organisation of salt-making in North Lynn?

Salterns and landscape change

1.5.17 Can the investigations help us to understand the natural environment and landscape in which the salt-making was taking place?

1.5.18 How do the salterns relate to the Gaywood River and the main channel of the Great Ouse, and what were their palaeoenvironments?

1.5.19 How did the salt-making industry contribute to the reclamation of the saltmarsh and what can it tell us about the dating/phasing of that process?

Regional research frameworks

1.5.20 More broadly, the site investigation takes place within, and will contribute to the goals of Regional Research Frameworks relevant to this area.

iii. Research and Archaeology: A Framework for the Eastern counties: 2. Research Agenda and Strategy (Brown & Glazebrook 2000, East Anglian Archaeology Occasional Papers 8):

1.5.21 *'From the Middle Anglo-Saxon period onwards there is evidence of both urban and rural craft production and industry. Is there a relationship between the two? To what extent was urban production city-serving and rural production largely conducted by itinerant craftsmen?' (p25, 27).*

1.5.22 *'The rich material culture of towns, often present in dense quantities, must continue to be assessed and the results analysed and synthesised in order to increase understanding of the economic foundations of towns. Research work must target: evidence for commercial and industrial activity; definition, specialisation, marketing and distribution of products; linkages between social and political development and economic activity; and communications between towns and with the hinterland*' (p31).

1.5.23 *'Industrial output, either from craft industries or early modern large-scale processes, will affect the urban environment. The impact of the economy can therefore be explored by: examination of evidence for industrial zoning; study of the relationship of industrial and commercial sites to distribution routes; and correlation of evidence for status with product specialisation and output*' (p31).

1.5.24 *'Within urban culture, as in the rural hinterland, the church with its organisation, its role in society and its economic power deserves special attention. The following areas of research need to be amplified: the economic influence of the church' (p31).*

iv. Research and Archaeology Revisited: A Revised Framework for the East of England (Medlycott 2011, East Anglian Archaeology Occasional Papers 24):

1.5.25 '*The Norfolk Coast and Broads NMP projects recorded large numbers of saltern mounds within The Wash and, to a lesser extent, around Breydon Water and the former Great Estuary (Albone et al. 2007). This has made a significant contribution to the study of this important medieval industry, and represents the first comprehensive identification and analysis of such sites within the county. The recognition of evidence for the possible Late Saxon origins of some of the saltern mounds provides further evidence for the early development of this form of salt-making (i.e sand washing)*' (p67).

1.6 Fieldwork methodology

1.6.1 The methodology used followed that detailed in the WSI (Clarke 2018d) approved by James Albone of NCC/HET, which required that four areas of excavation (Areas J, K, L and M, totaling *c*.0.37ha) be machine stripped into three of the saltern mounds (Salterns 4-6). As the archaeological levels were anticipated to be particularly deep, safe excavation procedures were followed to ensure that excavations were safe to enter. This included stepping the sides, as appropriate to the soil and site conditions.

Salterns 4 and 5

Area J and K: Adjoining Areas J (*c*.18m x 33m; 608m^2) and K (*c*.33m x 62m; 1873m^2) comprised the footprint of the proposed Hard PE area (Area J) and were excavated to the formation level for the underlying surface water attenuation tank (up to *c*.1.25m below ground level) and the eastern part of the proposed car park (Area K) to the formation level of the ground stabilisation works (*c*.1.00m below ground level). The excavation in these areas identified and recorded archaeological features and deposits associated with Salterns 4 and 5 and attempted to establish their stratigraphic relationship to the extant ditch which currently lies in between them (possible historical creek).

Salterns 5 and 6

Area L: Area L (*c*.5m x 195m; 971m^2) comprised the archaeological excavation of a trench along the centre-line of the proposed new drainage ditch on the northern and eastern boundaries of the site. The trench was stepped to correspond to the profile of the new drainage ditch, but was *c*.5m wide at the top. The proposed new ditch cut through the earthwork mounds of Salterns 5 and 6.

Saltern 4

Area M: Area M (*c*.7m x 13m and *c*.14 x 17m combined; 321m^2) comprised a small area on the western edge of Saltern 4 which was affected by the ground stabilisation works. This area was archaeologically excavated to the formation level of the proposed stabilisation works (*c*.1.00m below ground level).

1.6.2 This strategy was modified during the works which encountered flooded ground either side of the extant ditch between Areas J (Saltern 4) and K (Saltern 5). This reduced the footprint of both these excavation areas (Area J=316m^2 and Area K=925m^2). It was not therefore possible to investigate the stratigraphic relationship between the saltern mounds and the extant ditch. Due to the presence of perimeter fencing along the southern boundary of the development site it was impossible to excavate the proposed southern extent of Area M. Therefore, this excavation area was extended to the north to provide a satisfactory area of investigation (276m^2). A dense area of vegetation in the path of excavation Area L resulted in its separation into two sub-areas: Area L-South investigated Saltern 5 and Area L-North investigated Saltern 6.

1.6.3 Machine excavation was carried out by a tracked 360^o type excavator using a 2m-wide flat bladed ditching bucket under constant supervision of a suitably qualified and experienced archaeologist.

1.6.4 The site survey was carried out using a Leica GPS GS08 with SmartNET.

1.6.5 Spoil, exposed surfaces and features were scanned with a metal detector. All metal-detected and hand-collected finds were retained for inspection, other than those which were obviously modern.

1.6.6 Sufficient excavation was carried out in line with the proportions of each feature class to be excavated as outlined in the WSI (Clarke 2018d, 12).

1.6.7 All archaeological features and deposits were recorded using OA East's pro-forma sheets. Plans and sections of features were recorded at appropriate scales, and high-resolution digital photographs were taken of all relevant features and deposits.

1.6.8 A total of 16 bulk samples were taken from a range of excavated features. These each totalled between 10-40L and were processed by flotation at OA East's environmental processing facility at Bourn. Eight pollen tin samples were also taken across underlying natural and saltern mound deposits for micromorphology, pollen, ostracod or foraminifera analysis.

1.7 Project scope

1.7.1 The previous phase of archaeological evaluation work at the site has been reported on in full (Clarke 2018c), however, this assessment will draw some of the information from this evaluation together with the excavation results during the assessment where appropriate.

1.7.2 This is a detailed assessment of the stratigraphy with the aim of forming the full 'grey literature' component to support the publication of the results in an *East Anglian Archaeology* (EAA) monograph (see Section 7.4). Similarly, detailed assessment reports have been prepared for several artefact categories, the intention being that as much resource as possible be retained for the analysis work and the publication.

2 Factual Data and Statement of Potential: Stratigraphy

2.1 General

2.1.1 The excavation targeted three of the saltern mounds defined by the previous phases of evaluation in order to mitigate the impact of the development on the surviving archaeological remains (Fig. 3b). Excavation Areas K and M encompassed an area of *c*.750m^2 of Saltern 4. Excavation Areas J and L-South encompassed an area of *c*.500m^2 of Saltern 5. Excavation Area L-North encompassed an area of *c*.400m^2 of Saltern 6. Within each excavation area, machine-excavated or hand-dug test pits were excavated down to the contact level horizon between the basal deposits of the mound and underlying natural saltmarsh deposits. The following stratigraphic records were created during the excavation (Table 1). An abbreviated context inventory can be found in Appendix A.

Record type	Number
Context Registers	6
Context Numbers	243
Context Records	239
Plan Registers	1
Plans at 1:50	1
Section Register Sheets	1
Sections at 1:10	21
Sections at 1:20	5
Sample Register Sheets	4
Sample Numbers	24
Photo Register Sheets	2
Digital Photos	76

Table 1: Summary of stratigraphic records

2.1.2 As described above, this site forms part of a wider context of research into the salt-making landscape of Gaywood currently being undertaken for the Lynnsport development by OA East (Brudenell and Clarke 2017). Salterns 1-8 were identified during earlier phases of evaluation and excavation work at both the current Greenpark Avenue site (see Section 1.4) and the adjacent Lynnsport 4 and 5 development to the south (Fig. 2, ENF141949 and ENF139746; Clarke 2017a-b). Consequently, the salt-making deposits encountered on this site are described numerically as Salterns 4-6, with the remaining salterns lying outside the current excavation areas.

2.1.3 An overview of the results is presented below by area and these are described stratigraphically. Feature (cut) numbers in the text are written in **bold**. Summary descriptions of the identified features and deposits along with the artefacts recovered are given in this section, supplemented by a full context inventory presented in Appendix A, Table 7. An excavation plan of Areas K and M showing cut numbers allocated to features and deposits belonging to Saltern 4 is presented as Figure 4; evaluation trenches/results are also shown. Labelled groups of features and deposits in Saltern 5 revealed within Area J and Area L-South is presented as Figure 5. Similarly, an excavation plan of Area L-North showing labelled groups of features and deposits is presented as Figure 6. Detail plans of Period 2 hearth **1010** and filtration tank **875** excavated in Saltern 5 are given as Figures 7 and 8 respectively. Selected sections are included as Figures 9 and 10.

2.1.4 The preliminary phasing presented below is based on stratigraphy and spatial associations, with similarity of morphology of features also considered. Where possible, this has been combined with dating evidence provided primarily by scientific dating methods along with a few stratified artefacts.

2.1.5 Three main periods of activity have been identified:

Period 1: Saltmarsh formation

Period 2: Late Saxon to early medieval (*c*.AD850-1200)

Period 3: Later features and deposits

2.2 Period 1: Saltmarsh formation

Group 802: Marine tidal-flat deposits (saltmarsh)

2.2.1 Extending beneath Saltern 4 (1037; Fig. 4), Saltern 5 (1040=1006 and 1007; Fig. 5), and Saltern 6 (1042; Fig. 6) were natural deposits indicative of the mudflat and tidal creek environment of the saltmarsh exploited by the Late Saxon and early medieval salt-making activities. The top of these deposits was encountered at a height of *c*.2m OD at the base of Saltern 4, *c*.1.4-1.7m OD at the base of Saltern 5 and *c*.1.8m OD at the base of Saltern 6. These deposits, which were generally not excavated, comprised light to dark brownish yellow silty sand with occasional small stones.

2.3 Period 2: Late Saxon to early medieval (AD850-1200)

Areas K and M: Saltern 4 (Fig. 4)

Salt-making waste Group 1036

2.3.1 The deposit sequence of Saltern 4 commenced with a series of silts (Group 1036) which directly overlay the marine tidal flat deposits (1037) from a height of approximately 2m OD. There was no evidence for any intervening buried soil between this layer and the underlying saltmarsh deposits. At the north-eastern corner of Area M, a machine excavated test pit excavated into these deposits identified multiple thin tips of waste material (1036=830, 853-858; Fig. 9, Section 200), between 0.08-0.2m thick, comprising mid brownish yellow silty sand. The upper horizon of this group appeared to have formed a pre-existing surface of the mound into which a group of salt-making features were constructed that included two filtration units and evidence for brine-boiling.

*Clay-lined features **803** and **808***

2.3.2 Towards the southern limit of Area M, the remains of a sub-circular clay-lined pit (**803**) was observed to cut the basal layer (1036) of filtration waste at a height of 2.8m OD (Fig. 9, Section 201; Plate 2). It measured 0.7m in diameter by 0.4m deep. The cut was partly lined with bluish grey clay (804) up to 0.1m thick, while the backfill (805) consisted of mid greyish brown sandy silt. This was cut by the heavily truncated remains of a further filtration unit (**808**), up to 4m in breadth. This feature was similarly lined with bluish grey clay (806) and backfilled with mid greyish brown sandy silt. No finds were recovered from these features or any trace of the associated clay-lined water tank elements that would presumably once have been located adjacent to them.

Salt-making waste Group 1035

2.3.3 Overlying filtration waste deposits (Group 1036) in Area K (at a height of *c*.2.4m OD), was a series of hearth waste tips of burnt material (Group 1035) that contained baked clay debris from broken up hearths. These deposits were investigated by Test Pit 1 (contexts 859-864, not illustrated) and Test Pit 2 (contexts 865-871, not illustrated) which demonstrated that they were approximately 0.15m thick and consisted of mid-greyish/orange/dark red/brown sandy silt. Layer 861 yielded a fragment of charcoal (*Calluna vulgaris Erica sp*) radiocarbon dated to 901-1025 cal AD (95.4% confidence SUERC-87797 (1052 ± 26 BP)). A narrower date range of 951-1025 cal AD was determined with 88.4% confidence.

Salt-making waste Group 809

2.3.4 The filtration units in Area M were overlain by multiple layers of silt (833-837 and 840-852), between 0.06-0.4m thick, to a maximum height of approximately 3.2m OD at the subsoil (801) horizon (Fig. 9, Section 200). These layers equate to the sequence of stratified silts (810-812, 816-818, 820-828, 921, 929-934) recorded in Area K overlying hearth waste Group 1035 (Fig. 9, Section 202; Plate 3). Layer 816 yielded a single sherd (22g) of Grimston Thetford-type Ware pottery dating to between the late 10th to 11th century. These layers, that exclusively made-up the upper mound sequence, represent further tips of waste from silt filtration activity, as demonstrated by the presence of filtration units within the earlier mound sequence. The waste silt generally consisted of light brownish yellow silty sand. These silts extended up to the topsoil horizon at a height of *c*.3.2m OD.

*Clay-lined features **923** and **926***

2.3.5 Two clay-lined pits (**923** and **926**) were recorded in Section 202 (Fig. 9) along the southern baulk of Area K. These features cut into the upper sequence of salt-making waste Group 809 with their upper profiles truncated at the topsoil horizon (800) at a height of *c*.3.2m OD. The U-shaped profile of feature **923** indicates that this feature was probably the remains of a water tank of a silt filtration unit. The larger, more square-cut, profile of the larger feature (**926**) probably represents the filtration pit element of a further unit. Feature **923** measured 0.4m wide and 0.25m deep. It was lined with light grey blue clay (924) up to 0.2m thick and contained a single overlying backfill (925) that consisted of mid yellowish-brown silt. Approximately 2m to the east, feature **926** measured 1.25m wide and 0.5m deep. It was lined with blue grey clay (927) up to 0.1m thick and contained a single mid yellowish-brown backfill (928).

Areas J and L-South: Saltern 5 (Fig. 5)

Basal horizon deposit 1004/1005

2.3.6 Test Pit 4 (Plate 9), excavated into the northern end of the saltern, revealed a thin (*c*.0.05m thick) horizon of dark greyish brown silty clay and sand (1004/1005) which extended over the natural saltmarsh deposits beneath the northern part of the saltern at a height of approximately 1.7m OD (Fig. 9, Section 222). Micromorphological analysis of this horizon indicated it was the result of the repeated, micro-laminar, stop/start deposition of fine material, by slow water action with repeated episodes of surface drying out; a stream or marsh edge environment (App. D.1.7; App. D Plate 1).

2.3.7 This layer possibly represents the pre-existing land surface and perhaps nascent soil formation in this part of the saltmarsh prior to the establishment of the saltern.

Salt-making waste Group 1039

2.3.8 The deposit sequence within Test Pit 4 showed that overlying the basal horizon deposit (possible buried soil) were layers of waste filtration silt that indicate the commencement of salt-making activity (1001-1003; Fig. 9, Section 222). Both the excavation of Areas J (922=1039; Plate 4) and L-South demonstrated that waste filtration silts extended across the base of the saltern from a height of *c*.1.4-1.7m OD to a maximum height of *c*.2.6m OD. As with the material (Group 1036) encountered towards the base of the deposit sequence of Saltern 4, this group probably represents the resultant waste from silt filtration activity. Micromorphological analysis of layer 1002 in Test Pit 4 determined its swirled and convoluted aspect to be suggestive of erosive impact and mixing processes (App. D.1.6; App. D.1 Plate 2).

2.3.9 The eastern baulk section of Area L-South (Fig. 10, Section 218) provided a more detailed record of intercalated layers of filtration waste (970, 977, 979 and 988) and hearth waste (975, 976, 978, 980 and 987) that made-up the lower mound deposit sequence up to the level of the first group of features relating to salt-making (see below). The filtration waste deposits generally consisted of light greyish brown silty sand between 0.06-0.86m thick. The hearth waste consisted of layers (0.08-0.16m thick) of dark grey, ash-like silty sand with red fired clay inclusions. No finds were recovered from these deposits or any trace uncovered of the presumed filtration tanks and hearths that would have produced these waste products.

*Clay-lined features **989** and **991***

2.3.10 The upper horizons of Group 1039 may have formed a stable surface of the mound upon which the earliest phase of cut features identified within the mound were constructed. Two undated sub-circular pits (**989** and **991**) were revealed at a height of *c*.2m OD in the central part of Area L-South. The smaller pit (**989**) to the north measured up to 1.1m in diameter by 0.45m deep. This pit was filled by mid-brownish grey sandy silt (990). Approximately 3m to the south, the western part of a substantial pit (**991**) was exposed which measured greater than 6m in diameter and 0.54m deep, which contained a similar backfill (992) to that of the smaller pit.

Salt-making waste Group 907

2.3.11 The upper sequence of salt-making waste products attributed to this phase mostly comprised a homogenous layer of filtration waste silt (936=1034), up to 1.5m thick, overlay pits **989** and **991** (Fig. 10, Section 217 and Fig. 10, Section 218). This deposit generally consisted of light brownish yellow sandy silt. Interspersed within this group were the thinner layers of waste silt observed along the northern edge of the mound (Fig. 10, Section 218; 981, 982 and 985) and immediately below the uppermost horizon of this group (Fig. 10, Section 217; 907, 937 and 939). Fungal spores were relatively frequent in the pollen sub-sample from deposit 981, a spore associated with eroded or disturbed soils (App. C.2.4).

2.3.12 Within this mass of filtration waste material thin bands of dark brownish grey, ash-like hearth waste with red fired clay inclusions (Fig. 10, Section 218; 920, 938, 973, 974, 983, 984 and 986) was observed, up to *c*.0.4m thick. Excavation of deposit 920 (not illustrated) produced 24 pieces (*c*.6kg) of salt slag with vitrified patches and fired clay hearth lining attached to some fragments. Refitting of these items suggests a minimum of 10 discarded slag cakes (hearth bases). Possible air blast holes (tuyeres) were also observed in some fragments (App. B.1.4). The fresh breaks observed on these pieces suggest they were discarded near to a brine-boiling hearth site. The dimensions of the refitting fragments suggest the associated features may have taken the form of shallow, circular pit-like, clay-lined hearths of around 220mm diameter, over which the salt pans were placed. The identification of smaller cakes (hearth bases) might indicate the presence of some other smaller hearths (App. B.1.7).

2.3.13 The salt slag assemblage recovered from deposit 920 was complemented by 16 pieces (*c*.2kg) of fired clay representing a minimum of nine brick supports for lead or ceramic brine boiling pans (App. B.3.4). Seventy percent of these pieces displayed thin yellowish-green salt slag accretions on their surfaces to suggest brine spillage or spatter (App. B.3.6).

Salt-making features

Clay-lined features and pits (Fig. 5)

2.3.14 A group of features truncated filtration waste belonging to group 907. In the central part of the saltern mound, at a height of 3.39m OD, lay a group of three clay-lined features. The two smaller sub-circular pits (**892** and **900**) probably represent survivals of the deeper water tank elements of silt filtration units while adjacent, flat-based pit (**895**) is likely to represent the remains of the shallower filtration pit element.

2.3.15 The westernmost feature (**900**) measured 1.5m in diameter and 0.5m deep with a U-shaped profile. A bluish grey clay-lining (901), 0.05m thick, extended around the cut above which was a mid-yellow brown sandy silt backfill (902). To the south-east, pit **892**, which measured 0.9m in diameter and 0.16m deep, was similarly lined with clay (893) and backfilled (894). To the north, the largest feature of the group (**895**) measured 2m in diameter and 0.5m deep with a flat base. Its clay-lining (896) was overlain by a mid-yellow brown sandy silt backfill (897).

2.3.16 This latter feature was cut by a sub-circular pit **898** of unknown function, which measured up to 0.9m in diameter and 0.49m deep. It was backfilled with dark greyish brown silt (899). Immediately to the north, a larger pit (**908**; 1.45m in diameter x 0.6m deep; Plate 7) was partly revealed along the eastern excavation limit which contained a series of six backfills (914-919), between 0.08-0.25m thick, that consisted of alternate layers of mid-yellow brown and light to dark greyish brown silt.

2.3.17 Evidence for a further four clay-lined silt filtration units was revealed to the south of the main group, within the baulk section along the eastern excavation limit (Fig. 10, Section 217). This group, also cut the upper horizon of filtration waste Group 907 at a height of *c*.3m OD, and is therefore attributed to this phase of activity. The clay-lined features revealed in section (**942**, **945**, **948** and **951**) all shared a similar steep-sided and flat-based morphology. They measured between 1.85-3m in width and 0.6-0.9m deep and were lined with bluish grey clay (941, 946, 949 and 952 respectively) up to 0.05m thick. The backfills (943/944, 947, 950 and 953/954/955 respectively) similarly consisted of light to mid-yellow brown sandy silt, with the exception of a 0.1m thick ash-like silt (954) in pit **951**. Samples of both the clay lining (941) and backfill (943) of feature **942** produced foraminifera assemblages dominated by species (almost 85% in both cases) typical of a common silt extraction source situated on the low salt marsh/ tidal flat environment (App. C.3.27).

2.3.18 Three unlined pits (**956** (recorded in section), **887** and **889** (Fig. 5)) were similarly small, sub-circular features which measured between 1.3-1.6m in diameter and 0.12-0.4m deep with U-shaped profiles. Whereas pits **956** and **887** contained sterile mid-yellow/orange brown sandy silt backfills (957 and 888), pit **889** contained a burnt fill (990) consisted of red and orange brown sandy silt with frequent fired-clay and flecks of charcoal.

2.3.19 Two circular clay-lined pits (**1013**, Fig. 7, Section 223; **1019** (not illustrated)), which probably represent the remains of filtration units, were heavily truncated by hearth **1010**.

Hearth **1010** (Fig. 7)

2.3.20 Immediately below the subsoil truncation level, at approximately 3.2m OD, lay the remains of an enclosed hearth (**1010**; Fig. 7, Section 223). A spread of burnt deposits extended to the west, beneath which lay a substantial pit (**1011**) backfilled with a stratified sequence of waste products, that possibly represent an associated rake-out pit excavated to receive the hearth's waste.

2.3.21 The hearth structure lay within the north-eastern end of a sub-rectangular pit (**1010**) that measured *c*.9m in length and 7m wide by 0.5m deep. Both the hearth and pit were orientated towards the prevailing south-westerly wind direction. The hearth's fired-clay construction comprised a square feature (3m in length) with elements of the superstructure and base (1018) surviving *in-situ* (Fig. 7; Plates 10 and 11; App. E.1 Plate 1). The remains of the fired-clay superstructure extended up from the base as a central rectangular column. Further elements of this superstructure also extended around the north-western, north-eastern and south-eastern sides. This construction resulted in two similar-sized chambers either side of the central column which were open to the south-west. Each chamber was similarly backfilled with dark brownish grey ash-like silt (1008 and 1009). The pit was backfilled around the hearth with brownish yellow sandy silt (1012=1016/1017).

2.3.22 The fired clay superstructure (1018) was subject to archaeomagnetic dating technique (App. E). The magnetic direction recorded indicates last firing between AD870-1050 (95% confidence). A narrower date range of AD900-1030 is also considered at 68% confidence. This possible age range relates to the last time the feature was heated above *c*.400°C, and therefore potentially dates to the end of the phase of activity within the structure.

Rake-out pit **1011**

2.3.23 A large area (approximately 10m x 6m) of burnt deposits extended across the western part of pit **1010**, immediately to the southwest of the hearth which overlay further burnt deposits contained within pit **1011**. A section excavated into these deposits revealed a sequence of ash-like waste tips (Fig. 7, Section 224; Plate 12). These deposits (1025-1033) generally consisted of thin, light to dark grey, sandy ash lenses intercalated with light brownish yellow sandy silt. This pit therefore appears to have been excavated to dispose of the fuel ash waste produced by the adjacent brine-boiling hearth. Backfill 1033 yielded a fragment of charcoal (*Calluna vulgaris Erica sp*) radiocarbon dated to 1024-1154 cal AD (95.4% confidence SUERC-87802 (952 ± 26 BP)). This date corresponds to the radiocarbon date determined for a tip of hearth waste (994-998) within the southern part of the saltern (see Section 3.3.27 below). However, this date range only overlaps with the very end of that determined by archaeomagnetic dating for the hearth structure (see Section 2.3.21 above).

Salt-making waste Group 958

2.3.24 The build-up of waste products forming the saltern mound continued with tips of light brownish yellow filtration waste silt (961, 963 and 965), between *c*.0.5-1m thick, separated by thin (*c*.0.1m thick) dark brownish grey ash-like tips of hearth waste (958, 962, 964 and 966). The tip lines shown on Section 217 (Fig. 10), which survive below the subsoil horizon, show that the footprint of the saltern mound continued to expand outwards during the early medieval period.

2.3.25 Significantly, the earliest tip of hearth waste of this group identified in Section 217 (958) possibly equates to a hearth waste deposit (994-998) excavated in plan by Test Pit 3 (Fig. 5) which yielded a fragment of charcoal (*Quercus sp*) radiocarbon dated to 1030-1155 cal AD (99.4% confidence SUERC-87801 (939 ± 26 BP)). This date corresponds to the radiocarbon date determined for fuel ash waste (1033) from rake-out pit **1011** (see Section 3.3.20 above).

2.3.26 Similarly, one of the later hearth waste tips observed in Section 217 (964) possibly equates with a burnt layer (883) observed in plan (Fig. 5) at the base of the excavation which produced three sherds (70g) of ?Lincoln Saxo-Norman Sandy Ware pottery (late 10th to 11th century) to further support this chronological outline.

2.3.27 This southward mound growth is mirrored in baulk Section 218 (Fig. 10) that similarly records the continued build-up of salt-making waste products along its northern side. A *c*.0.6m thick deposit of hearth waste (972) is shown to have been tipped along the northern edge of the mound. This material was subsequently overlain by waste filtration silt deposits (969 and 971) which extended up to the subsoil horizon.

*Clay-lined features **872**, **875**, **879** and pit **959***

2.3.28 Cutting this latest group of salt-making waste products in the southern part of the mound and immediately below the subsoil horizon (*c*.3m OD) lay the heavily truncated remains of three clay-lined features (**872** (Plate 8), **875** and **879** (Fig. 8; Section 205). The *c*.0.02m thick bluish grey clay linings (874, 876 880 respectively) were overlain by light yellow brown sandy silt backfills (873, 877, 878 and 881 respectively). Both backfills 873 and 877/878 produced moderate amounts of ostracods indigenous to brackish water, saltmarsh and estuarine mudflats (App. C.3.14); 50%+ association with the upper mudflats (App. C.3.16). These sub-rectangular and flat based features are reminiscent of more complete examples of filtration units. Pit **872** measured 2.76m wide, in excess of 1.9m in length and 0.55m deep. Pit **875** measured greater than 2m wide and was 0.19m deep (Fig. 8).

2.3.29 A single unlined pit (**959**) was revealed in section within this group (Fig. 10, Section 217). It measured 1.3m wide and 0.3m deep with a U-shaped profile and contained a single mid yellow brown sandy silt backfill (960).

Filtration waste Group 967

2.3.30 Successive layers (967 and 968) of light to mid-yellow brown clayey silt were encountered at the southern end of excavation Area L-South. These deposits appeared in Section 217 (Fig. 10) to be the latest saltern-related deposits which overlay the southern edge of the mound (Plate 5). These layers extended up to the subsoil horizon at *c*.2.9m OD. The lower deposit (967) was observed to physically overlie the underlying saltmarsh deposits of Group 802 (1040) at a height of approximately 1.4m OD. Deposit 967 contained fungal spores associated with grazing animals (App. C.2.4), a well-documented later use for salterns after the decline of the salt-making industry (see Section 1.3.9).

Area L-North: Saltern 6 (Fig. 6)

Salt-making waste Group 909

2.3.31 In the north-eastern corner of the development site, Area L-North, excavated into Saltern 6, revealed a mound of stratified deposits of mid greyish brown/brownish grey sandy silt (909 and 911-913) extending up from the level of natural saltmarsh deposits 1042 (Fig. 10, Section 214; Plate 6). These deposits, similar to the deposits forming the bulk of Salterns 4 and 5 described above, were probably derived from silt filtration possibly associated with the salt-making process during the Late Saxon period. Deposit 909 produced three pieces of a vitrified hearth lining rim of a large (possibly 200-250mm) diameter iron smithing (or re-used saltern) hearth. The presence of blast holes from a tuyere was also observed (App. B.1.3). Within the waste silt lay a wedge of mid orange/red brown sandy silt material (910) up to 0.5m thick that more probably represents hearth waste. These deposits extended up to the subsoil horizon at a level of *c*.3.2m OD and equate to filtration waste (230) and hearth waste (204) deposits recorded within evaluation Trench 27 (Clarke 2018c).

2.4 Period 3: Later features and deposits

Area K (Figs 3 and 4)

Recent drainage channels

2.4.1 The topographical survey conducted on the site by OA East in 2018 (Fig. 3a) revealed a large network of drainage channels extending across the full extent of the development site (Clarke 2018c, figs 3-5). These channels fed a main drainage channel which traversed the full extent of the site at the time of excavation and was observed to run around the periphery of Saltern 5 (Fig. 3b). Excavation of the northern part of Area K revealed one of these feeder-drainage channels (Fig. 4; unnumbered).

2.4.2 Section 202 recorded a modern pit (**829**), that measured 3.5m in breadth and 0.75m deep, in the southeastern corner of Area K. It cut both the topsoil overlying Saltern 4 and waste filtration silts belonging to Group 809 (Fig. 9, Section 202). Its sterile backfills (809, 813-815 and 819) generally comprised of light brownish yellow silty sand.

Area L-South (Fig. 5)

Hayricks

2.4.3 Located within Area L-South were the heavily truncated remains of two curvilinear gullies (**886** and **903**/**905**) which cut filtration waste silts belonging to Group 907. These gullies measured between 0.35-0.66m wide and 0.08-0.16m deep with shallow U-shaped profiles. The fills varied between very dark grey silt (884 and 885) mid greyish brown silty sand (904 and 906). These features probably represent the vestiges of hayricks ('Riley circles') that would originally have formed closed circular ring-gullies, *c*.10m in diameter. Complete examples of this type of early modern feature were uncovered by OA East immediately to the south of the site during excavation work at the Lynnsport 4 and 5 development (Clarke 2017b).

Area L-North (Fig. 6)

Building footing

2.4.4 The brick footing of a small modern structure was partly uncovered in the northern arm of Trench L-North, immediately to the west of Saltern 6. This feature corresponds to the small rectangular area of raised ground (12m x 9m) shown at this location on the topographical survey of the site conducted by OA East in 2018 (Clarke 2018c; Fig. 3a).

All excavation areas

Modern overburden and vegetation disturbance

2.4.5 Layers of subsoil (801) and topsoil (800) were recorded in section overlying Salterns 4-6, measuring up to 0.5m thick (Fig. 9, Section 200 and 202). These saltern mounds, around the eastern periphery of the site, were heavily overgrown with trees and shrubs prior to the excavation. This subsoil probably represents the extent of root disturbance into the uppermost saltern waste deposits. Particularly dense undergrowth was observed across Saltern 5 during the previous evaluation of the site (Clarke 2018c, Plate 2). The undulating horizon recorded between the undisturbed deposits forming Saltern 4 and the topsoil is also probably due to root disturbance (Fig. 9, Section 202).

2.5 Statement of stratigraphic potential

2.5.1 The site data is of sufficient quality to address all of the project's Research Aims and Objectives and will form the basis of further analysis and targeted publication of the saltern mounds and their features, finds and environmental assemblages. What has survived within these salterns is *in-situ* and in this regard the stratigraphy has the potential to address those research questions which relate to salt-making.

3 Factual Data and Statement of Potential: Artefacts

3.1 General

3.1.1 The following finds were recovered:

Material	Number	Weight (g)
Iron slag	3	486
Salt slag	24	5910
Pottery	4	92
Fired clay	14	1780

Table 2: Summary of finds recovered

3.2 Slag (App B.1)

Iron slag

3.2.1 Three pieces (486g) of probable iron slag were recovered from a single context (909, Group 909) in Saltern 6, comprising large and irregular frothy re-fitting lumps of vitrified clay, broken off from a vitrified hearth lining rim of a large (possibly 200-250mm) diameter iron smithing (or re-used saltern) hearth. Examination of the form and surface of the slag has revealed the presence of blast holes from a tuyere tip. The possible imprint of the tongs can be seen upon several of the pieces.

Salt slag

3.2.2 Twenty-four pieces (5910g) of salt slag were recovered from a single context (920, Group 907) from Saltern 5. Matching individual pieces of both the re-fitting and non re-fitting fragments of these salt slag cakes suggests a minimum of 10 discarded hearth bases from at least two different (or a single subsequently modified) hearth of *c*.180mm diameter and 220mm diameter. The imprint of tongs used to remove the cakes, or else blast holes relating to the tuyere location can also be seen within some of the formerly molten surfaces. Rare inclusions of dark grey-black peat ash and more rarely animal bone were noted.

Statement of potential

A.1.1 As expected, both the salt slags and also the small amount of iron slag looked at from this site are very similar to those described from Marsh Lane, King's Lynn (Clarke 2016) and subsequently within the report on the chemical analyses of these slags carried out by Timberlake & Haylock in 2017. All of salt slag was recovered from the same context as the fired clay brick supports (see Section 3.4). The salt slags are significant remains in informing the process and technology involved in the brine-boiling process (one of the Research Objectives).

3.3 Pottery (App. B.2)

Summary

3.3.1 Four sherds of pottery weighing 92g were collected from two contexts during the excavation. One base fragment of Grimston Thetford-type ware was found in filtration waste layer 816 (Group 809, Saltern 4). Three sherds of a ?Lincoln Saxo-Norman Sandy ware jar were found in hearth waste 883 (Group 958, Saltern 5). Both these fabric types date to between the late 10th to 11th century.

Statement of potential

3.3.2 The neighbouring Lynnsport 4 and 5 excavations (Clarke 2017b) recovered two abraded sherds of pottery from features within Saltern 2 which perhaps derived from Lincoln. Fine shelly ware pottery, also possibly from a Lincoln-type kiln was also excavated from a hearth rake-out pit in Saltern 1. Although the evidence was limited, it seemed likely that small group of Lincoln derived pottery was of 10th-century date. Therefore, it is significant that three sherds of a ?Lincoln Saxo-Norman Sandy ware jar were found in hearth waste 883 (Group 958) within Saltern 5. This small assemblage, when considered along with the radiocarbon dates for the salterns, has the potential to refine the pottery chronology and shed light on any potential links between the salt-making tradition on the Norfolk Wash with Lincolnshire at this early date.

3.4 Fired clay (App. B.3)

Summary

3.4.1 Fourteen fragments (1780g) of briquetage, belonging to at least nine fired clay brick supports, were recovered from context 920 (Group 907, Saltern 5). Both the form and type of salt slag coatings upon these bricks suggests that they were constructed and used (probably as unbonded bricks) in supports for the presumably heavy lead or ceramic boiling pans which sat just a short distance above the top of the clay-lined hearths.

Statement of potential

3.4.2 The brick support fragments were recovered from the same context as the salt slag (see Section 3.2). Along with the salt slag, these pieces are significant remains in informing the process and technology involved in the brine-boiling process (one of the Research Objectives).

4 Factual Data and Statement of Potential: Environmental Evidence

4.1 General

4.1.1 Environmental bulk samples were collected from a representative cross-section of feature types and locations. Bulk samples were taken to analyse the preservation of micro and macro botanical remains. A small number of samples were also specifically taken for pollen, micromorphology, ostracod and foraminifera analysis.

4.1.2 The numbers of samples processed from each feature type are listed below.

Sample Type	Filtration Tank	Hearth rake-out pit	Pit	Filtration waste	Hearth waste	Soil horizon	Hayrick gully	TOTAL
Flotation	4	1	5	1	2	-	3	**16**
Pollen	-	-	-	4	2	-	-	**6**
Ostracods and Forams	6	-	-	-	-	-	-	**6**
C14 Dating	-	1	-	-	2	-	-	**3**
Micromorphology	-	-	-	1	-	1	-	**2**

Table 3: Summary of environmental samples taken

4.2 Environmental samples (App. C.1)

Summary

4.2.1 Sixteen samples were taken from features and deposits associated with Late Saxon to early-medieval salt-making. A limited list of plant species was identified that represent trees/shrubs and nettles that may have been present when the salterns were in use, or they may represent subsequent growth of vegetation. The identification of heather and charred stems/rhizomes may be an indication of their use as fuel, possibly as peat, in addition to oak wood/charcoal and possibly coal being utilised.

Statement of potential

4.2.2 The poor diversity of the plant taxa produced from the samples precludes the potential for further study. It is considered that the assemblage has little potential to aid the project's research priorities beyond the record of the taxa present.

4.3 Pollen remains (App. C.2)

Summary

4.3.1 Six sub-samples were taken from a column-tin sample through layers of filtration and hearth waste within Saltern 5 (in stratigraphic order Groups 1039, 907, 958 and 967). Unfortunately, none of the sub-samples contained sufficient pollen for interpretation. This is largely attributed to the lithology from which the sub-samples were taken, which was insufficiently organic. The preserved pollen was comprised of various tree and shrub taxa. Herb pollen comprised pollen of the goosefoot family (Chenopodiaceae), several species of which are salt tolerant, as well as rare grass pollen, fern spores and spores of *Sphagnum* moss. Fungal spores were relatively frequent in the sub-sample from deposit (981, Group 907) of a type that has an association with eroded or disturbed soils. In addition, deposit 967 (Group 967) contained spores associated with grazing animals.

Statement of potential

4.3.2 The preservation of pollen at the site is clearly poor and therefore is recommended that no further samples be tested for pollen.

4.4 Ostracods and foraminifera (App. C.3)

4.4.1 Foraminifera are marine single-celled organisms (such as simple alga) found in habitats ranging from saltmarshes to the deep oceans. They secrete a shell called a test, which is the part that survives. Foraminifera survive best in non-acidic conditions (Historic England 2011, 24).

4.4.2 Ostracods are small (normally <2mm) bivalve crustaceans with calcareous shells which inhabit nearly all types of aquatic environment from freshwater to marine. The robustness of their shells means that they survive in almost any non-acidic, water-lain deposit. Like foraminifera, the shells of most species have unique shapes and sculpturings, making them readily identifiable (Historic England 2011, 25).

Summary

4.4.3 Six sediment samples from incomplete examples of filtration units (tanks) **872**, **875** and **942** in Saltern 5 were processed and examined for ostracods and forams. Ostracods in moderate amounts were found within the sediments belonging to tanks **872** and **875**, but by contrast were rare and of low diversity within the sampled sediments infilling abandoned tank **942**. Very large numbers of foraminifera were present, particularly in the cases of samples from tanks **872** and **875**.

Statement of potential

4.4.4 Both the ostracod and foraminiferal evidence confirms the idea that the silts used in sleeching were collected from the lower saltmarsh/upper tidal mudflats zone of the tidal creeks which lay closest to the salterns. Brought together with the information gained from the other Lynnsport sites helps build a picture of this landscape whilst the salterns were in use.

4.5 Overall statement of potential

4.5.1 Although small, the research potential of these assemblages is increased when considering their eventual incorporation into the wider research into the salt-making industry of Gaywood resulting from the adjacent Lynnsport 1-5 developments and attendant excavations. The artefact and ecofact assemblages from Greenpark Avenue add to the corpus of material being gathered from this work that is considered to be of sufficient quality to address the majority of the project's Research Objectives (see Section 7 below) and helps provide a firm base on which to progress publication work.

5 Factual Data and Statement of Potential: Sediments and Soils

5.1 Micromorphology (App. D)

Summary

5.1.1 A soil block was sub-sampled from monolith <421> which provided for micromorphological analysis at the McBurney Laboratory, Department of Archaeology, University of Cambridge. This sample was taken across the thin deposit horizon 1004/1005 at the base of Saltern 5 and into the initial layer of filtration waste (1002) belonging to Group 1039. Deposits 1004/1005 are indicative of the repeated, micro-laminar, stop/start deposition of fine material, by slow water action with repeated episodes of surface drying out. This would be expected to be found on the edge of an active body of water, such as a small stream or marsh. In context 1002 above, these same sediments take on a swirled and convoluted aspect, suggesting that there are greater erosive impact and mixing processes going on, with a greater water flow involved.

Statement of potential

5.1.2 This work characterises the naturally lain nature of the uppermost tidal flat/saltmarsh sediments (1004/1005) upon which salt-making commenced with the mixed nature of the overlying material (1002) characteristic of the tips and dumps of waste filtration silts constituting the saltern.

6 FACTUAL DATA AND STATEMENT OF POTENTIAL: SCIENTIFIC DATING

6.1 Archaeomagnetic dating (App. E)

Summary

6.1.1 An archaeomagnetic investigation was carried out by the University of Bradford's School of Archaeological and Forensic Sciences on the remains of a brine boiling hearth (**1010**). A total of 23 samples were collected from the fired clay superstructure (1018) of this feature. The magnetic direction recorded by the feature returned one possible age range when calibrated against the current British reference curve (Batt *et al*. 2017) at 95% confidence levels: AD870 – AD1050 (AD900 - AD1030 at 68% confidence). It is important to note that this possible age range relates to the last time the feature was heated above *c*.400°C, and therefore potentially dates to the end of the phase of activity within the structure.

Statement of potential

6.1.2 The archaeomagnetic date has dated the 'enclosed' brine boiling hearth to the Late Saxon period. This data along with the radiocarbon dates and pottery has good potential to aid the reconstruction of the date range and longevity of the use of Saltern 5.

6.2 Radiocarbon dating (App. F)

Summary

6.2.1 Three samples were sent for radiocarbon dating comprising charcoal recovered from hearth waste and the fill of a hearth rake-out pit. The three fragments of charcoal produced dates spanning the Late Saxon and into the very early medieval period.

Laboratory number	Radiocarbon age (BP)	δ13C (‰)	Calibrated date range (AD)	Confidence %	Material	Cxt.	Cut/ Group	Saltern
SUERC-87797	1052±26	-27.3	901-1052 951-1025	95.4 88.4	Charcoal (*Calluna vulgaris Erica sp*)	861	Grp. 1035	4
SUERC-87802	952±26	-27.6	1024-1154	95.4	Charcoal (*Calluna vulgaris Erica sp*)	1033	**1011**	5
SUERC-87801	939±26	-24.4	1030-1155	95.4	Charcoal (*Quercus sp*)	994-998	Grp. 958	5

Table 4: Radiocarbon dates

Statement of potential

6.2.2 The radiocarbon dates retrieved at this stage have securely dated charcoal recovered from three contexts across two salterns. Further radiocarbon dates could provide additional dates which would aid in identifying the earliest and latest use of this particular group of saltern mounds and how they relate to the sequence of salt-working identified at the adjacent Lynnsport sites. With this aim, at the analysis stage both the radiocarbon and archaeomagnetic dates recovered from this site and the Lynnsport sites will be subjected to Bayesian modelling by SUERC at the analysis/publication stage.

7 Updated Project Design

7.1 Revised research aims

7.1.1 This project is part of a wider study into the salt-making industry of Gaywood, King's Lynn and the specific goals of these investigations have been set out in the document for the adjacent OA East investigations on the Lynnsport developments - 'Lynnsport 1-5: The emerging historical salt-making landscape of Gaywood, King's Lynn, Norfolk: Overarching Written Scheme of Investigation' (Brudenell and Clarke 2017). The following aims have been broken into a variety of categories relating to the salt-making industry.

Saltern mounds and mound formation

What period did the mounds develop over? Can we retrieve sufficient material to date mound's sequences and bracket their chronology?

7.1.2 Previous investigations by OA East into salterns within the Lynnsport developments have yielded very poor finds assemblages which is also reflected in the current excavations. Within Saltern 4, heather charcoal from a tip of hearth waste within the lower mound sequence (Group 1035) returned a radiocarbon date of 950-1025 cal AD (88.4% confidence). This date reiterates the single Grimston Thetford-type ware sherd (date range of late 10th to 11th century) excavated from the upper sequence of salt-making waste (Group 809). Within Saltern 5, the earliest secure date for salt-making was determined by archaeomagnetic dating of enclosed hearth **1010** of 870-1050 AD (95% confidence) with a less confident dating bracket (68%) also suggested of 900-1030 AD. As this date relates to the last time this feature was heated above *c*.400°C, this date range brackets the end of the use of this hearth. Heather charcoal from hearth waste tipped into adjacent rake-out pit **1011**, assumed to have been associated with this hearth, returned a later date of 1020-1150 cal AD (95.4% confidence). Within the upper sequence of salt-making waste products tipped across the southern side of the saltern (Group 958), oak charcoal from a layer of hearth waste (994-998) returned an almost identical date of 1030-1150 cal AD (95.4% confidence). This date was supported by the recovery of three sherds of a ?Lincoln Saxo-Norman Sandy ware jar was recovered from a further layer of hearth waste within this upper group of deposits.

7.1.3 The similar radiocarbon, archaeomagnetic and pottery dates for both Salterns 4 and 5 suggest this group of salterns uncovered on the site were broadly contemporary in date and indicate salt-making activity being carried out across the 10th to 12th centuries. This date range is notably later than the dating bracket determined for the adjacent saltern group excavated at Lynnsport 4 and 5 to the south of the site; along the historical *Salter's Waie* (current Greenpark Avenue). Investigations by OA East indicated those salterns commenced during the 9th century and went out of use prior to the 11th century, suggesting a northward progression (Clarke 2017b, 36).

Were there periods of hiatus in mound formation, and can this be identified from soil stabilisation horizons?

7.1.4 The thin deposit horizon (1004/1005) observed in section at the contact between the tidal flat deposits and the saltern deposits was sampled for micromorphological analysis. Similar thin horizons were observed during the excavation of the saltern at Marsh Lane (Clarke 2016) and Lynnsport 4 and 5 (Clarke 2017b) that displayed leaching horizons indicative of buried soils. These layers were characterised as naturally lain saltmarsh sediments belonging to the uppermost reaches of the tidal flats. This observation is therefore important evidence for determining the environment upon which salterns were established. The preferred locations for these mounds may have lain along a constrained zone along the tidal limit of the coastline, which probably shifted over time.

7.1.5 No stabalisation horizons were encountered in any of the salterns to indicate periods of hiatus in salt-making activity. Similarly, there were no sharp horizons mapped within the mounds profiles to suggest periods of abandonment or erosion of the waste deposits constituting the mounds.

Is there any evidence to support the hypothesis that mounds further east (landward) are earlier than those to the west (seaward)? In particular, are there further Mid-Late Saxon dates on eastern/landward salterns?

7.1.6 Gaywood's historic North Marsh, upon which the salt-making industry lay, acted as the delta for Gaywood River until it was diverted and canalised along its present course along the southern margins of the marsh in 1425. Its historical course probably flowed through the marsh's central part where it was known as 'le Seadyck' (Norfolk Records Office (NRO) reference BL 55/1). Therefore 'landward' may be taken to mean both the mounds further east *and* closer to the higher causeway of dry land to the south connecting Gaywood with King's Lynn. Therefore, the more 'seaward' locations may possibly also be taken to include the more 'riverward' salt-making sites as this delta was gradually infilled by saltern mounds. Excavation by OA East of one of the most landward salterns mapped by the NHER at Marsh Lane determined salt-making may have commenced at that site as early as the 8th century, the Middle Saxon period (Clarke 2016). As discussed above, the more 'landward' excavations at Lynnsport 4 and 5 to the south also provided a slightly earlier dating bracket than the current site of between the 10th to 12th century. This model would also fit the dating evidence recently excavated from a group of three salterns excavated at Lynnsport 1, that although the most eastward excavation on the marsh, lay adjacent to the Late Saxon and medieval river channel. Radiocarbon dates and pottery from two of those salterns suggest a contemporary dating bracket to the current site of salt-making activity having been carried out between the 10th to 12th century (Blackbourn 2019, 25).

What evidence is there for the secondary use of the salt mounds and surrounding flats after the salt industry declined?

7.1.7 Fragments of a large diameter iron smithing hearth were recovered from salt-making waste material (Group 909) forming Saltern 6. It is possible brine-boiling hearths also had a secondary use as smithing hearths. Iron slag has also been recovered from each of the salterns excavated at Lynnsport 1 indicating that iron smithing, although secondary to salt-making, was perhaps practiced more widely at these saltern sites. This activity may have been allied to the repair and maintenance of tools directly employed in salt-making.

7.1.8 Documentary evidence supports the hypothesis that the North Marsh of Gaywood was utilised exclusively as valuable saltmarsh pasture and meadowland throughout the later medieval and post-medieval periods. One of the uppermost layers on the southern side of Saltern 5 (Group 967) contained fungal spores associated with grazing animals. The appearance of two partially revealed hayricks, placed upon Saltern 5, add to two complete examples of late 18th century date excavated by the adjacent Lynnsport 4 and 5 excavation, to the south of Saltern 4. The lack of any later artefacts further suggests these mounds lay largely undisturbed until relatively recently.

Saltern fixtures and features

What structures were associated with the salterns (salt-cotes) and what activities were conducted in them?

7.1.9 No structural evidence (post holes or beamslots) was encountered on any of the salterns. The only structural remains recorded thus far by the adjacent Lynnsport development was a group of post holes and a gully associated with a group of filtration tanks excavated at Lynnsport 1 (Blackbourn 2019). The enclosed brine-boiling hearths are presumed to have been housed within purpose-built shelters known as salt-cotes - the Saxon *saeltearn* - to protect this volatile activity from any adverse weather. Amongst the many, mostly extinct, saltern mounds mentioned by name in the Gaywood Dragge (survey) of 1487 (NRO BL/MA 2/2), the examples of Bulecote, Turncoults, and Hashecoates probably best illustrate the former presence of such structures upon them. As the upper parts of each of the salterns were commonly found to have been disturbed by roots or modern truncation it is probable that shallow structural remains are less likely to have survived on this site. However, as only a percentage of Salterns 4-6 was excavated it remains a possibility that such structures lie outside the excavation areas.

What are the forms of the brine-boiling hearths and how did hearth technology change over time? Were different hearth forms linked to the production of different grades of salt? Can such variation be measured from the chemical composition of the salt slags?

7.1.10 Brine-boiling was known from historical sources to have been carried out using lead pans (*plumba*) placed over specially constructed clay hearths. This is borne out by the recovery of fired clay briquetage from all previous OA East excavations at the Lynnsport and Marsh Lane developments. The current site has recovered fragments of upwards of nine fired clay brick supports for lead pans from a layer of hearth waste (920, Group 907) within Saltern 5. Other examples of these supports excavated nearby include a single soft fired brick found in the upper mound sequence (*c*.12th to mid-13th century) of the saltern excavated at Marsh Lane (Clarke 2016). Possible pedestals were also recovered from the 12th to 13th century saltern site at former Queen Mary's nursing home, King’s Lynn (Cope-Faulkner 2014). Further afield, soft silt brick supports have been found *in-situ* with the hearth excavated at Wainfleet St Mary, Lincolnshire

(McAvoy 1994) with additional examples of hand-made bricks found at Walpole St Peter, Norfolk (Clarke 2009).

7.1.11 Significantly, an *in-situ* example of a brine boiling hearth (**1010**) was unearthed within the upper sequence of deposits constituting Saltern 5. The surviving elements included the base and the lowest part of the enclosing sub-square superstructure. A central column of clay also survived which separated two chambers. This distinctive 'double-chambered' hearth arrangement for brine-boiling first came to light in King's Lynn when a single example, dated by archaeomagnetic means to *c*.1245 was excavated at the former Queen Mary's Nursing Home (Faulkner 2014). Two further early medieval examples (*c*.AD1066-1250) were later excavated by OA East at the Marsh Lane saltern (Clarke 2016). The only other *in-situ* remains excavated locally was a very heavily truncated hearth uncovered during the evaluation of Saltern 1 at the adjacent Lynnsport 4 and 5 development (Clarke 2017a). The secure archaeomagnetic date (AD870-1050 (95% confidence)) provided for the current example therefore pushes the origin of this type of brine boiling oven back to at least the Late Saxon period.

Is there patterning in the layout of tanks and filtration units? Is there any evidence that they changed in form and size over time?

7.1.12 No complete examples of filtration units were revealed during the excavations. A total of 12 clay-lined features were identified in Saltern 5, with a further four excavated in Saltern 4. These incomplete examples consisted more commonly of the base of the circular collection tanks and more rarely the flat-based rectangular filtration pits. As described for Marsh Lane (Clarke 2016) and Lynnsport 4 and 5 (Clarke 2017b) the presence of these partial remains possibly indicate the clay-lining was being recycled for the construction of later filtration units as each mound developed. The circular clay-lined bases of the collection tanks would be the most difficult part of the clay-lining to recover. The morphology of these remains conformed to the 'formal' design of this characteristic salt-making feature observed on both the Norfolk and Lincolnshire coastline facing The Wash, which on the evidence excavated at Marsh Lane and Lynnsport 4 and 5 may have originated during the Middle Saxon period.

What clay was used for lining the filtration units and constructing the hearths? What fuel was being burnt in the hearths? What were the sources?

7.1.13 All clay-lined features identified during this excavation used the same light to mid blue grey clay as that excavated at Lynnsport 4 and 5, which determined the inclusion of seeds of freshwater taxa within the clay (Clarke 2017b). There was only scant evidence of what was used to fuel the hearths which is a common theme on saltern sites of this period; the fuel ash waste probably reduced further by post-depositional weathering to the black soil stains observed within the waste material. Charred heather was identified in the hearth waste remains which would suggest the use of peat turves. Peat obtained from nearby turbaries has always assumed to have been the main fuel source from its mention in historical documents associated with salterns. Charcoal of oak was also present and may have been utilised as fuel, presumably less easy to source locally.

Is there any evidence that channels and creeks were being modified or lagoons created to improve the efficiency of the salt-making process?

7.1.14 It was not possible to excavate the channel extending around Saltern 5 due to the waterlogged ground conditions. This channel dates back to at least 1820 when it is shown on the Inclosure Award map. It remains open for debate whether it delineates the course of an older tidal creek which may have provided a means of waterborne transport to the site.

Salt makers and social context

Can we gauge anything about the scale and duration of episodes of salt-making from the refuse left behind by the salt makers (pottery, animal bone etc.)? Is there any associated settlement activity? Is there any evidence to support the hypothesis that salt-making was only a seasonal activity?

7.1.15 No thin bands of material indicative of buried soils or sharp horizons to suggest erosion processes were observed in any of the mounds to evidence periods of abandonment or hiatus in salt-making. The significant scale of Salterns 5 and 6, which only partly lay within the excavation area, demonstrate this site was a significant salt-making site in the North Marsh with probably a corresponding long duration in use. The slight dating evidence from Salterns 4 and 5 indicate a duration of use spanning perhaps 200-300 years, bridging both the Late Saxon and early medieval period with activity perhaps centered on the late 10th to 11th centuries.

7.1.16 The longevity of these salterns would therefore appear to be more in keeping with the longevity (perhaps as much as *c*.400 years) determined for the saltern excavated to the north-east at Marsh Lane, that continued in use, albeit possibly intermittently, across a broad period (*c*.850-1250) from the beginning of the Late Saxon to the early medieval period (Clarke 2016). The salterns to the south excavated at Lynnsport 4 and 5 did not produce any medieval material or radiocarbon dates and were considered to be shorter lived, representing the build-up of *c*.100+ years of salt-making deposits, centred on the 9th century (Clarke 2017b).

7.1.17 No associated settlement activity was revealed by the excavations.

7.1.18 The above observations are only tentative at this stage as the excavation areas were small in size and did not allow for the full saltern mounds to be excavated. The salt-making material constituting these mounds and the features uncovered within them should only be taken as a partial 'snap-shot' into each saltern.

What other activities were taking place on the salt mound? Evidence for iron smithing was found at Marsh Lane, but how widespread is this?

7.1.19 A small quantity of metal working debris related to iron smithing was recovered from a single context within Saltern 6. This has been interpreted as direct evidence for the re-use of the salt hearths as iron smithing hearths; either for the mending or re-forging of iron tools associated with salt-making itself or merely opportunistic use. Iron smithing slag was also recovered from Salterns 10-12 excavated at the recent Lynnsport 1 excavation to the east, suggesting opportunistic re-use of the saltern hearths for this activity was widely practiced (Blackbourn 2019).

Can historical sources help us to better understand the scale and organisation of salt-making in North Lynn?

7.1.20 See Section 7.3.3 below.

Salterns and landscape change

Can the investigations help us to understand the natural environment and landscape in which the salt-making was taking place?

7.1.21 Unfortunately, none of the sub-samples contained sufficient pollen for interpretation. The preserved pollen comprised various tree and shrub taxa along with herb pollen including several species of the salt tolerant goosefoot family (Chenopodiaceae). More complete macrofossil and pollen assemblages have recently been obtained from the archaeological investigation on the Lynnsport 1 development (Blackbourn 2019). The micromorphological analysis of the deposits underlying Saltern 5 supports the current view that preferred locations for new salt-making sites lay at the uppermost tidal limit of the coastal mudflats. Both the ostracod and foraminiferal evidence confirms the idea that the silts used in sleeching were collected from the surrounding upper tidal mudflats penetrated by the tidal creeks which constituted the lower (more seaward) saltmarsh.

7.1.22 Assessment of the ostrocod assemblage (Appendix C.3) has provided a very reasonable picture of the source environment of these sleeching silts - suggesting the specific zones within the local estuarine saltmarsh system where these might have been dug then transported to the mounds/ saltern hearths for further processing. The evidence from Saltern 5, Greenpark Avenue is almost certainly better than that obtained from either Lynnsport Site 1 (Blackbourn 2019) or Lynnsport Sites 4 & 5 (Clarke 2017b).

How do the salterns relate to the Gaywood River and the main channel of the Great Ouse, and what were their palaeoenvironments

7.1.23 Documentary evidence demonstrates that prior to its diversion along the southern margins of Gaywood's North Marsh in 1425, the Gaywood River flowed through the central part of the North Marsh, *c*.250m to the north of the site (NRO reference BL 55/1).

7.1.24 The salt-making activity on the site clearly pre-dates the diversion of the Great Ouse to King's Lynn in the 13th century. The arrival of this substantial freshwater estuary may have had a significant negative impact on salinity levels of the mudflats on the North Marsh and contributed to a more general decline in the salt-making industry. The raising of ramparts around King's Lynn in the 13th century, at the time of the diversion of the Great Ouse, possibly further contributed to the abandonment of some of the salterns located outside the defensive circuit. Documentary evidence from a survey of the North Marsh in the 15th century suggests a shift in land use to extensive permanent grazing pastures (NRO BL/MA 2/2). This was an unintended consequence of the general raising of the ground level across the saltmarsh as a result of mound building. Construction of the Old East Seabank flood defences (Fig. 2, NHER 5528) in the 17th or 18th century, possibly associated with the 18th-century canalisation and diversion of the Great Ouse to its current course, was a further significant alteration to the landscape of the North Marsh. The presence of both remnant ridge and furrow or 'lazybedding' agricultural features (see Section 1.3.9) and Riley circles (hayricks) excavated at the current site and on Lynnsport 4 and 5 to the south demonstrate a range of agricultural activity probably continued on the saltmarsh until Inclosure in 1820.

How did the salt-making industry contribute to the reclamation of the saltmarsh and what can it tell us about the dating/phasing of that process?

7.1.25 The date range for these 'landward' salterns on the southern margins of Gaywood's historical North Marsh, adjacent to *Salter's Waie* (current Greenpark Avenue), complement the date range for the 'landward' saltern excavated at Marsh Lane. The evidence points towards a possible late 8th century date for the commencement of salt-making activity in the North Marsh. Documentary evidence (see Section 8.3 below) provides evidence for 'seaward' salterns still being in-use on the western margins of the North Marsh in the 15th century. A bracket of reclamation of the North Marsh for pasture between the later *c*.8th century and *c*.15th century may therefore be postulated for the salt-making industry. This reclamation may also have gradually converged on the pre-existing course of the River Gaywood.

7.1.26 As discussed in Section 7.1.9 above, the date range for the current crop of salterns complement both the 'landward' salterns of Lynnsport 4 and 5 on the southern margins of Gaywood's historical North Marsh (adjacent to Salters Way) and that previously excavated at Marsh Lane to the east. The evidence points towards a possible late 8th century date for the commencement of salt-making activity in the North Marsh. Documentary evidence (NRO BL/MA 2/2) provides evidence for 'seaward' salterns still being in-use on the western margins of the North Marsh in the 15th century. A bracket of reclamation of the North Marsh for pasture between the later *c*.8th century and *c*.15th century may therefore be postulated for the salt-making industry in the North Marsh. This reclamation was punctuated by the major episodes of landscape change related to the management of the River Ouse and establishment of sea defences detailed in Section 7.1.37. This reclamation may also have gradually converged on the pre-existing course of the River Gaywood.

Research frameworks

7.1.27 In general terms, the artefactual, ecofactual and stratigraphic data recovered from the site that inform the goals of the wider OA East study into the salt-making industry of Gaywood discussed above (Brudenell and Clarke 2017) will also contribute to the goals of Regional Research Frameworks relevant to this area listed in Sections 1.5.20-5.

7.2 Interfaces, communications and project review

7.2.1 The Post-Excavation Assessment has been undertaken principally by Toby Knight (TK) and Graeme Clarke (GC) and edited and quality assured in-house by Project Manager Matt Brudenell (MB), Post-Excavation Editor Rachel Clarke (RC) and Head of Post-Excavation & Publications Elizabeth Popescu (EP). It will be distributed to the Client (NPS Property Consultants Limited) and James Albone (JA) from Norfolk County Council (NCC) for comment and approval.

7.2.2 Following approval of the Post-Excavation Assessment, discussions will be had between GC, MB, RC, the Client and JA to progress the post-excavation analysis and publication. It is anticipated that this excavation will be incorporated within an overall publication encompassing the findings of both the current project and the OA East excavations on the adjacent Lynnsport development. Input shall also be sought at this stage from Elizabeth Popescu (EP), the in-house Head of Post-Excavation and Publications. As a result of this meeting, a Publication Synopsis will be prepared.

7.2.3 Meetings will be arranged at relevant points during the post-excavation analysis with JA, or be conducted via email or telephone as appropriate.

7.3 Methods statement

Stratigraphy

7.3.1 The stratigraphic text included within this report details the grouping and phasing of the site, and a complete context inventory has also been included. The specialist information, especially the pottery and radiocarbon dating results, have been integrated into this assessment to aid dating and support the grouping and phasing of the site. The next stage of publication work will combine these results along with the results of all of the adjacent Lynnsport development sites to allow for a more integrated discussion of the salt-making remains on both the site and landscape levels. During the final analysis and publication stage, contexts, finds and environmental data will be analysed alongside scientific dating using an MS Access database in combination with AutoCAD and GIS applications. The specialist information will be updated and added to as appropriate. The final stratigraphic narrative incorporating the updated specialist information will form the basis of this site's contribution to the overall publication.

Illustration

7.3.2 The existing CAD plans and sections will be updated with any amended phasing and additional sections digitised if appropriate. Publication figures will be generated using Adobe Illustrator. Finds recommended for illustration will be drawn by hand and then digitised, or where appropriate photography of certain finds-types will be undertaken.

Documentary research

7.3.3 In general primary and published sources will be consulted where appropriate using the Norfolk Historic Environment Record and other resources (*e.g* Norfolk Records Office and National Archives) and will also include aerial photographs, historic maps and reports on comparable sites locally and nationally in order to place the site within its landscape and archaeological context. As it is anticipated this project will be incorporated with the Lynnsport project into a single publication, this evidence will be collated to avoid duplication of effort (see catalogue of historical records for Clarke 2017b, 43), and where relevant reproduced in the subsequent publication.

7.3.4 A search for primary medieval documents will be undertaken by historian Nick Holder (NH) for evidence pertaining to salt-making in Gaywood's North Marsh relating to the themes of ownership, links to ecclesiastical establishments, social context and resources addressed by the Research Objectives.

7.3.5 A search of the NHER aerial photography record was made as part of the desk-based assessment produced for the site's development by NPS Archaeology (Copsey and Hobbs 2016), with the findings detailed in Section 1.3.7 and 1.3.9. No further aerial photography analysis is required. Historical maps were also consulted as part of the desk-based assessment; summarisd in Section 1.3. A search of further records that will be consulted will include Andrew Bryant's map of 1876 and the Gaywood Tithe map of 1838.

7.3.6 LiDAR data shall be consulted along with historical mapping in the further analysis of the overall saltern complex within the North Marsh.

Artefactual, ecofactual and sediment analysis

7.3.7 All the artefacts, ecofacts and selected sediments have been assessed/analysed with detailed recommendations for any additional work given in the individual specialist reports (Appendices B1-3, C1-3 and D.1). Further work is recommended below. It is anticipated that at the publication stage the assemblages gained from both the Greenpark Avenue and Lynnsport development sites will be drawn together and combined into analysis reports for each material type.

Slag:

- Chemical analysis should be undertaken on the salt slag assemblage for indications of lead and other elements (such as undertaken using pXRF on the Marsh Lane assemblage (Timberlake Appendix B.6 in Clarke 2016)).
- Incorporation into proposed publication.

Pottery:

- No further work other than incorporation into proposed publication.

Fired clay:

- Chemical analysis should be undertaken to confirm the indications of lead and other elements (pXRF analysis has already been undertaken on the Marsh Lane briquetage assemblage (Timberlake Appendix B.6 in Clarke 2016)).
- Incorporation into proposed publication.

Environmental bulk samples:

- No further work other than incorporation into proposed publication.

Pollen:

- No further work other than incorporation into proposed publication.

Ostracods and foraminifera:

- At the publication stage, it will be necessary to compare the ostracod and foraminifera assemblages recovered from this site with the ostracod and foraminiferal populations recorded from the tanks and waste silts at Lynnsport Site 1 (Blackbourn 2019) and Lynnsport Sites 4 & 5 (Clarke 2017b).
- Incorporation into proposed publication.

Micromorphological analysis:

- No further work other than incorporation into proposed publication.

Radiocarbon dating:

- A further suite of at least two radiocarbon dates is required from selected layers of deposits within the salterns to aid the reconstruction of the chronology of salt-making at this site. With this aim a review of the charcoal recovered from the salterns should be carried out.
- Incorporation into proposed publication. Bayesian analysis of the radiocarbon dating data may also be required at the publication stage which will incorporate the archaeomagnetic date.

7.4 Publication and dissemination of results

7.4.1 Following approval of the Post-Excavation Assessment Report by NCC/HES, it will be lodged with the NHER and available online at the ADS and on the OA Library (https://library.thehumanjourney.net/).

7.4.2 Tasks associated with report writing are identified in Table 6 (see Section 8.2 below). It is proposed that the results of this project and all phases of OA East's work on the Lynnsport developments (including evaluation data) will be published in the EAA monograph series under the working title 'The Middle to Late Saxon and Medieval Salt-Making Industry of Gaywood's North Marsh. Excavations at Lynnsport, King's Lynn, Norfolk'.

7.4.3 A full publication synopsis will be submitted to the EAA committee following approval of the final PXA &UPD for the Lynnsport developments (see Section 8.2.1).

7.5 Retention and disposal of finds and environmental evidence

7.5.1 Recommendations for the retention and/or disposal of each artefactual or ecofactual assemblage have been made by the relevant specialists during this assessment stage (see Appendices B.1-3 and C1-3). On completion of full synthesised analysis of each material type at the publication stage, discussions will be had between the relevant parties (see Section 7.2 above) to oversee the disposal of redundant material and preparation for archiving of material considered to hold continuing value for the archaeological record. The retained material will be deposited with the site archive in due course (see below).

7.6 Ownership and archive

7.6.1 All artefactual material recovered will be held in storage by OA East and ownership of all such archaeological finds will be given over to the relevant authority to facilitate future study and ensure proper preservation of all artefacts. During analysis and publication preparation, OA East will hold all material and reserves the right to send material for specialist analysis. It is Oxford Archaeology Ltd's policy, in line with accepted practice, to keep site archives (paper and artefactual) together wherever possible.

7.6.2 The archive will be prepared in accordance with current OA East guidelines, which are based on current national guidelines. NCC requires transfer of ownership prior to deposition.

7.6.3 Excavated material and records will be deposited with, and curated by, Norwich Castle Museum under county HER code/Event Numbers ENF143325 (evaluation) and ENF145594 (excavation). Norwich Castle Museum, will also allocate the Accession Number NWHCM:2018.77 for these records. A digital archive will be deposited with OA Library/ADS.

7.6.4 OA East will retain copyright of all reports and the documentary and digital archive produced in this project (unless the client has reserved copyright); OA East will maintain the archive to the standards recommended by the Chartered Institute for Archaeologists (CIfA 2014), the Archaeological Archives Forum (Brown 2011).

8 Resources and Programming

8.1 Project team structure

8.1.1 The project team is set out in the table below:

Name	Initials	Organisation	Role
Matthew Brudenell	MB	OAE	Project Manager and prehistoric pottery specialist
Elizabeth Popescu	EP	OAE	Post-Excavation and Publication Manager
Rachel Clarke	RC	OAE	Editor
Rachel Fosberry	RF	OAE	Environmental co-ordinator
Graeme Clarke	GC	OAE	PX Project Officer & Co-Author; documentary research
Simon Timberlake	ST	Freelance	Slag, fired clay, ostracod and foraminifera specialist
Sue Anderson	SA	Freelance	Pottery specialist
Mary Rutherford	MR	OAN	Pollen specialist
SUERC	SUERC	SUERC	Radiocarbon dating and Bayesian modelling
Patrick Quinn	PQ	UCL	Ceramic petrology
Séverine Bézie	SB	OAE	Illustrator
James Fairbairn	JF	OAE	Finds photography
Nick Holder	NH	Freelance	Historical researcher
Katherine Hamilton	KH	OAE	Archive Supervisor

Table 5: Project team

8.2 Task list and programme

8.2.1 Compilation of a final archive report is normally completed within one year of the approval of the Post-Excavation Assessment and Updated Project Design (PXA & UPD). However, in this case, it is anticipated a final archive report will not be produced with any further analysis forming part of the proposed EAA publication into the wider body of work carried out by OA East on the adjacent Lynnsport developments (see Section 7.4). The final PXA & UPD for Lynnsport 3 is anticipated to be submitted by the end of 2019 at the earliest. Consequently, a publication proposal for the monograph likely to be submitted to EAA in early 2020. A task list of further analysis work on assemblages recommended by specialists for the current site to be incorporated within this overall publication, is identified in Table 6.

8.2.2 A task list is presented below.

Task No.	Task		Staff	No. Days
Project Management				
1	Project management		MB EP	3
2	Team meetings		MB RC EP GC	2
3	Liaison with relevant staff and specialists, distribution of relevant information and materials		GC, MB	3
Stage 1: Stratigraphic/artefactual/ecofactual analysis and documentary research for publication				
4	Integrate ceramic/artefact/C14 dating with site matrix		GC	1

Task No.	Task		Staff	No. Days
5	Update database and digital plans/sections to reflect any changes		GC	1
6	Finalise site phasing		GC	1
7	Add final phasing and groups to database		GC	1
8	Compile group and phase text based on PXA text		GC	1
9	Update overall stratigraphic text and site narrative for incorporation into the publication		GC	1
10	Review, collate and standardise results of all final specialist reports and integrate with stratigraphic text and project results		GC	1
Artefact studies				
11	Slag: incorporation into publication		ST	1
11	Late Saxon and medieval pottery: incorporation into publication		SA	0.5
12	Fired clay: incorporation into publication		ST	1
13	Research into residual surface metals (copper/tin/lead) on salt slag and fired clay surface using pXRF;		ST	1
Ecofact studies				
14	Ostracod assemblage: compare with Lynnsport development assemblages and incorporation into publication		ST	1.5
15	Foraminifera assemblage: compare with Lynnsport development assemblages and incorporation into publication		ST	1.5
16	Charred and waterlogged plant plant remains from bulk samples: incorporation into publication		RF	0.5
17	Pollen: Incorporation into archive report		MR	0.5
18a	Radiocarbon dating of 2 x further charred remains samples at *c.*£315 per sample		RF/SUERC	-
18b	Bayesian modelling of radiocarbon and archaeomagnetic dates in relation to stratigraphy at *c.*£305 per day		SUERC	1
Documentary research				
19	Research into relevant Anglo-Saxon and medieval saltern sites		GC	2
20	Additional research into the history of King's Lynn		GC	1
21	Visit NHER		GC	1
22	Research into Anglo-Saxon and medieval documents		NH	3
Stage 2: Publication				
23	Produce draft publication		GC	5
24	Compile list of illustrations/liaise with illustrators		GC SB EP RC	1
25	Produce publication figures		SB	3
26	Select photographs for inclusion in the publication		GC	0.5
27	Photography of selected slag and fired clay examples for publication		JF	0.5
28	Internal edit		EP/RC	2
29	Incorporate internal edits		GC	0.5

Task No.	Task		Staff	No. Days
30	Final edit		EP RC MB	1
31	Send to publisher for refereeing		EP/RC	0.5
32	Post-refereeing revisions		EP/RC	2
33	Copy edit queries		EP	1
34	Proof-reading		GC EP MB	1
Stage 4: Archiving				
47	Compile paper archive		GC	1
48	Archive/delete digital photographs		GC	1
49	Compile/check and deposit material archive		GC /KH	2

Table 6: Task list

* See Appendix H for product details and Appendix I for the project risk log.

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APPENDIX A CONTEXT INVENTORY

Area	Context	Cut	Deposit Group Number	Saltern	Period	Category	Feature Type	Function
	800		800		3	layer	topsoil	
	801		801		3	layer	subsoil	
	802		802		1	layer	natural	tidal flat deposit
K	803	803		4	2	cut	filtration unit	concentrated brine production
K	804	803		4	2	fill	filtration unit	clay lining
K	805	803		4	2	fill	filtration unit	disuse
K	806	803		4	2	fill	filtration unit	clay lining
K	807	808		4	2	fill	filtration unit	disuse
K	808	808		4	2	cut	filtration unit	concentrated brine production
K	809	829		4	3	fill	Modern truncation	backfill
K	810		809	4	2	layer	saltern mound	filtration waste
K	811		809	4	2	layer	saltern mound	filtration waste
K	812		809	4	2	layer	saltern mound	filtration waste
K	813	829		4	3	fill	Modern truncation	backfill
K	814	829		4	3	fill	Modern truncation	backfill
K	815	829		4	3	fill	Modern truncation	backfill
K	816		809	4	2	layer	saltern mound	filtration waste
K	817		809	4	2	layer	saltern mound	filtration waste
K	818		809	4	2	layer	saltern mound	filtration waste
K	819	829		4	3	fill	Modern truncation	backfill
K	820		809	4	2	layer	saltern mound	filtration waste
K	821		809	4	2	layer	saltern mound	filtration waste
K	822		809	4	2	layer	saltern mound	filtration waste
K	823		809	4	2	layer	saltern mound	filtration waste
K	824		809	4	2	layer	saltern mound	filtration waste
K	825		809	4	2	layer	saltern mound	filtration waste
K	826		809	4	2	layer	saltern mound	filtration waste
K	827		809	4	2	layer	saltern mound	filtration waste
K	828		809	4	2	layer	saltern mound	filtration waste
K	829	829		4	3	Cut	Modern truncation	Unknown
K	830		1036	4	2	layer	saltern mound	filtration waste
M	833		809	4	2	layer	saltern mound	filtration waste
M	834		809	4	2	layer	saltern mound	filtration waste
M	835		809	4	2	layer	saltern mound	filtration waste
M	836		809	4	2	layer	saltern mound	filtration waste
M	837		809	4	2	layer	saltern mound	filtration waste
M	840		809	4	2	layer	saltern mound	filtration waste
M	841		809	4	2	layer	saltern mound	filtration waste
M	842		809	4	2	layer	saltern mound	filtration waste
M	843		809	4	2	layer	saltern mound	filtration waste
M	844		809	4	2	layer	saltern mound	filtration waste
M	845		809	4	2	layer	saltern mound	filtration waste

Area	Context	Cut	Deposit Group Number	Saltern	Period	Category	Feature Type	Function
M	846		809	4	2	layer	saltern mound	filtration waste
M	847		809	4	2	layer	saltern mound	filtration waste
M	848		809	4	2	layer	saltern mound	filtration waste
M	849		809	4	2	layer	saltern mound	filtration waste
M	850		809	4	2	layer	saltern mound	filtration waste
M	851		809	4	2	layer	saltern mound	filtration waste
M	852		809	4	2	layer	saltern mound	filtration waste
M	853		1036	4	2	layer	saltern mound	filtration waste
M	854		1036	4	2	layer	saltern mound	filtration waste
M	855		1036	4	2	layer	saltern mound	filtration waste
M	856		1036	4	2	layer	saltern mound	filtration waste
M	857		1036	4	2	layer	saltern mound	filtration waste
M	858		1036	4	2	layer	saltern mound	filtration waste
M	859		1035	4	2	layer	saltern mound	hearth waste
M	860		1035	4	2	layer	saltern mound	hearth waste
M	861		1035	4	2	layer	saltern mound	hearth waste
M	862		1035	4	2	layer	saltern mound	hearth waste
M	863		1035	4	2	layer	saltern mound	hearth waste
M	864		1035	4	2	layer	saltern mound	hearth waste
M	865		1035	4	2	layer	saltern mound	hearth waste
M	866		1035	4	2	layer	saltern mound	hearth waste
M	867		1035	4	2	layer	saltern mound	hearth waste
M	868		1035	4	2	layer	saltern mound	hearth waste
M	869		1035	4	2	layer	saltern mound	hearth waste
M	870		1035	4	2	layer	saltern mound	hearth waste
M	871		1035	4	2	layer	saltern mound	hearth waste
L	872	872		5	2	cut	filtration unit	concentrated brine production
	873	872		5	2	fill	filtration unit	disuse
L	874	872		5	2	fill	filtration unit	clay lining
L	875	875		5	2	cut	filtration unit	concentrated brine production
L	876	875		5	2	fill	filtration unit	clay lining
L	877	875		5	2	fill	filtration unit	disuse
L	878	875		5	2	fill	filtration unit	disuse
L	879	879		5	2	cut	filtration unit	concentrated brine production
L	880	879		5	2	fill	filtration unit	clay lining
L	881	879		5	2	fill	filtration unit	disuse
L	883		958	5	2	layer	saltern mound	Hearth Waste
L	884	886		5	3	fill	gully	silting
L	885	886		5	3	fill	gully	silting
L	886	886		5	3	cut	gully	drainage
L	887	887		5	2	cut	pit	unknown
L	888	887		5	2	fill	pit	disuse
L	889	889		5	2	cut	pit	unknown
L	890	889		5	2	fill	pit	disuse
L	891	889		5	2	fill	pit	disuse
L	892	892		5	2	cut	filtration unit	concentrated brine production
L	893	892		5	2	fill	filtration unit	clay lining
L	894	892		5	2	fill	filtration unit	disuse

Area	Context	Cut	Deposit Group Number	Saltern	Period	Category	Feature Type	Function
L	895	895		5	2	cut	filtration unit	concentrated brine production
L	896	895		5	2	fill	filtration unit	clay lining
L	897	895		5	2	fill	filtration unit	disuse
L	898	898		5	2	cut	pit	unknown
L	899	898		5	2	fill	pit	disuse
L	900	900		5	2	cut	filtration unit	concentrated brine production
L	901	900		5	2	fill	filtration unit	clay lining
L	902	900		5	2	fill	filtration unit	disuse
L	903		Hayricks	5	3	cut	gully	drainage
L	904	903	Hayricks	5	3	fill	gully	silting
L	905		Hayricks	5	3	cut	gully	drainage
L	906	905	Hayricks	5	3	fill	gully	silting
L	907		907	5	2	layer	saltern mound	filtration waste
L	908			5	2	cut	pit	unknown
L	909		909	6	2	layer	saltern mound	filtration waste
L	910		909	6	2	layer	saltern mound	hearth waste
L	911		909	6	2	layer	saltern mound	filtration waste
L	912		909	6	2	layer	saltern mound	filtration waste
L	913		909	6	2	layer	saltern mound	filtration waste
L	914	908		5	2	fill	pit	disuse
L	915	908		5	2	fill	pit	disuse
L	916	908		5	2	fill	pit	disuse
L	917	908		5	2	fill	pit	disuse
L	918	908		5	2	fill	pit	disuse
L	919	908		5	2	fill	pit	disuse
L	920		907	5	2	layer	saltern mound	hearth waste
	921		809	4	2	layer	saltern mound	Filtration Waste
J	922		1039	5	2	layer	saltern mound	filtration waste
K	923	923		4	2	cut	filtration unit	concentrated brine production
K	924	923		4	2	fill	filtration unit	clay lining
K	925	923		4	2	fill	filtration unit	disuse
K	926	926		4	2	cut	filtration unit	concentrated brine production
K	927	926		4	2	fill	filtration unit	clay lining
K	928	926		4	2	fill	filtration unit	disuse
K	929		809	4	2	layer	saltern mound	filtration waste
K	930		809	4	2	layer	saltern mound	filtration waste
K	931		809	4	2	layer	saltern mound	filtration waste
K	932		809	4	2	layer	saltern mound	filtration waste
K	933		809	4	2		saltern mound	filtration waste
K	934		809	4	2	layer	saltern mound	filtration waste
L	936		907	5	2	layer	saltern mound	filtration waste
L	937		907	5	2	layer	saltern mound	filtration waste
L	938		907	5	2	layer	saltern mound	Hearth Waste
L	939		907	5	2	layer	saltern mound	filtration waste
L	941	942		5	2	fill	filtration unit	clay lining
L	942	942		5	2	cut	filtration unit	concentrated brine production
L	943	942		5	2	fill	filtration unit	disuse
L	944	942		5	2	fill	filtration unit	disuse

Area	Context	Cut	Deposit Group Number	Saltern	Period	Category	Feature Type	Function
L	945	945		5	2	cut	filtration unit	concentrated brine production
L	946	945		5	2	fill	filtration unit	clay lining
L	947	945		5	2	fill	filtration unit	disuse
L	948	948		5	2	cut	filtration unit	concentrated brine production
L	949	948		5	2	fill	filtration unit	clay lining
L	950	948		5	2	fill	filtration unit	disuse
L	951	951		5	2	cut	filtration unit	concentrated brine production
L	952	951		5	2	fill	filtration unit	clay lining
L	953	951		5	2	fill	filtration unit	disuse
L	954	951		5	2	fill	filtration unit	disuse
L	955	951		5	2	fill	filtration unit	disuse
L	956	956		5	2	cut	pit	unknown
L	957	956		5	2	fill	pit	disuse
L	958		958	5	2	layer	saltern mound	hearth waste
L	959		959	5	2	cut	pit	unknown
L	960	959	959	5	2	fill	pit	disuse
L	961		958	5	2	layer	saltern mound	filtration waste
L	962		958	5	2	layer	saltern mound	hearth waste
L	963		958	5	2	layer	saltern mound	filtration waste
L	964		958	5	2	layer	saltern mound	Hearth Waste
L	965		958	5	2	layer	saltern mound	filtration waste
L	966		958	5	2	layer	saltern mound	hearth waste
L	967		967	5	3	layer	natural?	filtration waste
L	968		967	5	3	layer	natural?	filtration waste
L	969		958	5	2	layer	saltern mound	filtration waste
L	970		1039	5	2	layer	saltern mound	filtration waste
L	971		958	5	2	layer	saltern mound	filtration waste
L	972		958	5	2	layer	saltern mound	Hearth Waste
L	973		907	5	2	layer	saltern mound	Hearth waste
L	974		907	5	2	layer	saltern mound	Hearth waste
L	975		1039	5	2	layer	saltern mound	Hearth Waste
L	976		1039	5	2	layer	saltern mound	Hearth waste
L	977		1039	5	2	layer	saltern mound	filtration waste
L	978		1039	5	2	layer	saltern mound	Hearth Waste
L	979		1039	5	2	layer	saltern mound	filtration waste
L	980		1039	5	2	layer	saltern mound	Hearth waste
L	981		907	5	2	layer	saltern mound	filtration waste
L	982		907	5	2	layer	saltern mound	filtration waste
L	983		907	5	2	layer	saltern mound	filtration waste
L	984		907	5	2	layer	saltern mound	Hearth Waste
L	985		907	5	2	layer	saltern mound	filtration waste
L	986		907	5	2	layer	saltern mound	Hearth Waste
L	987		1039	5	2	layer	saltern mound	Hearth Waste
L	988		1039	5	2	layer	saltern mound	filtration waste
L	989	989		5	2	cut	pit	unknown
L	990	989		5	2	fill	pit	disuse
L	991	991		5	2	cut	pit	unknown
L	992	991		5	2	fill	pit	disuse

Area	Context	Cut	Deposit Group Number	Saltern	Period	Category	Feature Type	Function
L	994		958	5	2	layer	saltern mound	hearth waste
L	995		958	5	2	layer	saltern mound	hearth waste
L	996		958	5	2	layer	saltern mound	hearth waste
L	997		958	5	2	layer	saltern mound	hearth waste
L	998	993	958	5	2	layer	saltern mound	hearth waste
L	1001		1039	5	2	layer	filtration waste	salt production
L	1002		1039	5	2	layer	filtration waste	salt production
L	1003		1039	5	2	layer	filtration waste	salt production
L	1004			5	2	layer	buried soil	land surface
L	1005			5	2	layer	buried soil	land surface
L	1006		802	5	1	layer	natural	tidal flat deposit
L	1007		802	5	1	layer	natural	tidal flat deposit
L	1008	1010		5	2	fill	hearth pit	disuse
L	1009	1010		5	2	fill	hearth pit	disuse
L	1010	1010		5	2	cut	pit	hearth pit
L	1011	1011		5	2	cut	pit	hearth rake-out pit
L	1012	1010		5	2	fill	pit	backfill
L	1013	1013		5	2	cut	filtration unit	concentrated brine production
L	1014	1013		5	2	fill	filtration unit	disuse
L	1016	1010		5	2	fill	hearth pit	backfill
L	1017	1010		5	2	fill	hearth pit	backfill
L	1018	1010		5	2	fill	enclosed hearth	clay superstructure
L	1019	1019		5	2	cut	filtration unit	concentrated brine production
L	1020	1019		5	2	fill	filtration unit	clay lining
L	1021	1019		5	2	fill	filtration unit	disuse
L	1022	1019		5	2	fill	filtration unit	disuse
L	1023	1019		5	2	fill	filtration unit	disuse
	1025	1011		5	2	fill	pit	hearth waste tip
L	1026	1011		5	2	fill	pit	hearth waste tip
L	1027	1011		5	2	fill	pit	hearth waste tip
L	1028	1011		5	2	fill	pit	hearth waste tip
L	1029	1011		5	2	fill	pit	hearth waste tip
L	1030	1011		5	2	fill	pit	hearth waste tip
L	1031	1011		5	2	fill	pit	hearth waste tip
L	1032	1011		5	2	fill	pit	hearth waste tip
L	1033	1011		5	2	fill	pit	hearth waste tip
L	1034		907	5	2	layer	saltern mound	filtration waste
M and K	1035		1035	4	1	layer	saltern mound	Hearth Waste
M and K	1036		1036	4	1	layer	saltern mound	filtration waste
M and K	1037		802	4	1		saltern mound	tidal flat deposit
J and L	1039		1039	5	2	layer	saltern mound	Filtration Waste
J and L	1040		802	5	1	layer	saltern mound	tidal flat deposit
L	1042		802	6	1	layer	saltern mound	tidal flat deposit

Table 7: Context inventory

APPENDIX B ARTEFACT ASSESSMENTS

B.1 Slag, by Simon Timberlake

Introduction

B.1.1 Three pieces of probable iron slag were recovered from this saltern site (486g) alongside 24 pieces (5.91kg) of salt slag.

Methodology

B.1.2 The slag was identified visually using an illuminated x10 magnifying lens, and compared where necessary with an archaeological reference collection. The pieces were tested with a magnet to determine the presence of free iron or wustite and with dilute hydrochloric acid to determine the presence of carbonate.

Iron slag

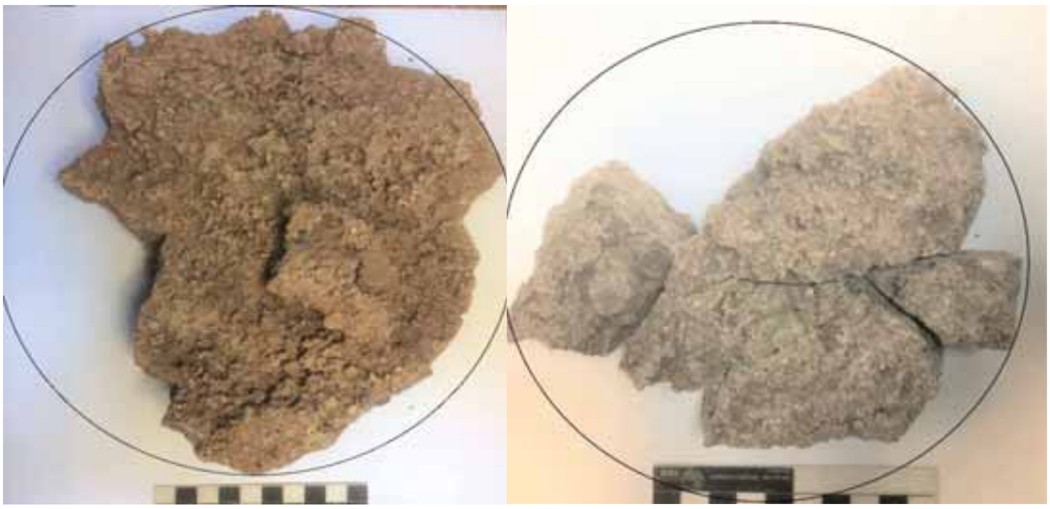
B.1.3 All three pieces of probable iron slag consist of large and irregular frothy re-fitting lumps of vitrified clay broken off from a vitrified hearth lining (VHL) rim of a large (possibly 200-250mm) diameter iron smithing (or re-used saltern) hearth (context 909, Saltern 6: total dimensions 190 x 130 x 90mm; weight 486g). The fragile low-density slag appears to be relatively low in iron, yet is still faintly magnetic in places, with a distinct rusty surface discolouration (App. B.1 Plate 1). The association of these re-fitting pieces and lack of abrasion suggest that these are likely to be moderately *in-situ*. to the feature, or to the group of features close to where they were found. Examination of the form and surface of the cindery slag has revealed the presence of blast holes from a tuyere tip, and also the sort of oxidation patina associated with this. The formation of these light gaseous slags can be interpreted as the result of the melting of the clay hearth lining and the slumping of this mass across the air inlet (tuyere opening), the air blast having then become ineffective until this had been broken and snapped-off from the end of the pipe using (most probably) iron tongs. The possible imprint of the tongs can be seen upon several of the pieces.

App. B.1 Plate 1: Three re-fitting pieces of vitrified clay melted in front of the tuyere hole of an iron smithing (re-used saltern) hearth. Context 909, Saltern 6

Salt slag

B.1.4 Some 24 pieces (5.91kg) of salt slag, consisting of fragments of cakes (hearth bottoms) composed of a vitrified saline silicate with a thin flint-tempered clay and silt hearth lining attached to the underside (of some) were recovered from hearth waste 920 belonging to Group 907 (Table 8). The very irregular top (spatter surface) of these plus the sharp edges of the fragment breaks all suggest that they (as with the iron slags) are likely to be *in-situ* to the features near/in which they were found.

B.1.5 Matching individual pieces of both the re-fitting and non re-fitting fragments of these salt slag cakes suggests a minimum of 10 discarded hearth bases from at least two different (or a single subsequently modified) hearth of c.180mm diameter and 220mm diameter (App. B.1 Plates 2 and 3). The imprint of tongs used to remove the cakes, or else blast holes relating to the tuyere location can be seen within some of the formerly molten surfaces. Inclusions of the flint-tempered clay lined hearth wall and also the heat-reddened silt underlying this can be seen upon the top or within the uppermost layers of this variably vitrified and alternately dense/porous slag. The denser re-melted layers of slag are represented by a greenish-yellow to light green glass (vitrification). There are clearly considerable amounts of salt still present within the porous groundmass. Rarer inclusions of dark grey-black peat ash and more rarely animal bone were noted.



App. B.1 Plates 2 and 3: (Left): A slag cake of *c*.220mm (920.1) and (Right): Re-fitting pieces of a cake of *c*.180mm (920.2)

Cxt. no.	Nos. pieces	Size (mm)	Wt. (g)	Description	Estimated hearth base diameter (mm)	Category	Context assocn.
920.1	1	220x180x35	1410	c.60% of concavo-convex cake of salt slag as hearth base with hackly/ bubbly pink to yellow-green upper surface with rare inclusions of reddish silt blobs and lithified peat, a re-attached slag	220mm	**salt slag**	hearth waste

Cxt. no.	Nos. pieces	Size (mm)	Wt. (g)	Description	Estimated hearth base diameter (mm)	Category	Context assocn.
				blob, and hackly underside (see Figure 2)			
920.2	5	60-115mm x 30-60 (thick)	945	<40% of a plano-convex cake of salt slag with a partially vitrified yellow-green surface and vitrified lenses internally (x5 re-fit pieces)	180mm	**salt slag**	hearth waste
920.3	2	160x100x30-40 + 110x90x 30-50	1315	x2 non-re-fitting frags of same slag (hearth base) cake with yellow-green vitrified lenses and inclsions of broken-off clay lining – remains of this upon underside	220mm+	**salt slag**	hearth waste
920.4	3	140x100x20	321	x3 re-fitting pieces of a thin plano to concavo-convex slag cake (c.30%)	c.180mm?	**salt slag**	hearth waste
920.5	1	80x50x20-45	187	single fragment of double fused slag cake with some clay inclusions (<10%)		**salt slag**	hearth waste
920.6	2	60x70x30	125	re-fitting small fragments of rough agglomeratic salt slag cake with larger inclusions or reddish burnt silt and clay plus x1 piece of animal bone and some peat stain	small?	**salt slag**	hearth waste
920.7	2	90x150x60 + 40x10	838	c.50% of a v irregular and uneven plano-convex salt slag cake with the remains of a tempered flint + clay fused hearth lining upon underside alongside accreted lump of laminated dumped silt layer from underneath. At the centre are two holes made by iron tongs (used to remove this?) or else the tuyere blast	c.220 mm+	**salt slag + hearth lining**	hearth waste
920.8	2	140x85x35-20 + 50x20	297	<25% of a v.irregular and uneven plano-convex salt slag cake	c.180mm?	**salt slag**	hearth waste
920.9	4	110x85x40 + 70 + 50 + 30	436	non-refitting fragments of a v irregular and uneven plano to biconvex salt slag cake with various holes which may relate to the use of tongs or a tuyere		**salt slag**	hearth waste
920.10	2	30x15x25 + 20x15	13	x2 v small rim edge fragments from a thin dense plano-convex salt slag cake with attached fused and fired buff-pink silty clay basal lining		**salt slag + hearth lining**	hearth waste
920.11	1	30x20x15	5	strongly-fired and burnt clay fragment from surface/ rim edge of salt slag cake		**hearth lining**	hearth waste

Table 8: Catalogue of salt slag from hearth waste 920 (Group 907, Saltern 5). MNI hearth bases = 10

Discussion

B.1.6 As expected, both the salt slags and also the small amount of iron slag looked at from this site are very similar to those described from Marsh Lane, King's Lynn (Clarke 2016) and subsequently within the report on the chemical analyses of these slags carried out by Timberlake & Haylock in 2017.

B.1.7 Interestingly, the size(s) of the (minimum) ten slag cakes identified within the Greenpark Avenue (Lynnsport) salt slag assemblage correspond quite well to the estimated size(s) of both the salt slag cakes and also the smithing hearth bases recovered from Marsh Lane, suggesting that it was general practice to fire (heat) the salt pans over shallow round pit-like clay-lined hearths of around 220mm diameter, although the presence of smaller cakes might indicate the use of some other smaller hearths (thus potentially smaller salt pans) – either as ones originally constructed as such, or otherwise as re-modified examples. Nevertheless, it is important to recognise how a salt slag cake (or hearth bottom) is formed.

B.1.8 As with smithing hearth bases formed during ironworking, the saltern hearth bases simply consist of the re-melted waste materials (such as the 'boiled-over' salt solution, fragments of fired clay briquetage, sleeching silt, fuel ash, and clay wall lining) that have fallen into the base of the fire and fused as the temperature of the hearth is artificially raised. Salt slag is thus an agglomerate of all this material which in places has melted to a pale cream grey to yellowish-green coloured glass, but in others is more porous and cindery.

B.1.9 The presence of what could be air blast holes within the side or base of the slag cakes would seem to suggest that we are looking at the use of a tuyere and bellows to raise the temperature of the fire, but not necessarily (as in the case of blacksmith forging) either continuously or as vigorously.

B.1.10 Such a set-up would help to explain why these hearths appear to have been used interchangeably between salt-making and iron smithing, the latter almost certainly a more occasional event associated with the re-forging of the iron tools and the making of horseshoes etc. necessary for the operation of the salterns and for the haulage of silt, fuel and the finished salt product.

B.1.11 The clay bricks (briquetage) around the edges of the circular hearths would have supported the lead (and perhaps also the ceramic) salt pans above them.

B.1.12 The practice of using lead pans during the medieval period for the boiling of brine at coastal saltcote sites associated with sleeching has been confirmed by archaeological excavation as well as by historic record. At Wainfleet St. Mary on the Lincolnshire coast a series of 15th century sleeching mounds, filtration tanks and pan boiling hearths were excavated in some detail (McAvoy 1994). The actual pans had been removed, yet a series of lead off-cuts from these remained, along with the arrangements of the brick supports.

B.1.13 Meanwhile documentary reference to the use of such pans at saltern sites during the medieval – post-medieval period comes from both Brownrigg (1748) and Duncan (1812):

> 'the brine being thus prepared they boil it with turf fires in small leaden pans..' (Brownrigg 1784) 'These pans....made of lead…are placed on bricks about 20 inches from the ground…to admit a line of peats beneath them. The pans are commonly about 4 feet long, 3 feet broad, and 5 inches deep' (Duncan 1812)

Further work required

B.1.14 The salt slag cake assemblage should be retained, at least until a decision has been made as to whether any chemical analysis should be undertaken on this for indications of lead and other elements (such as undertaken using pXRF on the Marsh Lane assemblage).

Disposal

B.1.15 Following the work above, or a decision not to undertake further work, all of the material barring perhaps one or two selective examples (such as 920.1, 920.6 and 920.7) can be disposed of.

B.2 Pottery, by Sue Anderson

Introduction and Methodology

B.2.1 Four sherds of pottery weighing 92g were collected from two contexts during the excavation. Table 9 shows the quantification by fabric.

B.2.2 Quantification was carried out using sherd count, weight and estimated vessel equivalent (eve). All fabric codes were assigned from the Norfolk post-Roman fabric series (based on Jennings 1981). Form terminology follows MPRG (1998). The catalogue was input directly into an MS Access database, which forms the archive catalogue.

Results

B.2.3 One base fragment of Grimston Thetford-type ware was found in layer 816 (Area M, Saltern 4). This is similar to material from elsewhere on the Lynnsport site, particularly from Area I (Blackbourn 2019: Lynnsport 1, Saltern 12), where a similar fine fabric was recovered. It suggests a late 10th or 11th-century date.

B.2.4 Three sherds of a ?Lincoln Saxo-Norman Sandy ware jar were found in hearth waste 883 (Area L, Saltern 5). This was light grey, hard-fired, and contained fine clear quartz sand, moderate very fine mica, and sparse black ?ferrous sand up to 0.5mm which was visible in the surface. The rim form is tapered and neckless, similar to Thetford ware type 3 (Anderson 2004). This fabric is contemporary with Grimston Thetford-type ware.

Desc.	Fabric	Date range	Fill	Cut	Grp	Salt -ern	No	Wt/g	eve	MNV
Grimston Thetford-type ware	THETG	L.10th-11th c.	816	-	809	4	1	22		1
?Lincoln Saxo-Norman Sandy ware	SNLS	L.10th-11th c.	883	-	958	5	3	70	0.23	1
Total	**-**	**-**	**-**	**-**	**-**	**-**	**4**	**92**	**0.23**	**2**

Table 9: Medieval pottery by fabric

B.3 Fired Clay, by Simon Timberlake

Introduction

B.3.1 Fourteen fragments (1780g) of briquetage fired clay brick support were recovered from this saltern site (Table 10), all from the same context as the salt slag (920, Group 907, Saltern 5).

Methodology

B.3.2 The fired clay was identified visually using an illuminated x10 magnifying lens, and compared where necessary with an archaeological reference collection. The pieces were tested with dilute hydrochloric acid to determine the presence of carbonate and then (where possible) fitted together, and the fabric composition and original sizes determined.

Briquetage

Fabric

B.3.3 All but two of the pieces are composed of a fine grained soft pink quartz silty fabric with a small amount of mica, occasional soft sand and clay laminae, and moderate amounts of fine-grained and finely-broken up plant material such as thin grass or algal material (present as flattened burnt-out voids within very thin layers). Another two pieces possess a similar fabric which was instead much harder and biscuit-like in texture with increased amounts of burnt-out organic, the silt within this being considerably more lithified and cemented (Type Ab).

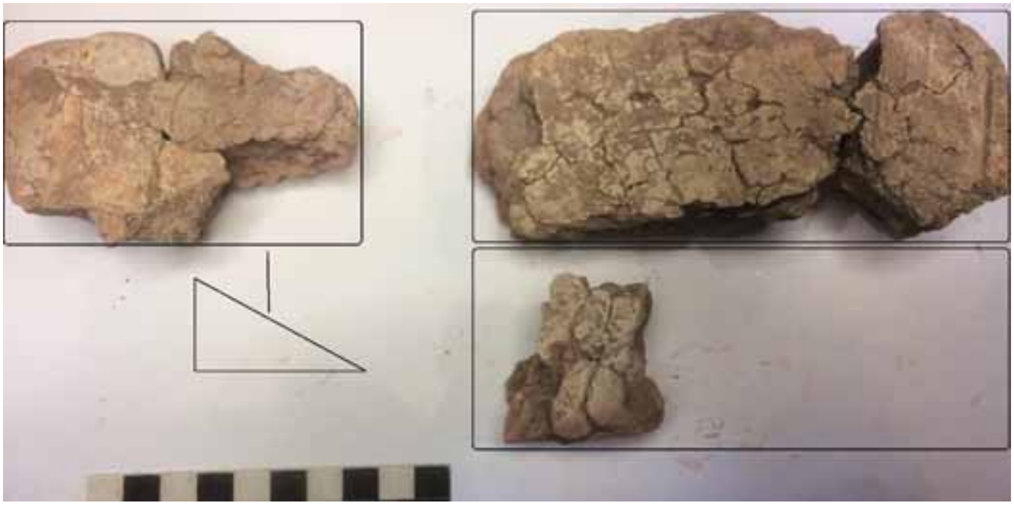
Brick form

B.3.4 A minimum of nine different bricks were identified amongst the range of fragments. For the most part these are narrow and rectangular, with up to half having traces of chamfered ends, which were perhaps designed to support the sloping edge(s) of briquetage pan(s). No complete examples of these were seen, the fabric being both soft and brittle, and also easily worn away by both physical abrasion and water. The most complete of these bricks (920.13) was 140mm long x 50mm wide x 60mm deep. An example of one of the chamfered (or perhaps even dome topped) bricks (920.15) was approximately 160mm long (within its surviving section) x 70mm wide x 60mm deep. However, the narrowest brick (920.17) was only around 100mm long x 40mm wide x 55mm deep. Yet another square (but very incompletely preserved) domed brick ([920.19) was just 30mm long x 35mm deep x 75mm wide (across the arched section).

B.3.5 The mode of manufacture of these bricks was clearly evident from the occasionally clean knife cuts associated with the shaping (forming) of the squarish sides. In addition, the flat tops of some of these were marked with a light diagonal hachured line engraving (the lines being parallel and about 20mm apart; App. B.3 Plate 1, 920.13). It seems feasible that this was designed to help with the re-assembly of the bricks in rows either side of the hearths.

Salt slag accretion

B.3.6 Thin layers of a hackly/ bubbly yellowish-green salt slag (App. B.3 Plate 2, 920.15) were found accreting to the top surface and occasionally the front side(s) of more than 70% of the pieces examined. Examination of the contact of this slag with the brick showed clear evidence of a fused surface, suggesting that this related to spillage of the brine through boiling, then firing upon those brick sides most exposed to the flame and the heat of the furnace.



App. B.3 Plate 1: Briquetage pan supports (bricks) with chamfered ends showing original outlines and profiles (Context 920.12-14, Saltern 5)

App. B.3 Plate 2: Briquetage pan supports with residue of accreted salt slag showing original outlines and profiles (Context 920.15-18, Saltern 5)

App. B.3 Plate 3: Briquetage – square brick with domed top (Context 920.19, Saltern 5)

Context no.	Nos. pieces	Size (mm)	Wt. (g)	Description	Estimated brick dimensions (mm)	Category
920.12	2	90x55x60	172	small brick (x2 re-fitting pieces) with hachured engraved top, salt bleaching, but with no appreciable slag. Worn hole in side	90mm	small rectang brick
920.13	2	140x50x60	355	poorly re-fitting parts of rectangular brick with clear diagonal hachure engraved top and yellowish salt discolouration. Inclusion of paler clay	140-150mm	rectang brick
920.14	1	40x40x60	67	fragment of a fairly narrow rectangular brick with diagonal hachured to and salt discolouration	c.90mm	narrow brick
920.15	1	160x70x60	419	large fragment of a very corroded and heat-damaged brick with a chamfered (sloping) front and possibly a domed profile with thick salt slag	150-160mm	chamfered or domed brick
920.16	1	20x25x45	21	end of a small v narrow brick	90mm?	narrow brick
920.17	2	40x45x60 + 60x40x50	164	x2 poorly refitting frgments of probably the same brick with an accumulation of hackly salt slag	100mm?	narrow rectang brick
920.18	2	80x65x60 + 40x65x60	441	x2 poorly re-fitting fragments of probably the same brick with traces of hachured top and a light accumulation of hackly salt slag	150mm	wider rectang brick
920.19	1	30x75x35	56	probably the end of a short rectangular dome topped brick with a light salt slag and glaze on top and front side	90 – 100mm	small domed brick
920.20	2	55x30x60 + 20	93	the highly altered end of a brick (Fabric Ab) with thick layer of salt slag	90mm?	small brick
920.21	2	25 + 20	6	x2 small fragments with salt slag (non-diagnostic)		brick

Table 10: Catalogue of briquetage (fired clay brick supports) from context 920 (Group 907, Saltern 5)

Discussion

B.3.7 As is implied above, both the form and type of salt slag coatings upon these bricks suggests that they were constructed and used (probably as unbonded bricks) in supports for the presumably heavy lead or ceramic boiling pans which sat just a short distance (perhaps as little as 6cm) above the top of the clay-lined hearths. A reasonable assumption is that the domed and chamfered bricks helped to support the sloping sides of the pans, although the exact arrangement of these bricks cannot at the moment be determined from the displaced fragments that survive. What does seem clear is that the various sizes of the Greenpark Avenue saltern bricks, though slightly different, were not completely from those recorded from Marsh Lane, most of which were dated by their pottery association to be (most probably) Late Saxon in date. The majority of these were also narrow and rectangular; the Marsh Lane bricks ranging from 160x70x90mm to 90x60x35mm to 60x60x40mm in size. Analysis of the brick fabric and the local sediments suggests that all of the Greenpark Avenue bricks could have been made on site; either from the more clay-rich parts of the sub-mound silts or else from the dumped (sleeched) silts themselves.

B.3.8 The use of hand-made brick (briquetage) supports for the boiling pans appears to be the favoured method of mounting these pans in the medieval period, as suggested by the excavation of the coastal saltcotes at Wainfleet St. Mary on the Lincolnshire coast. Here a series of 15th century sleeching mounds, filtration tanks and pan boiling hearths were excavated; the pans had been removed, yet a series of lead off-cuts remained along with the arrangement of brick supports (McAvoy 1994).

B.3.9 The use of bricks is also attested during the medieval – post medieval period by both Brownrigg (1748) and Duncan (1812):

> 'the brine being thus prepared they boil it with turf fires in small leaden pans..' (Brownrigg 1784) 'These pans....made of lead…are placed on bricks about 20 inches from the ground…to admit a line of peats beneath them…' (Duncan 1812).

Further work required

B.3.10 The briquetage assemblage should be only retained for the purposes of chemical analysis if this is required again to confirm the indications of lead and other elements (NB pXRF analysis has already been undertaken on the Marsh Lane briquetage assemblage).

Disposal

B.3.11 Following the work above, or a decision not to undertake further work, all of the material, barring perhaps one or two good examples (for the purposes of any unknown future analysis), may be disposed of, following a full photographic record.

APPENDIX C ENVIRONMENTAL ASSESSMENTS

Environmental Samples, by Rachel Fosberry

Introduction

C.1.1 Sixteen samples were taken from deposits associated with early-medieval salt-making at the site in order to assess the quality of preservation of plant remains and their potential to contribute to the research aims of the project.

Methodology

C.1.2 The samples were processed by tank flotation using modified Siraff-type equipment for the recovery of preserved plant remains, dating evidence and any other artefactual evidence that might be present. The floating component (flot) of the samples was collected in a 0.3mm nylon mesh and the residue was washed through 10mm, 5mm, 2mm and a 0.5mm sieve.

C.1.3 A magnet was dragged through each residue fraction for the recovery of magnetic residues prior to sorting for artefacts. Any artefacts present were noted and reintegrated with the hand-excavated finds.

C.1.4 The dried flots were subsequently sorted using a binocular microscope at magnifications up to x 60 and an abbreviated list of the recorded remains are presented in Table 11.

C.1.5 Identification of plant remains is with reference to the Digital Seed Atlas of the Netherlands (Cappers et al. 2006) and the authors' own reference collection. Nomenclature is according to Stace (2010). Charcoal has been identified by Denise Druce (OA North) prior to selection of items suitable for radiocarbon dating.

Quantification

C.1.6 Items such as seeds have been scanned and recorded qualitatively according to the following categories

= 1-5, ## = 6-25, ### = 26-100, #### = 100+ specimens

C.1.7 Items that cannot be easily quantified such as charcoal, molluscs and foraminifera have been scored for abundance

+ = rare, ++ = moderate, +++ = abundant

Key to table: v=vitrified

Results

C.1.8 Preservation of plant remains is varied. Carbonised (charred) remains are limited to small fragments of charcoal identified as oak (*Quercus* sp.), heather (*Erica/Calluna* sp.) and roundwood. Some of the charcoal is vitrified and occasional coal/clinker has been identified.

C.1.9 Seeds are present in an untransformed state in that they are not carbonised and must therefore be either waterlogged or resistant to decay. Taxa include stinging nettle

(*Urtica dioica*), docks (*Rumex* spp.), elder (*Sambucus nigra*) and bramble (*Rubus* sp.) which all produce woody seeds that are more likely to survive, particularly in salty deposits. Waterlogged seeds of rush (*Juncus* sp.) and annual seablite (*Suaeda maritima*) occur in Sample 414 from Test Pit 4 (Saltern 5).

C.1.10 Other items include foraminifera, ostracods (see Appendix C.3) and snail shells. The presence of the burrowing snail (*Ceciliodes acicula*) could indicate that there has been movement of material between contexts.

Sample No.	Context No.	Trench	Cut No.	Feature type	Function	Volume processed (L)	Flot Volume (ml)	Untransformed seeds	Forams	Ostracods	Charred stems	Charcoal <2mm	Charcoal > 2mm	Charcoal Volume (ml)	Snails	Ceciliodes?	Small mammal bones	briquetage	Charred stems	Charred rhizomes	Charred peat?	Charcoal notes
401	877	L	875	Filtration tank	Filtration waste	9	50	++	+++++	0	+	0	+	<1	+/+	+	0	0	+	0	0	
402	878	L	875	Filtration tank	Filtration waste	13	40	++	+++++	+	0	0	+	<1	+/+	+	0	0	0	0	0	
403	881	L	879	Filtration tank	Filtration waste	11	50	+	++	+	0	0	+	<1	+/+	+	0	0	0	0	0	
404	873	L	872	Filtration tank	Filtration waste	13	50	++	+++++	++	0	0	+	<1	+/+	+	0	0	0	0	0	
405	884	L	886	Ditch	Unknown	16	70	++	+++	0	+	+	+	5	+/+	+	0	#NR	+	0	0	Quercus sp and indet roundwood
406	891	L	889	Filtration tank	Filtration waste	9	30	++	++	0	0	0	+v	0	+/+	+	0	0	0	0	0	
407	904	L	903	Gully terminus	Filtration waste	16	60	++	++++	0	0	0	+V	<1	+/+	+	0	0	0	0	0	
408	906	L	905	Gully terminus	Filtration waste	16	40	+	++++	0	0	0	0	0	+/+	+	0	0	0	0	0	
409	916	L	908	Filtration tank	Filtration waste	12	15	++	+++	0	0	0	+V	<1	+/+	+	0	0	0	0	0	
410	915	L	908	Filtration tank	Filtration waste	8	30	+	+++	0	0	+	+	1	+/+	+	0	0	0	0	0	
413	994-998	L	993	Test pit		14	180	+	0	0	0	0	+	10	0	0	0	0	+	+	++++	Calluna/Erica sp twig frags and Quercus sp
414	1001-1004	L	1000	Test pit		20	5	+++	++++	+	0	+	0	0	+/+	0	0	###	0	0	0	
415	1008	L	1010	Hearth	Filtration waste	20	20	0	0	0	0	0	0	<1	+/+	+	0	###	0	0	0	
416	1009	L	1010	Hearth	Filtration waste	20	1	0	+++	0	0	0	0	0	0	+	0	0	0	0	0	
423	1033	L	1011	Filtration tank	Filtration waste	18	60	0	0	0	++	0	+	2	0	0	0	0	++	0	0	Calluna/Erica sp twig frags
411	861	K	-	Saltern	Filtration waste	20	80	+	0	0	++	+++	0	2	0	+	#	##	++	+	+	Calluna/Erica sp twig frags

Table 11: Environmental samples

Discussion

C.1.11 The environmental samples from this site have produced environmental indicators in the form of foraminifera and ostracods (see Appendix C.3) along with a limited list of plant species that represent trees/shrubs and nettles that may have been present when the salterns were in use, or they may represent subsequent growth of vegetation. The identification of heather and charred stems/rhizomes may be an indication of their use as fuel, possibly as peat, in addition to oak wood/charcoal and possibly coal being utilised.

C.1.12 These results add to the corpus of results of environmental sampling from salt-making sites at Lynnsport.

Retention, dispersal and display

C.1.13 The sample flots will be retained in the project archive. One litre sub-samples have been retained for pollen analysis, if required.

C.2 Pollen, by Mairead Rutherford

Introduction

C.2.1 Six sub-samples were submitted from the site for pollen assessment. The samples were all taken from silts and silty sands, from layer deposits associated with Saltern 5 (Table 12).

Area	Saltern	Sample Number	Context Number
L	5	<417>	965
L	5	<417>	966
L	5	<417>	967
L	5	<418>	974
L	5	<418>	981
L	5	<418>	988

Table 12: Sub-samples assessed for pollen

Methodology

C.2.2 The samples were prepared using a standard chemical procedure (method B of Berglund and Ralska-Jasiewiczowa 1986), using HCl, NaOH, sieving, HF, and Erdtman's acetolysis, to remove carbonates, humic acids, particles > 170 microns, silicates, and cellulose, respectively. The sample was then stained with safranin, dehydrated in tertiary butyl alcohol, and the residues mounted in 2000cs silicone oil. Slides were examined at a magnification of 400x by ten equally-spaced traverses across two slides to reduce the possible effects of differential dispersal on the slides (Brooks and Thomas 1967) or until at least 100 total land pollen grains were counted. Pollen identification was made following the keys of Moore *et al* (1991), Faegri and Iversen (1989), and a small modern reference collection. Plant nomenclature follows Stace (2010). Nomenclature for non-pollen palynomorphs (NPP) follows van Geel (1978) and van Geel and Aptroot (2006). The preservation of the pollen was noted, and an assessment was made of the potential for further analysis.

Results

C.2.3 Although some pollen was preserved, unfortunately, none of the sub-samples contained sufficient pollen for interpretation. This is largely attributed to the lithology from which the sub-samples were taken, which was insufficiently organic. The very low pollen counts are presented in Table 13.

C.2.4 The preserved pollen comprises various tree and shrub taxa, for example, alder (*Alnus*), hazel-type (*Corylus*-type), oak (*Quercus*), pine (*Pinus*), willow (*Salix*) and heather (*Calluna*). Herb pollen comprised pollen of the goosefoot family (Chenopodiaceae), several species of which are salt tolerant, as well as rare grass pollen (Poaceae), docks/sorrels (*Rumex*-type), meadowsweets (*Filipendula*) and ribwort plantain (*Plantago lanceolata*). Rare fern spores of common polypody (*Polypodium vulgaris*) and monolete ferns (Pteropsida) were also recorded as well as spores of *Sphagnum* moss. Fungal spores of *Glomus* (HdV-207) were relatively frequent in the sub-sample from deposit ***981***. This fungal spore has an association with eroded or disturbed soils. In addition to spores of *Glomus* (HdV-207), deposit ***967*** contained spores of *Sordaria* (HdV-55A/B) and *Sporomiella* (HdV-113), both associated with grazing animals (van Geel 1978; van Geel and Aptroot, 2006).

Recommendations

C.2.5 No further pollen work is recommended on the samples from this site.

Sample Number			**417**	**417**	**417**	**418**	**418**	**418**
Context			**965**	**966**	**967**	**974**	**981**	**988**
Preservation			**Mixed**	**-**	**Mixed**	**-**	**Mixed**	**-**
Potential			**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Depth (m)			**0.29-0.31**	**0.04-0.06**	**0.12-0.13**	**0.14-0.15**	**0.23-0.24**	**0.39-0.40**
Trees/Shrubs								
Alnus		Alder	2		2			
Betula		Birch	1					
Calluna		Heather	2					
Corylus avellana-type		Hazel-type	6		2		5	1
Pinus		Pine	1				1	
Quercus		Oak			1			
Salix		Willow			1			
Herbs								
Amaranthaceae		Goosefoot family	1		6	1	1	1
Filipendula		Meadowsweets			1			
Plantago lanceolata		Ribwort plantain			1			
Poaceae		Grass family			1		1	
Rumex-type		Docks/Sorrels	1					
Ferns								

Sample Number			**417**	**417**	**417**	**418**	**418**	**418**
Context			**965**	**966**	**967**	**974**	**981**	**988**
Preservation			**Mixed**	**-**	**Mixed**	**-**	**Mixed**	**-**
Potential			**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Depth (m)			**0.29-0.31**	**0.04-0.06**	**0.12-0.13**	**0.14-0.15**	**0.23-0.24**	**0.39-0.40**
Pteropsida		Monolete fern spores	2	1	1	1		1
Polypodium vulgare		Common polypody					1	
		Total land pollen	22	1	16	2	9	3
		Number of traverses	10	10	10	10	10	10
Sphagnum		Moss spores	6		2		4	
Aquatics								
Typha latifolia		Bulrush					1	
Microscopic charcoal			+					+
Deteriorated grains			1		5		1	
Fungal spores/NPP								
Glomus HdV-207					1	1	6	
Sordaria HdV-55A/B					3			
Sporomiella HdV-113					1			

Table 13: Raw pollen counts for sub-samples

C.3 Ostracods and Foraminifera by Simon Timberlake

Ostracods

Introduction

C.3.1 Two samples were taken from contexts 878 (sample <402>) and 873 (sample <404>) from the Saltern 5 waste mound silts, and another four samples from the north and south sides of ‘filtration tank’ (pit) **942**; respectively sample <419> (contexts 941 and 943) and sample <420> (contexts 941 and 943). Ostracods in moderate amounts were found within the first two samples looked at (i.e. samples <402> and <404>), but by contrast they were rare and of low diversity within the sampled sediments infilling the abandoned ‘tanks’. Most of the ostracods were found just within the smaller size fractions of the flots (0.5-0.25mm and <0.25mm).

Methodology

C.3.2 Standard processing of the environmental samples by flotation was undertaken by OAE Archaeobotanist Rachel Fosberry using Endecott sieves, the only variation in the technique being that for the purposes of this assessment the fractions examined were limited to: 1-2mm (generally without ostracods), 0.5-1mm, and 0.25-0.5 mm and

<0.25 mm (containing most of the ostracods) . The smallest size fraction was examined to record the presence juveniles, hence to establish an idea of population structure and thereby determine the degree of autocthoneity of the species recovered. The reporting of juvenile instars to the flot fractions may well be linked to the ability of some of these shells to float, but perhaps also to an entrapment of these within fibrous material such as roots or algae. The recovery of ostracods by this method is never going to be complete, yet it is conceivably representative of the assemblage present. Ostracods were not recorded within any of the other fractions examined by the archaeobotanist.

C.3.3 The examination of the four fractions involved a whole count where this was practically possible within the timescale allowed by the assessment (i.e. only when looking at volumes of residues up to 2g in weight). If this was not possible then a carefully measured fraction of the sediment was counted and the final numbers calculated (i.e. estimated) accordingly.

C.3.4 The ostracods were examined using an illuminated stage Vickers binocular microscope with x10 eyepiece and a x1-x3 objective, with individual ostracods being removed using an extra-fine camel hair brush. Standard texts plus a reference collection of published SEM images were used for the purposes of ostracod identification.

C.3.5 The numbers of male and female adult valves and carapaces were counted, and wherever possible those of the sexually dimorphic later instars also.

C.3.6 Notes were made concerning the presence or absence of noded and smooth polymorphs of some of these species, as well as the range of smaller juvenile instars that could be seen within this assemblage. All this data has been presented in Table 14.

Results

C.3.7 An initial assessment of the samples revealed the presence of ostracods within all six contexts (Table 14). These were moderately well preserved in all samples, but slightly better within samples <404>, <419> and <420>. In all cases both adults and juveniles (carapaces and valves) were identifiable, and in some cases both males and females (dimorphism and precocious sexual dimorphism); it seemed possible therefore to determine the likelihood of autochthoneity of individual species.

C.3.8 A total of 306 ostracods were counted within sample <402> (fill 878 of filtration unit **875**; identified from a sample consisting of 7.91g of sieve residue made up of 1.15g (2mm-1mm), 1.53g (1mm-0.5mm), 4.06g (0.5-0.25mm) and 1.17g (<0.25mm) fractions (NB no ostracods were found within the largest-sized fraction 2mm-1mm)). The minimum number of individuals (MNI) based upon the population structure with instar moults valves/carapaces present was estimated in this case as 199, with an ostracod density per sample of 45 individuals per gm sediment. Some 8% (24) of these ostracods consisted of the brackish water (lower saltmarsh) species *Loxoconcha elliptica,* 15% (46) *Cytheromorpha fuscata* (a species of the saltmarsh creeks) and up to 55% (168) *Leptocythere* sp. Most of the latter consisted of *Leptocythere lacertosa* (another saltmarsh/ estuarine upper mudflat species). The latter showed a good population structure composed of similar numbers of adult and juvenile carapaces and left and right valves indicating a high degree of autocthoneity. *Loxoconcha rhomboidea* (a species of the estuarine lower mudflats) made up just 0.3% (1 individual). Truly freshwater species such as *Candona candida* (10) and *Darwinula stevensoni* (10) made up another 7% of the ostracod total. The estuarine/ marine species *Xestoleberis* sp. (34) along with *Semicytherura angulata* (5), *Semicytherura nigrescens* (1) and *Cythereis fischeri* (5) made up another 13%. The clearly allocthonous marine species *Hemicytherura cellulosa* (1) and *Cytheropteron nodosa* (2), both of which were present as slightly less well-preserved individuals formed the balance of c.1%. Molluscs were noted in the samples including small shells of *Valvata piscinalis* (freshwater snail), *Hydrobia sp.* (a brackish water snail), *Columnella edentula* (a terrestrial marshland snail), *Bithynia tentaculina* (a freshwater snail), *Pisidium sp*. (a freshwater bivalve) and *Ceciloides acicula* (a terrestrial sub-ground dwelling snail). Fragments of echinoid spine and fish teeth reflect washed-in marine allochems.

C.3.9 Some 121 ostracods were counted within sample <404> (fill 873 of filtration unit **872**; identified from a sample consisting of 7.11g of sieve residue made up of 1.32g (2mm-1mm), 1.58g (1mm-0.5mm), 3.58g (0.5-0.25mm) and 0.63g (<0.25mm) fractions (NB no ostracods were found within the largest-sized fraction 2mm-1mm)). The minimum number of individuals (MNI) based upon the population structure with instar moults valves/carapaces present was estimated in this case as 102, with an ostracod density per sample of 21 individuals per gramme of sediment. Some 26 of these ostracods (21%) consisted of the 'smooth' polymorph form of the brackish to hypersaline tolerant species *Cyprideis torosa* (cf. *C. littoralis*) which may inhabit the saltmarsh ponds or creeks. Another 31% (38) of these ostracods consisted of the brackish water species *Leptocythere lacertosa* which are typical of the estuarine upper mudflats, and *Loxoconcha elliptica* (an ostracod of the Lower Saltmarsh) a further 5% (6 individuals) and *Loxoconcha rhomboidea* (a species of the estuarine lower mudflats) just 2% (7).Truly freshwater species such as *Candona candida* (6) and *Cypridopsis vidua* (10) which is often associated with Chara, made up 20% of the ostracod total. The estuarine/ marine species *Xestoleberis* sp. (12) along with *Semicytherura sella* (2) provided another 13%. More clealy allocthonous was the marine species *Cytheropteron nodosa* (6) at 5%. Molluscs were noted in the samples including small shells of *Bithynia tentaculina* (a freshwater snail), *Vertigo antivertigo* (a terrestrial marshland snail) and *Ceciloides acicula* (a terrestrial sub-ground dwelling snail).

C.3.10 Just 3 ostracods (MNI=2) were recorded from sample <419> (contexts 941 of filtration unit **942**; at a density of 2 ostracods per gm (just 1.86g of residue from the >0.25mm fraction was examined). These consisted of a single left valve (juv.) of *Cyprideis torosa* (cf. *C. littoralis*) and a left and right valve of *Leptocythere lacertosa*; both being brackish water species. From the overlying context 943 associated with the same sample from the north end of this 'filtration tank' **942** another 5 brackish water ostracods (MNI=2) were recovered from just 2.61g of residue (a similar ostracod density of 2 individuals per gm sediment). These consisted of 3 *Leptocythere lacertosa* (two adult and a juvenile valve) plus 2 valves of *Loxoconcha elliptica*.

C.3.11 From the south monolith <420> sampling the same 'filtration tank' **942** a further 4 ostracods were recovered from the lowermost clay lining 941 (*Leptocythere lacertosa* (3) and the freshwater ostracod *Candona candida* (1)) and another 4 from upper fill

943. The latter included the brackish water *Leptocythere lacertosa* (2) and the estuarine-marine species *Cythereis fischeri* (1) and *Semicytherura angulata* (1).

Comparison of species count patterns for the saltern waste silts and 'filtration tank' monoliths

C.3.12 Despite quite big differences in ostracod abundance and population structures (adults: juveniles + males:females) between the (relatively) ostracod-rich samples taken from the saltern waste silts (<402> and <404>) and the monoliths (<419> + <420>) taken from the interior of 'filtration tank' **942** there exists a certain commonality in the species recorded, suggesting perhaps a similar origin for all of the sediments seen (App. C.3 Figs 1 and 2).

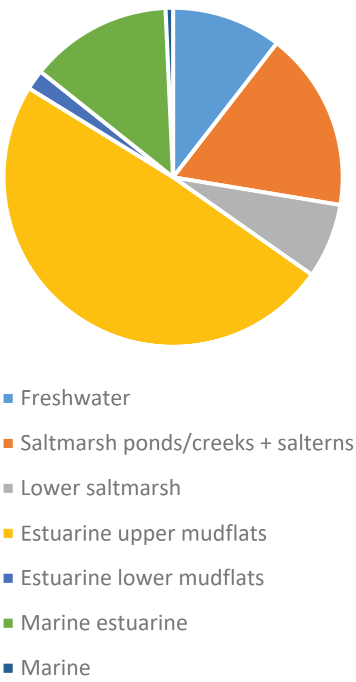
genus/ species	<402> (878) <0.25 – 1mm (6.76g)	<404> (873) <0.25 – 1mm (5.79g)	<419> (941) >0.25 mm (1.86g)	<419> (943) >0.25 mm (2.61g)	<420> (941) >0.25mm (4.35g)	<420> (943) >0.25mm (0.55g)	salinity	water temp/ pH/ depth	substrate	degree autoct (0-4)	habitat environment
***Cyprideis torosa (cf littoralis)* smooth shell**		**26** (Adult: 1 ♀C + 6♀RV /6♀LV; Juv.: 13♂lv)	**1** (Juv: 1LV)				euryhaline (2‰ - 40‰) 'smooth' shell>7‰ sal	eurytherm (4-19ºC)	sandy-mud or algae	2	saltmarsh pond/ creeks and brine tanks
Xestoleberis sp.	**34** (Adult: 1C + 2LV/10RV; Juv.A-1 20 lv/rv; A-2 1C)	**12** (Adult:12C)								2	marine-estuarine
Leptocythere lacertosa	**163** (Adult: 3C +27LV/27RV; Juv.A-1: 27C +31lv/19rv; A-2: 11C + 9lv/9rv)	**38** (Adult: 6C + 6LV /6RV; Juv: 8C + 8rv/ 4lv)	**2** (Juv: 1lv / 1rv)	**3** (Adult: 1LV/ 1RV; Juv: 1lv)	**3** (Adult: 1RV; Juv.: 1lv/ 1rv)	**2** (Juv: 1lv/1rv)	euryhaline	eurytherm depth 1-30m	mud + fine sand	4	estuary/ saltmarsh: upper mudflats
Leptocythere porcellanea	**1** (Juv. 1lv)								more muddy	1	estuary/ saltmarsh
Leptocythere sp.	**4** (Juv.:1 lv/ 3rv)									1	estuary/ saltmarsh
Cytheromorpha fuscata	**46** (Adult: 20C + 11LV+11RV + 1♀LV + Juv. A-1: 1♂lv+1♂rv; A-2: 1lv)						1-35‰ marine-brackish + brine seeps	pH 9.1-9.5 1-30m depth	vegetat + medium sand	2	saltmarsh pond/ creeks
Loxoconcha elliptica	**24** (Adult.10♂C +10 ♀RV; Juv.: 2♀lv + 1♀rv + 1♂rv)	**6**(Adult: 6♂LV)		**2** (Adult: 1♀LV; Juv: 1♀lv)			brackish mesohaline 7-19‰	4-19ºC tidal flow	epifaunal muddy + algal substrate	3	estuarine + lower saltmarsh
Loxoconcha rhomboidea	**1** (Adult:.1♀LV)	**7**(Adult:6♂ RV; Juv: 1lv)							muddy	3	estuarine + lower mudflats

genus/ species	<402> (878) <0.25 – 1mm (6.76g)	<404> (873) <0.25 – 1mm (5.79g)	<419> (941) >0.25 mm (1.86g)	<419> (943) >0.25 mm (2.61g)	<420> (941) >0.25mm (4.35g)	<420> (943) >0.25mm (0.55g)	salinity	water temp/ pH/ depth	substrate	degree autoct (0-4)	habitat environment
Cythereis fischeri	**5** (Adult: 2C + 1RV + 2LV)					**1** (Adult:1RV)				3	estuarine
Candona candida	**10** (Juv.10C)	**6** (Juv 6LV)			**1** (Juv: 1rv)		oligohaline <5.3‰	oligother <13ºC	muddy bottoms	2	freshwater
Darwinula stevensoni	**10** (Juv. 10C)						<0.5‰	2.2-8ºC still-slow		1	freshwater
Cypridopsis vidua		**18**(Adult:18C)					wide tolerance	5-36ºC pH5-12 <1.5m	epiphytic on Chara	2	freshwater
Semicytherura angulata	**5** (Adult: 2C + 2RV + 1LV)					**1** (Adult:1RV)				1	marine/ estuarine
Semicytherura nigrescens	**1** (Adult: 1LV)									1	marine/ estuarine
Semicytherura sella		**2** (Adult: 1C + 1LV)								1	marine/ estuarine
Hemicytherura cellulosa	**1** (Juv. 1C)									0	marine
Cytheropteron nodosa	**2** (Adult: 1LV + 1RV)	**6** (Adult:6LV)								0	marine
Carophytes (oogonia)	0	0	0	0							freshwater
SNAILS etc	*C. acicula, V.piscinalis, C. edentula, B. tentaculina, Hydrobia sp. Pisidium juv.*, echinoid spine, fish tooth	*Ceciloides acicula, Bythinia tentaculina, Vertigo antivertigo*									terrestrial + freshwater marshland
Total nos. ostracods	**306**(MNI=199 45 per g	**121(**MNI=102 21 per g	**3** (MNI =2) 2 per g	**5** (MNI =2) 2 per g	**4** (MNI =3) 1 per g	**4** (MNI = 3) 7 per g					

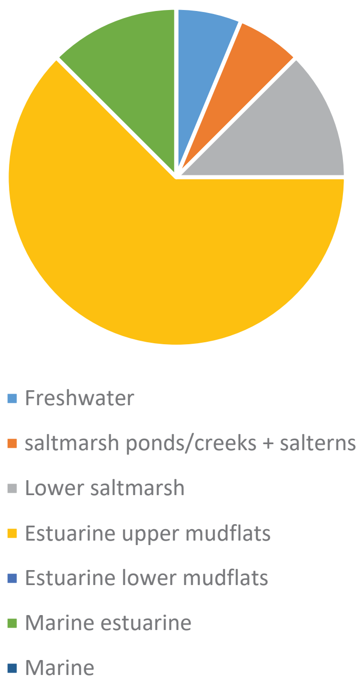
Table 14: *Ostracods from samples <402> + <404> (contexts 873 + 878 in the <0.25, 0.25 – 0.5, 0.5 – 1mm fractions) recovered from the Saltern 5 waste silts plus the samples <419> + <420> (taken from the N and S ends respectively of the 'Filtration tank' 942 (contexts 941 + 943)*. Total ostracod counts are provided

alongside ostracod densities (nos. per gm sediment) for each sample. The sample assessment provides some estimate of autochthoneity for the recorded species populations

App. C.3 Fig. 1: Habitat preferences of ostracods from Saltern 5 waste silts 873 + 878



App. C.3 Fig. 2: Habitat preferences of ostracods from infill silts of 'Filtration Tank' **942**



Discussion

C.3.13 Samples <402> and <404> taken from the Saltern 5 waste silts show an abundant and diverse ostracod fauna with strong indications of autocthoneity with regards to the brackish water saltmarsh and estuarine mudflats preference species. This is particularly the case with *Leptocythere lacertosa* a species which is common to the junction of the open saltmarsh with the upper estuarine mudflats, whilst *Leptocythere porcellanea* inhabits sheltered waters where it is confined to saltmarsh creeks. Another ostracod of the lower saltmarsh is *Loxoconcha elliptica* which is often found living within the brackish waters of the estuarine edge, as well as in lagoons and brackish water pools, usually upon mud and algal substrates (Smith 2013, p.69). Strictly speaking *Loxoconcha elliptica*, *Loxoconcha rhomboidea* and *Cythereis fischeri* are all estuarine species (Smith *ibid*. p.68), although *L. elliptica* prefers the lower saltmarsh zone and *L. rhomboidea* prefers the more regularly water-covered lower mudflats (Rosenfeld 1972, 11-49). Both *Cyprideis torosa* (cf. *C. littoralis*) and *Cytheromorpha fuscata* inhabit the shallow creeks and saltwater ponds of estuarine saltmarshes which not infrequently dry out and become temporarily more saline (Keyser & Aladin 2004). Estuarine ostracods which prefer more stable conditions (salinities) include such species as *Cythereis fischeri*, the various *Xestoleberis* species, *Semicytherura angulata*, *S. nigrescens* and *S. sella* (Smith *ibid*., 68, fig.3.12) – all of which are recorded within Lynnsport (Greenpark Avenue) Saltern 5 waste silt samples, but less abundantly, and clearly not so autocthocthonously as *Leptocythere* and

Cyprideis. Similarly it remains an interesting question whether the presence of isolated but well-preserved juveniles of *Candona candida*, an ostracod which does not generally tolerate salinities of greater than 5.3‰ (Gobert 2012), suggests freshwater tanks or ponds within the vicinity of the saltern – the latter possibly kept for the purposes of the sleeching. *Darwinula stevensoni* is (normally) also an oligohaline preferring species, whilst *Cypridopsis vidua* inhabits permanent freshwater bodies and prefers Chara and the epiphytes which feed on it (Roca *et al.* 1993). Importantly none of these freshwater ostracods show the same developed population structure as the brackish water species, and their degree of autocthoneity is lower. Given the very small numbers of ostracods recorded from samples <419> and <420> it is difficult to give the same level of weighting to these results, yet the general impression is that the environment(s) these represent are similar. This can be seen in the graphical comparison of ostracod habitat (preferences) which is shown in App. C.3 Figs 1 and 2.

C.3.14 This provides a very reasonable picture of the source environment of these sleeching silts - suggesting the specific zones within the local estuarine saltmarsh system where these might have been dug then transported to the mounds/ saltern hearths for further processing. The evidence from Saltern 5, Greenpark Avenue is almost certainly better than that obtained from either Lynnsport Site 1 (Blackbourn 2019) or Lynnsport Sites 4 & 5 (Clarke 2017b).

C.3.15 The habitat preferences for the various ostracod species recovered from the Saltern 5 waste silts reveals a c.20% association with saltmarsh ponds and creeks, a 50%+ association with the Upper Mudflats, a 2% association with the Lower Mudflats, a 5-10% with the Lower Saltmarsh, the remainder being Marine-Estuarine (15-20%), Freshwater (c.12%) and lastly Fully Marine (c.1%) – the three latter categories being marginally to fully allocthonous to the endemic silt. Meanwhile the habitats represented by the sparse ostracod fauna from samples <419> and <420> (the 'filtration tank') are similar but a little different. Around 60% of these associate with the Upper Mudflats, 15% with the Lower Saltmarsh, 5% with the Saltmarsh ponds and creeks and another 10%+ with the Marine-Estuarine biotope. However, if we weigh the species according to their probable degrees of autocthoneity with respect to the silts there is a much greater likelihood that both sets of data are more similar. We may therefore be looking at predominantly autocthonous species which overwhelmingly associate with the Upper Mudflats, and to a lesser extent with the Lower Saltmarsh and the Saltmarsh creeks and ponds. In all probability therefore it is the upper tidal mudflats which are key to the source of these silts.

C.3.16 Associated with the variably brackish and sometimes more highly saline waters present within the saltmarsh creeks and ponds we witness the same 'smooth shelled' (and generally un-noded) saline tolerant polymorph of the ostracod *Cyprideis torosa* sometimes referred to as '*C.littoralis*' (Kilyeni & Whittaker 1974; Frenzl *et al*. 2012; Bloomer *et al*. 2016). But in contrast to Lynnsport Sites 4 & 5 where this ostracod was found in very large numbers within the clay lining of the 'filtration unit' to Saltern 1, this species is neither abundant nor obviously autochthonous to the habitats of the 'filtration tanks' examined here on Saltern 5 and at Lynnsport 1 (contexts 418 + 425; Blackbourn 2019). Yet it is clearly still present within silts.

C.3.17 It is possible there were other endemic populations inhabiting some of the brine tanks associated with these mound(s), yet we should consider the following: (1) that the population of these particular ostracods may have become (periodically) depleted as the saline water was tapped off (yet it seems unlikely that these would not have quickly have replenished their numbers with the species living in some sort of balance below the level of the sediment sieve or filter); (2) That these sub-rectangular flat-bottomed pits were not sleeching or filtration tanks, or if they were, they had then been emptied of any *in-situ*. sediments and subsequently infilled with washed-in saltern mound material; or (3) That there was a distinct functional difference between the clay-lined tank-like features referred to as 'filtration units' and the features referred to as 'filtration tanks'. The periodic re-lining of the former may also have resulted in the inclusion of the microscopic dead and moulted shells of these creatures into the clay base.

C.3.18 *Leptocythere lacertosa* is a euryhaline and slightly eurythermal species which prefers a sandy/muddy substrate at water depths of little more than 1m which is common to estuary saltmarsh environments, in particular to the upper mudflats zone (Rosenfeld 1972; Smith *et al.* 2012, 152-3; Smith 2013, 68 Fig.3.12). *Cytheromorpha fuscata* is chloride-dependent species more properly tolerant of marine brackish water which is occasionally also found in inland lakes where brine seepages occur (Neale & Delorme 1985 in Thorpe & Couich (eds.) 2001, 821), but which is often found alongside *L. lacertosa* and *C.torosa* (Keyser & Aladin 2004). *Loxoconcha elliptica* is an ostracod of the lower saltmarsh biotope (Horne & Bloomer 2000; Athersuch *et al*. 1989; Smith 2013, fig.3.12).

C.3.19 Smith (2013 *ibid.*) notes the common occurrence of *Semicytherura angulata* and other *Semicytherura* species within the brackish water tidal marine environments of the Late Pleistocene - Holocene roddon network which links the Flag Fen basin of Whittlesey (North Cambridgeshire) with the Wash and North Sea coastline closer to Kings Lynn. These species she considered typical of the marine/ estuarine environment, therefore marginally allocthonous to the zone of saltmarsh/ mudflats, although the inclusion of some of these within the latter sediments is to be expected. Likewise the inclusion of a small percentage (<10%) of the allocthonous shallow-water marine shelf species such as *Neocytherideis sp*., *Xestoleberis* and *Cytheropteron* would be part of a normal mix. This matches to some extent the minor allocthonous species composition of the foraminifera population (Table 15).

C.3.20 Immediately surrounding the saltern was an area of fresh and saltwater marshland, and on the top of these mound(s) damp vegetated soils, as suggested by the observed (but not counted) mollusc evidence (Table 14).

Foraminifera

Methodology

C.3.21 Standard processing of the environmental samples by flotation was undertaken by OA East Archaeobotanist Rachel Fosberry using Endecott sieves. The only variation here was in the counting technique, which for the purposes of this assessment was only undertaken for the 0.25-0.5mm size fraction; the size range which contained most of the better-preserved tests. The reason for this was simply the overall abundance of forams within the sample(s) looked at given the limited time available within the costed period of the work. However, it was considered still to be representative of the types and abundance present.

C.3.22 The examination involved a whole count of this fraction if this was practically possible within the timescale allowed, but if this was not possible then a carefully measured fraction of the sediment was counted and the final numbers calculated (estimated) accordingly. The cut-off point in terms of the volume/ weight of sediment which could be looked at *in toto*. was approximately 2g (as with the ostracods)

C.3.23 The forams were examined using an illuminated stage Vickers binocular microscope with x10 eyepiece and a x1-x3 objective with individual ostracods being removed using an extra-fine camel hair brush. Standard texts plus a reference collection of published SEM images were used for the purposes of identification. These were identified only to generic level except where these could be rapidly and accurately assessed to species level within the timescale.

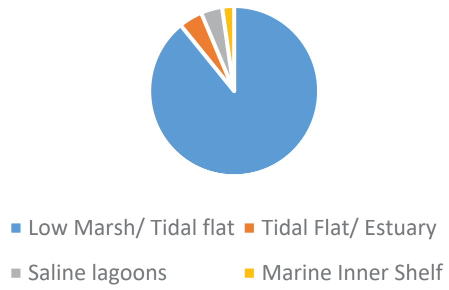
Results

C.3.24 Very large numbers of foraminifera were typical of these samples (Table 15), particularly in the cases of samples <402> and <404> which contained more than 8000 forams each (more than 1700 individuals in total). In all four samples (two of which (<419> and <420>) included another two sub-samples) the benthic rotalline forams *Elphidium* (which included *E. williamsoni*) and *Hayesina* were the dominant genera, *Hayesina* being the more numerous of the two in all cases (at least a proportion of these were confirmed as being *H. germanica*). The Discorbacean rotallines *Cibicides* and *Discorbis* and *Planorbulina* were the next most abundant genera, followed by the Rotaliacean *Ammonia* (c.f. *Ammonia becarra*), the Miliolinid *Miliolina subrotunda*, the Nodosariacids *Lagena spicatula* and *Lagena clavellata*, *Trochammina*, *Lenticulina* and ?*Globorotalia* (planktonic foram). Forams were more abundant within the upper layer (941) than the lower layer (943) of the 'filtration tank' (**942**) sampled within each of the two monoliths (<419> + <420>); the upper infill horizon consistently having a larger number of the rotallines *Elphidium* and *Hayesina*. Whilst there are numerical differences between the two samples of waste silt (<402> and <404>) in terms of numbers of individuals (of specific genera), these are much less obvious. The different proportions of these may however be significant, suggesting perhaps slightly different locations for the extraction of silts which were then dumped within the saltern waste heaps, backfilled, or otherwise concentrated within the 'filtration tank'(s).

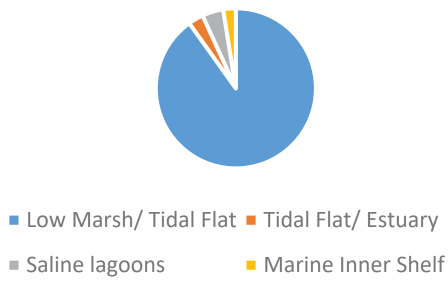
sample **genus/ species**	**<402> (878) 0.25-0.5mm (4.06g)**	**<404> (873) 0.25–0.5mm (3.58g)**	**<419> (941) >0.25mm (1.86g)**	**<419> (943) >0.25mm (2.61g)**	**<420> (941) >0.25mm (4.35g)**	**<420> (943) >0.25mm (0.55g)**	**marine/ littoral environment**	**autoc.**
Elphidium sp. *E. williamsoni* *E. exoticum* *E. excavatum*	**3050** (540) (20)	**3426** (168) (12) (12)	**27** (6)	**180** (5)	**40** (2)	**125** (2)	Low Marsh/ Tidal Flat	Y

sample genus/ species	**<402> (878) 0.25-0.5mm (4.06g)**	**<404> (873) 0.25–0.5mm (3.58g)**	**<419> (941) >0.25mm (1.86g)**	**<419> (943) >0.25mm (2.61g)**	**<420> (941) >0.25mm (4.35g)**	**<420> (943) >0.25mm (0.55g)**	**marine/ littoral environment**	**autoc.**
Haynesina sp. *H. germanica*	**4450**	**3924** (30)	**53** (44)	**222** (8)	**62**	**174** (8)	Low Marsh/ Tidal Flat	Y
Ammonia sp. *A. beccarii*	**280** (280)	**90** (90)					Low Marsh/ Tidal Flat	Y
Discorbis	430	258	2 (poor)	23	4	3	Hypersaline lagoonal	Y?
Cibicides	110	288	4 (poor)	6	4	4	Tidal Flat/ Estuary	Y
Miliolina subrotunda	270	102	1 (poor)	6		5	Tidal Flat/ Estuary	Y
Quinqueloculina	10			5	2		Coastal lagoon	Y?
Lagena spicatula	50	18	1	1			Marine/Inner Shelf	N
Lagena clavellata		18				1	Marine/Inner Shelf	N
Hoeglundina			2					N
Planorbulina	220	30		9	2	4	Marine/Inner Shelf	N
Trochammina		30					High to Low Marsh	Y?
Textularia				1			Low marsh/ Estuarine	
Reofax						1	Brackish lagoon	
Asterigina		6					Marine/Inner Shelf	N
Amphistigena		6					Marine	N
Melonis?		6						
Robertina		6						
Milliammina					2		Hypersaline lagoonal	N?
Lenticulina		12	5		6	1	Marine/Inner Shelf	N
Globorotalia		18 (poor)					Planktonic	N
Total nos. forams	**8870** (2185 per g)	**8238** (2301 per g)	**95** (51 per g)	**453** (174 per g)	**122** (28 per g)	**318** (578 per g)		

Table 15: Foraminifera from Samples <402>, <404>, <419> and <420> with habitat preferences/environments indicated



App. C.3 Fig. 3: Habitats of the Foraminifera from Saltern 5 waste silts



App. C.3 Fig. 4: Habitats of the Foraminifera from the silt infill of 'Filtration Tank' **942** (samples <419> + <420>)

Discussion

C.3.25 The pie charts shown above indicate the proportional habitat preferences of the various foraminifera genera/ species identified within the four different samples taken from the waste silts in samples <402> + <404> (App. C.3 Fig. 3) and the infill layers 941 and 943 of the 'filtration tank' in samples <419> and <420> (App. C.3 Fig. 4). Given that most of the forams have not been identified to species level these graphs should only be considered as an *indication* of the sort of habitats suggested and thus a probable environment based upon the sum total of the evidence currently known (i.e. the probability of this being determined by the numbers of species of these same genera known to inhabit similar environments).

C.3.26 Comparing the proportional habitats as they are represented by the foraminifera of these 'filtration tank' infill contexts with those of the waste (sleeched) silt layers a similar picture emerges of a common silt extraction source dominated by foraminifera which are typical of a Low Salt Marsh/ Tidal Flat environment (almost 85% in both cases). The picture therefore is more or less identical in each (i.e. between Samples <402> + <404> and Samples <419>+<420>). This supports the idea that (1) 'filtration tank' **942** is probably infilled with washed-in or backfilled waste silt from the saltern mound, or (2) that a very similar source or zone of the saltmarsh/ estuarine mudflats has been exploited over time.

C.3.27 Given the well-preserved nature of most of the hyaline foraminifera examined it has proved difficult to distinguish allocthonous from autocthonous forams based just upon the condition of the test, given that some of the autocthonous forms were being re-worked by the tide as much as the allocthonous ones. Nevertheless, the fully marine genera were in general more abraded and rarer than the brackish water saltmarsh genera, the identification of these generic habitat preferences being crucial in this respect (Brasier 1980, 101 fig.13.10).

C.3.28 Smith (2013, 97-103, figs.4.7 and 4.9) illustrates some of the more common foraminifera species of the Fenland roddon silts of Cambridgeshire which match the sort of species diversity of forams encountered within the tidal creeks and mudflats surrounding the saltern sites at Kings Lynn, though not necessarily in the same proportions. For instance *Hayesina* (*H.germanica*) was dominant within the Fenland roddons yet the *Elphidium* species weren't, the latter being replaced instead by *Ammonia beccara* (*ibid*. Fig.3.10). Likewise J*adammina*, *Trochammina* and *Miliammina* have been recorded as typical coastal marsh species (Bloomer *et al.* 2007), yet these genera are poorly represented within the Lynnsport 1 saltern silts and even rarer within Saltern 5 (Greenpark Avenue).

C.3.29 It is difficult to be certain of the age or stratigraphic horizon of the saltmarsh mudflat silts used in the sleeching process. These could have been taken from the Terrington Beds (3000-1900 yrs BP) which outcrop close to Kings Lynn or alternatively could have been scraped off from the much more recently deposited tidal mudflats.

Summary conclusions on ostracods and foraminifera

C.3.30 Ostracods were present within all four samples (and sub-samples) taken from the Saltern 5 mound waste silts and from two monoliths taken from the north and south sides of a putative 'filtration tank'. These were both abundant and diverse within the sleeched silt layers, but quite sparse within the 'filtration tank'. In all cases these were dominated by brackish water saltmarsh species which appeared to be autocthonous to the silts and to a source within the zone of the Estuarine Upper Mudflats and Lower Saltmarsh.

C.3.31 By far the most numerous ostracod species present within the waste silts was *Leptocythere lacertosa*, whilst the 'smooth shell' polymorph of *C. torosa* (*C.littoralis*) which was autocthonous to parts of the saltmarsh creek environment did not appear to be endemic to the saltern itself, nor to the 'filtration tank(s)' sampled. It is possible therefore that some of these tanks may have already been cleaned out and backfilled, or perhaps they were never used for filtration or for brine accumulation. This should be compared with the autocthonous ostracod population found within the clay-lined 'filtration unit' feature sampled at Lynnsport Sites 4 and 5 (Clarke 2017b).

C.3.32 A few allocthonous marine ostracods were encountered within the waste silts and 'filtration tank' infill alongside small numbers of freshwater ostracods such as *Candona candida*, *Darwinula stevensoni* and *Cypridopsis vidua*. The latter would appear to confirm the presence of freshwater waterbodies such as ponds or tanks within the vicinity, some of which may have supplied water for the sleeching process.

C.3.33 Foraminifera were present in large numbers within the waste silt layers, but much less so within the samples taken from the 'filtration tank'. However, all the assemblages examined were dominated by the benthic rotalline foraminifera *Elphidium* and *Hayesina,* the latter being the most numerous of the two genera. Both of these are typical genera/species of the Low Marsh and Tidal Mudflats (consisting of 85% of the habitats represented by the foraminifera in each case).

C.3.34 This similarity in the foraminiferal assemblages supports the idea that the 'filtration tank' was infilled with washed-in or backfilled waste silt from the saltern mound, or alternatively that a very similar source or zone of the saltmarsh/ estuarine mudflats has been exploited over time.

C.3.35 In conclusion both the ostracod and foraminiferal evidence confirms the idea that the silts used in sleeching were collected from the Lower Saltmarsh/ Upper Tidal Mudflats zone of the tidal creeks which lay closest to the salterns.

Future work

C.3.36 At the publication stage, it will be necessary to compare the ostracod and foraminifera assemblages recovered from this site with the ostracod and foraminiferal populations recorded from the tanks and waste silts at Lynnsport Site 1 (Blackbourn 2019) and Lynnsport Sites 4 & 5 (Clarke 2017b).

APPENDIX D SEDIMENTS AND SOILS

D.1 Micromorphological analysis of laminar deposits, by Charles French

Introduction and methodology

D.1.1 A soil block was sub-sampled from monolith <421> provided for micromorphological analysis at the McBurney Laboratory, Department of Archaeology, University of Cambridge (after Murphy 1986; Courty *et al*. 1989; French 2015, app. 3). The monolith was taken from the laminar deposits associated with a Late Saxon to Early medieval saltern mound site on the edge of a former salt marsh. The sub-sample was taken across the central zone of monolith <421> which exhibited multiple finely laminar sediments (contexts 1004 and 1005; basal horizon deposit beneath Saltern 5) and context 1002 above (waste filtration silt, Group 1039).

D.1.2 The monolith thin sections were described using the accepted terminology of Bullock *et al*. (1985), Stoops (2003) and Stoops *et al*. (2010) (Sections C.1.9-10). Through the micromorphological analysis, the aim is to characterise the components of the sediments and the nature of their depositionary processes.

Thin section analysis

D.1.3 <421> was characterised by three main fabric units, as follows:

Unit 1 (context 1005): very fine quartz sand with minor very fine charcoal fragments and 10% micro-sparite calcium carbonate, with some micro-laminae of slightly wavy silty clay crusts and horizontal organisation of the very fine sand grains
distinct horizontal boundary with
Unit 2 (context 1004): multiple finely laminar silty clay crusts alternating with very fine quartz sand lenses, with either amorphous humic (App. D.1 Plate 1) or amorphous sesquioxide staining (App. D.1 Plate 2)
distinct horizontal boundary with
Unit 3 (context 1002): 'swirled'/convoluted very fine-fine sandy loam with a moderately sesquioxide impregnated groundmass of silty (or dusty) clay.

D.1.4 This lower two-thirds of this sequence (contexts 1004 and 1005, basal horizon deposit beneath Saltern 5) is comprised of either laminae of very fine to fine sand or silty clay crusts with greater to lesser impregnation with amorphous iron oxides. This suggests that there are short, episodic influxes of eroded fine material which are then subject to rapid drying out (Lindbo *et al*. 2010), a sequence repeated over and over again. This probably reflects stop/start alluvial/river channel edge deposition of fine sediments. In context 1002 above (waste filtration silt, Group 1039), these same sediments take on a swirled and convoluted aspect, suggesting that there are greater erosive impact and mixing processes going on, with a greater water flow involved.

Interpretative suggestions

D.1.5 This sequence is indicative of the repeated, micro-laminar, stop/start deposition of fine material, by slow water action with repeated episodes of surface drying out. This would be expected to be found on the edge of an active body of water, such as a small stream or marsh.

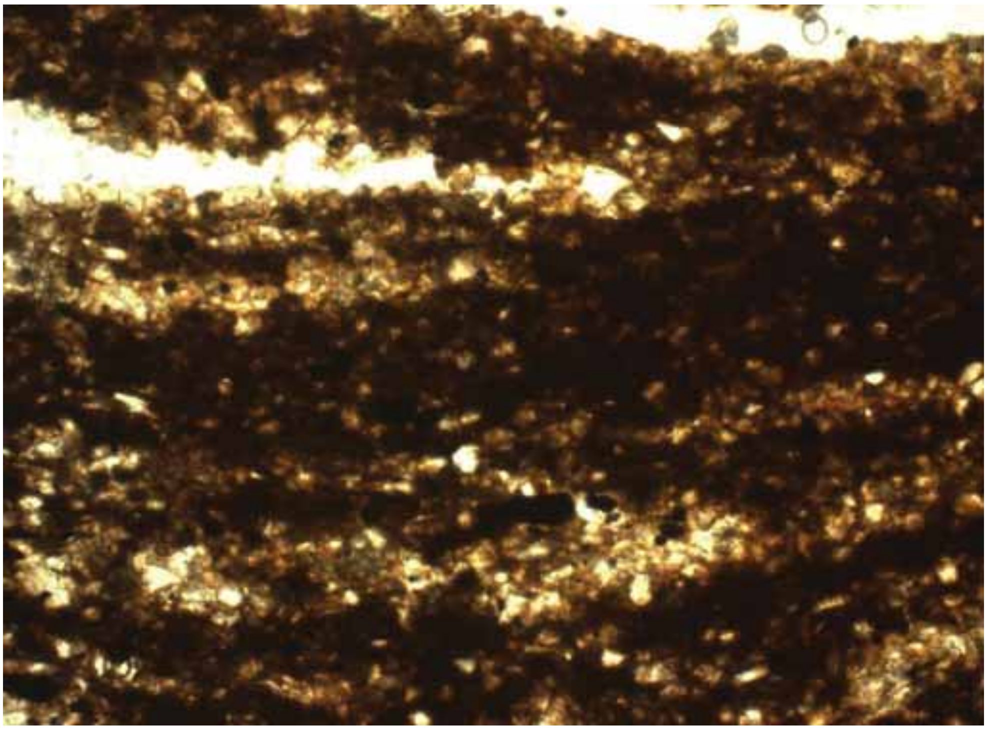
Acknowledgements

D.1.6 I would like to thank Dr Tonko Rajkovača of the McBurney Laboratory, Department of Archaeology, University of Cambridge, for making the thin section slides.

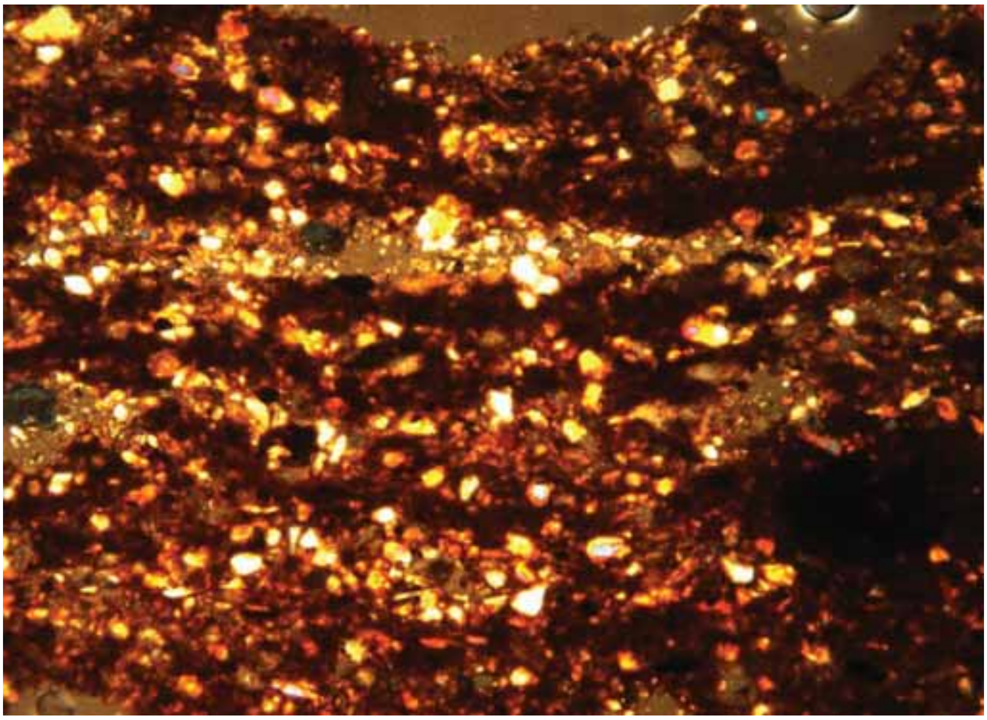
The detailed micromorphological descriptions

D.1.7 Sample 421 (from 6-16cm in the monolith)

This sample is composed of three fabric units (from bottom to top):
Fabric unit 1 (context 1005): predominantly (90%) very fine quartz sand, 50-100um, sub-rounded; 10% micro-sparite calcium carbonate, <50um; pale greyish brown (CPL/PPL); 5% fine charcoal, <75um; distinct horizontal boundary with
Fabric unit 2 (context 1004): all finely laminar; alternating laminae of brown humic silt and very fine quartz sand, or very fine quartz sand and strongly amorphous sesquioxide stained silty clay; pale brown/brown (PPL/CPL) and pale brown/reddish brown (PPL/CPL);
distinct boundary with
Fabric unit 3 (context 1002): poorly sorted, swirled/convoluted aspects; 70% very fine to fine quartz sand with 25-30% dusty clay with moderate amorphous sesquioxide staining, reddish brown/pale brown (CPL/PPL); a few fragments of brown silty clay crusts, <2mm.



App. D.1 Plate 1: Photomicrograph of alternating laminae of very fine quartz and humic very fine sand/silt, Sample 421, fabric unit 2 (Context 1004, Saltern 5; frame width = 4.5mm; plane polarized light)



App. D.1 Plate 2: Photomicrograph of strongly sesquioxide stained laminae of dusty clay and very fine sand, Sample 421, fabric unit 2 (context 1004, Saltern 5; frame width = 4.5mm; cross polarized light)

APPENDIX E ARCHAEOMAGNETIC DATING

E.1 Archaeomagnetic investigation of brine boiling hearth 1010, by A. Wilkinson and C.M. Batt

Summary

E.1.1 This report describes the archaeomagnetic investigation, by the University of Bradford's School of Archaeological and Forensic Sciences, of the superstructure remains (1018) of brine boiling hearth **1010** recorded during excavation of Saltern 5. A total of 23 samples were collected from the hearth (Lab code AM315) and all had a measurable remanence, indicating that the material sampled contained sufficient magnetic minerals to record a stable magnetic direction.

E.1.2 The magnetic direction recorded by hearth **1010** (AM315) returned one possible age range when calibrated against the current British reference curve (Batt et al. 2017) at 95% confidence levels: AD870 – AD1050 (AD900 - AD1030 at 68% confidence) which seems in good agreement with the archaeological evidence. It is important to note that whilst the date range produced is broad, other archaeological evidence may help to constrain the range.

E.1.3 An introduction to archaeomagnetic dating can be found in Section E.1.18-33. Detailed magnetic measurements are available in electronic form on request.

Archaeomagnetic ID:	AM315
Feature:	Fired feature (brine boiling hearth)
Location – latitude:	52.763
Location – longitude;	0.413
Magnetic deviation:	-0.160
Number of samples (taken/measured/used in mean):	23/23/19
AF demagnetisation applied:	7.5mT
Distortion correction applied:	N/A
Declination (at Site):	25.1
Inclination (at Site):	64.9
Alpha-95 (α_{95}):	2.8
Date range):	AD 870 to AD 1050 (95% confidence) AD 900 to AD 1030 (68% confidence)
Archaeological date range:	Possible Late Saxon feature

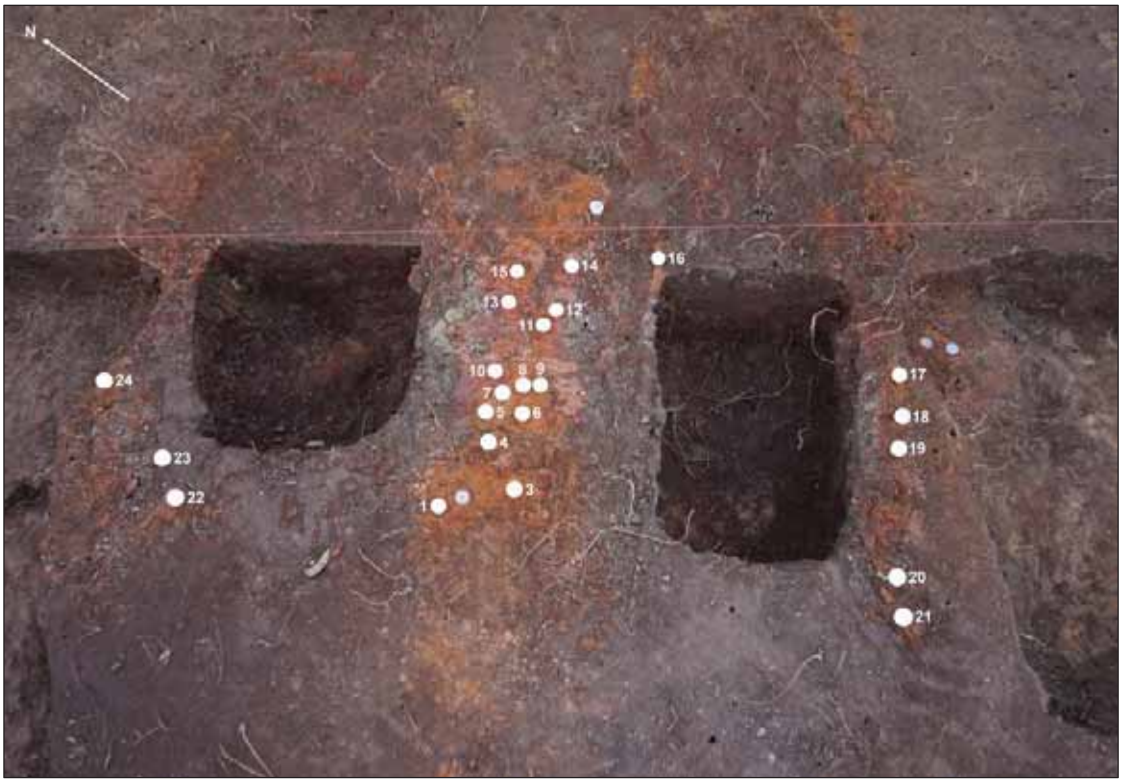
Table 16: Summary of archaeomagnetic information

Site and context details

E.1.4 Lindsey Kemp (Oxford Archaeology East), supervised by Dr Zoe Outram (Historic England) collected archaeomagnetic samples from hearth **1010** at the Lynnsport site, King's Lynn, Norfolk on 19th February 2019. This study investigates the samples to determine whether the date of last heating can be ascertained.

E.1.5 The feature showed evidence of being fired in the past and may be the remains of a brine boiling hearth (Kemp, pers. com.). Sampling was undertaken from cleaned horizontal surfaces across the feature, mainly using the button method (see Appendix, Section E.1.18-33) as the material tended to be too hard to allow tubes to be inserted. The samples were oriented using a magnetic compass in the field, as there appeared to be no local disturbances to the geomagnetic field caused by the feature itself or any other local factors.

E.1.6 A total of 23 samples, as shown in App. E.1 Plate 1 (there was no Sample No. 2) were removed from the feature. However, the buttons on Sample Nos. 8 and 24 fell off during removal on site and following transportation of the remaining 21 samples back to Bradford, the buttons on Sample Nos. 9, 11, 18 and 23 were dislodged but a small portion of the sample remained attached to each button.



App. E.1 Plate 1: Hearth **1010**, Saltern 5: annotated to show position of archaeomagnetic samples (image courtesy of Lindsey Kemp)

Analysis

E.1.7 At the Archaeomagnetic Dating Research Laboratory, University of Bradford, the samples were consolidated using sodium silicate solution and where appropriate, cut in order to fit into the magnetometer. Sample No. 12 was sub-sampled by attaching two extra buttons (creating Sample Nos. 25 and 26) to the sample and orientating them with respect to the original button.

E.1.8 The samples were measured using a Molspin fluxgate spinner magnetometer to investigate the natural remanent magnetisation (NRM) recorded in each sample (see

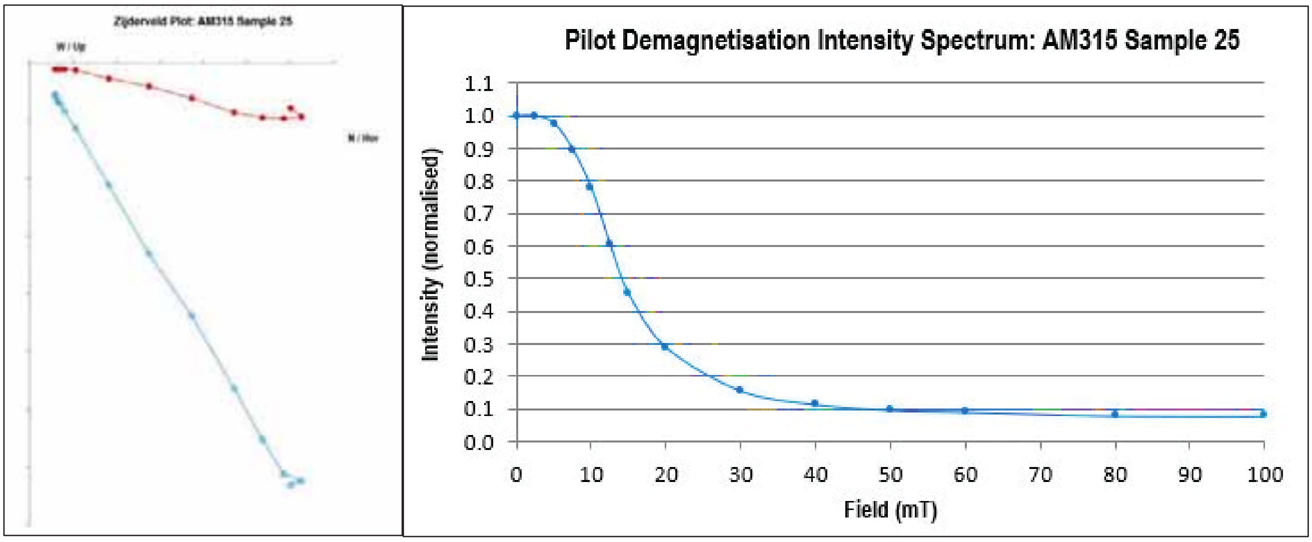
Table 16). The stability of the samples was investigated through a pilot study of a subset of three samples with relatively high intensities (Sample Nos. 13, 16 and 25) using step-wise alternating field (a.f.) demagnetisation (progressively in steps from 2.5mT to 100mT). The mean declination values were corrected for local magnetic variation, necessary as the orientation was carried out with a magnetic compass.

Results

E.1.9 The intensity of the samples was very variable (Table 17), largely reflecting sample size. The results of the pilot a.f. demagnetisation study showed a single stable component after 7.5mT (see App. E.1 Fig. 1). In order to remove any secondary components (often laboratory viscous overprints) of magnetisation, leaving the archaeologically significant characteristic remanent magnetisation (ChRM), the remaining samples were demagnetised at 7.5mT. The magnetic measurements for the NRM, the ChRM and the a.f. field used to remove the secondary components of the magnetisation have been summarised in Table 17.

Sample	NRM			a.f field (mT)	ChRM			Comments
	Dec	Inc	Intensity		Dec	Inc	Intensity	
1	33.2	58.7	134.532	7.5	32.5	61.9	107.931	Tube sample
3	32.2	61.4	3.940	7.5	31.5	61.8	4.289	
4	21.0	63.0	3.890	7.5	25.5	62.0	4.516	
5	29.6	64.8	1.125	7.5	30.8	62.8	1.490	
6	16.3	64.1	5.859	7.5	20.0	64.2	6.985	
7	22.9	63.7	8.157	7.5	21.7	63.8	9.774	
9	45.0	74.3	0.196	7.5	32.5	52.5	0.319	
10	11.6	60.8	0.633	7.5	19.1	62.4	0.820	
11	12.1	54.6	0.139	7.5	349.0	54.4	0.127	Discordant outlier
12	14.8	66.7	6.765	7.5	10.8	67.8	7.792	
13	19.5	67.3	10.718	7.5	17.7	68.1	12.926	Pilot study
14	5.2	65.4	2.724	7.5	0.9	66.5	3.287	
15	330.0	74.2	2.265	7.5	322.8	71.5	1.251	Discordant outlier
16	7.2	68.2	33.422	7.5	8.8	67.3	16.002	Pilot study
17	34.9	75.1	12.119	7.5	35.1	75.5	8.029	
18	36.6	62.5	1.606	7.5	31.2	64.0	0.951	
19	30.5	70.6	21.233	7.5	28.8	67.4	11.196	
20	54.3	66.6	4.670	7.5	50.9	66.2	2.988	
21	39.1	59.9	16.776	7.5	37.4	58.5	10.484	
22	125.6	39.4	91.868	7.5	126.8	37.9	61.459	Discordant outlier
23	0.5	79.6	2.262	7.5	5.6	83.9	1.364	Discordant outlier
25	16.2	67.2	10.557	7.5	19.4	66.5	7.112	Pilot study
26	13.9	67.7	9.584	7.5	17.1	65.6	6.764	

Table 17: Details of the archaeomagnetic analysis of the NRM and ChRM



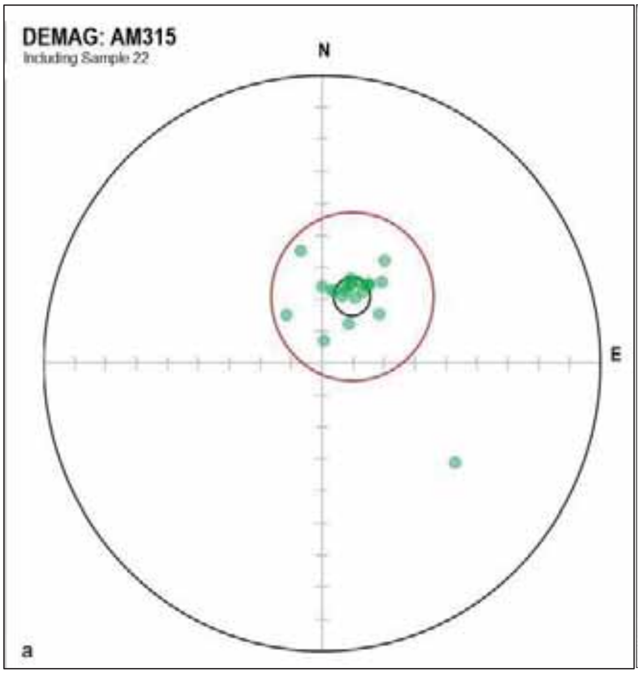
App. E.1 Fig. 1: Details of the archaeomagnetic analysis of the NRM and ChRM

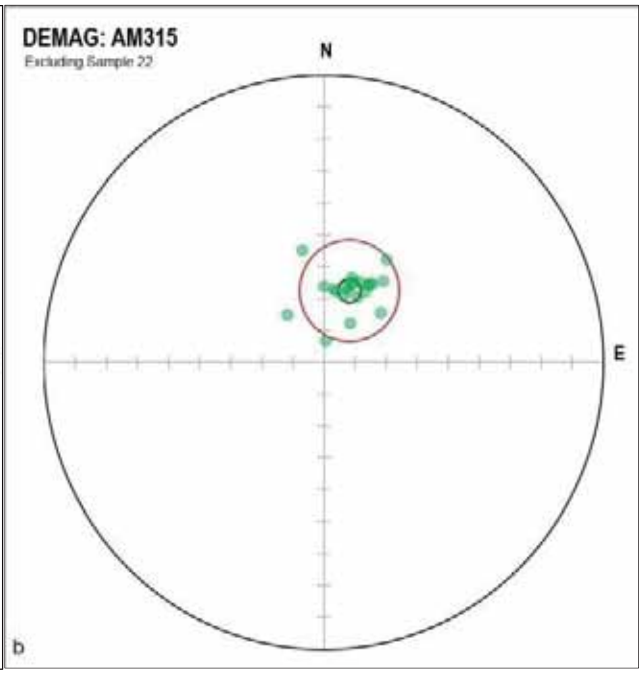
E.1.10 The ChRM directions for all 23 samples are plotted on a stereographic plot, App. E.1 Fig. 2a. The small black circle represents the alpha-95 (α95) angle around the mean direction (see Table 18) which has a value of 5.9° (which exceeds the 5° normally considered the maximum for dating purposes; see Appendix, Section E.1.18-33). By using the outlier discordancy analysis as outlined by McFadden (1982), which produces an angle from the mean direction, shown as a red circle in App. E.1 Fig. 2, directions outside of the red circle can be identified outliers. These directions can be removed from the final ChRM results to produce a more precise magnetic direction. Outliers may be caused by differential movement of parts of the structure, disturbance during sampling or arise in weak samples with intensities close to the noise level of the instruments.

E.1.11 In App. E.1 Fig. 2a, the direction due to Sample No. 22, was identified as a clear outlier. With Sample No. 22, excluded, a reassessment of the remaining 22 samples, App. E.1 Fig. 2b, indicates three other directions, Samples Nos. 11, 15 and 23 as outliers which together with Sample No. 22 can be removed from the final analysis to determine a revised magnetic direction (Table 18). Samples Nos. 9, 10, 11 and 18 with relative intensity values of 1.0 and below, were considered sufficiently high enough to be measurable to contribute to the final sample analysis.

	Number of samples (n)	Dec	Inc	Alpha-95 (α95)
AM315 – all samples (see Figure 2a)	23	25.8	67.3	5.9
AM315 – excluding Sample No. 22 (see Figure 2b)	22	20.7	66.2	3.7
AM315 – excluding Sample Nos. 11, 15, 22 & 23	19	25.1	64.9	2.8

Table 18: Corrected magnetic direction for AM315





App. E.1 Fig. 2: Stereographic plots of the ChRM vectors including Sample 22 (a) and excluding Sample 22 (b), showing the mean direction (small black circle) and the angular area within which vectors are considered concordant with the mean direction, whilst those without are considered discordant (red circle)

Archaeomagnetic dating

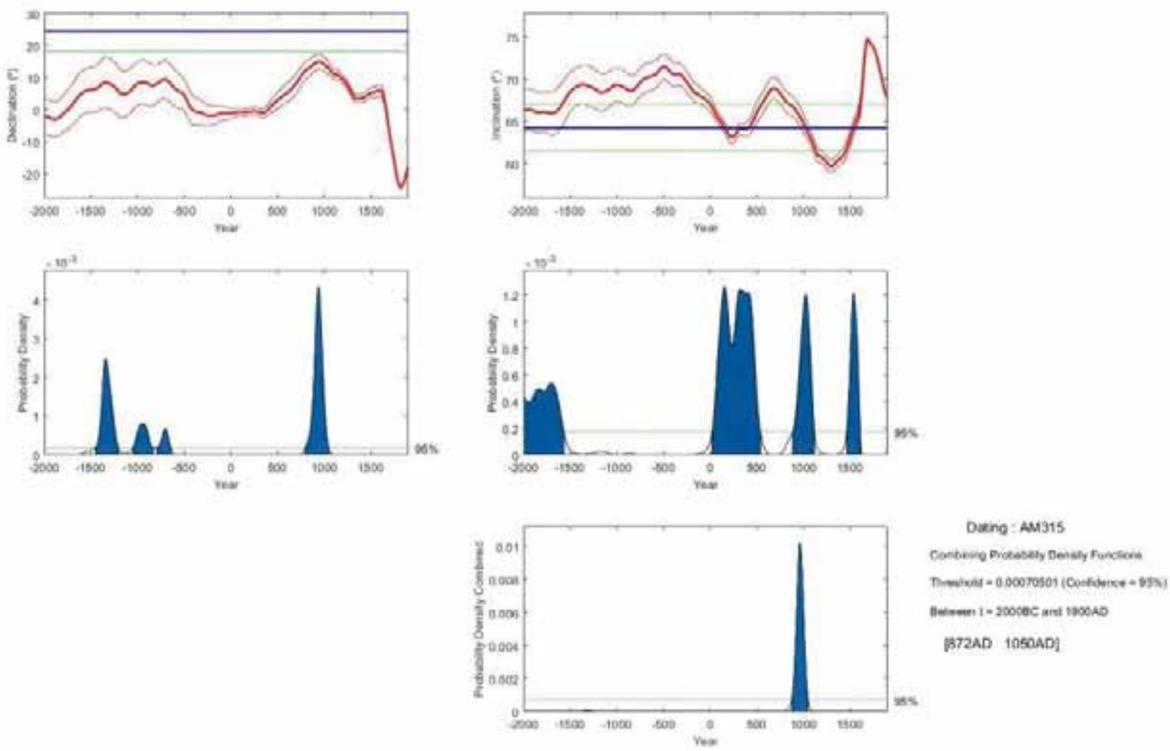
E.1.12 After the removal of the secondary magnetic component and discordant outliers, the magnetic directions were well grouped with an α95 value of 2.8° (Table 19), well inside the limit of 5° normally considered to be datable (Linford, 2006). The mean ChRM was dated by comparison with the UK archaeomagnetic calibration curve (Batt et al. 2017) using a Matlab tool developed by Pavón-Carassco et al. (2011), using the reference location of Meriden (ϕ = 52.43° N, λ = 1.62° W).

	Number of samples (n)	Dec	Inc	Alpha-95 (α95)
AM315	19	25.1	64.9	2.8

Table 19: Corrected magnetic direction for AM315

E.1.13 The date range calculated at the 95% confidence level is shown in App. E.1 Fig. 3.

E.1.14 It is important to note that this possible age range relates to the last time the feature was heated above c.400°C, and therefore potentially dates to the end of the phase of activity within the structure.



App. E.1 Fig. 3: Probability density for AM315 produced by the Archaeomagnetic Dating Tool for Matlab. Top row shows master secular variation curves for the observation site (red bold curves with red error bands) of the declination and inclination with the archaeomagnetic directions (blue line) and associated scatter (green lines). Middle row shows the individual probability density functions for the declination and inclination – the green line indicates the 95% probability threshold. Bottom row shows the combined probability density marked with the green line of 95% probability, and the archaeomagnetic age range

Discussion and conclusions

E.1.15 The samples from the possible brine boiling hearth at the Lynnsport site (AM315) were shown to have good magnetic stability and to record similar magnetic directions, which indicated that they contained suitable magnetic minerals and had been heated to a sufficiently high temperature to retain a record of the past geomagnetic field. The demagnetisation behaviour identified predominantly magnetically soft minerals, such as magnetite. Although intensity values for some of the samples were low, it was considered they contained sufficient magnetic minerals to have recorded a stable direction when the feature cooled after firing. There were a larger number of samples with outlying magnetic directions identified than is typical, which is probably due to differential movement of the structure after firing and the difficulty of sampling friable material.

E.1.16 The magnetic direction recorded indicates last firing between AD870 and AD1050. This is consistent with the archaeological evidence suggesting a Late Saxon date. However, the date range is larger than would be hoped for, given that the α95 value of 2.8° is well inside the acceptable limits. This reflects uncertainty in the behaviour of the geomagnetic field in this period, arising from a paucity of archaeomagnetic data. If the date at 68% confidence is considered, it seems most likely that the last firing fell in the range AD900 to AD1030. It would be possible to improve this date range by combining it with other dating evidence (if available), in a Bayesian model. It is also possible that further refinements to the British archaeomagnetic dataset may allow the precision of the date to be improved in the future.

Appendix: An introduction to archaeomagnetic dating

Principles

E.1.17 Archaeomagnetic dating is a derivative dating method, based on a comparison of the ancient geomagnetic field, as recorded by archaeological materials, with a dated record of changes in the Earth’s field over time in a particular geographical area. The geomagnetic field changes both in direction (declination and inclination) and in strength (intensity) and archaeomagnetic dating can be based on either changes in direction or intensity or a combination of the two. Dating by direction requires the exact position of the archaeological material in relation to the present geomagnetic field to be recorded, and so the material must be undisturbed and sampled *in-situ*. Dating by intensity does not require *in-situ* samples but is less precise and experimentally more difficult. The laboratory at the University of Bradford uses archaeomagnetic dating by direction.

E.1.18 **Suitable materials for dating**

E.1.19 For archaeological materials to be suitable for dating using magnetic direction they must contain sufficient magnetised particles and an event must have caused these particles to record the Earth’s magnetic field. Many geologically derived materials e.g. soils, sediments, clays, contain sufficient magnetic minerals. There are primarily two types of archaeological events which may result in the Earth’s magnetic field at a particular moment being recorded by archaeological material: heating and deposition in air or water.

E.1.20 If materials have been heated to a sufficiently high temperature (>400°C) they may retain a thermoremanent magnetisation (TRM), which reflects the Earth’s magnetic field at the time of last cooling. Suitable archaeological features would include hearths, kilns and other fired structures.

E.1.21 Sediments may acquire a datable detrital remanent magnetisation (DRM) from the alignment of their magnetic grains by the ambient field during deposition. Such an effect allows deposits in wells, ditches and streams to be dated. However, this aspect of archaeomagnetic dating is still under development, as factors such as bioturbation and diagenesis, can cause post-depositional disturbance of the magnetisation.

E.1.22 Archaeomagnetic dating can be applied to features expected to date from 5000BC to the present day, as this is the period covered by the current British calibration curve.

However, as discussed below, the precision of the date obtained will vary according to the period being dated.

Sampling

E.1.23 Samples of robust fired materials are taken by attaching a 25mm flanged plastic reference button to a cleaned stable area of the feature using a fast-setting epoxy resin (Clark et al. 1988). The button is levelled, using a spirit level, and held in place with a small bead of plasticine while the resin sets. The direction of north is then marked on the button using a magnetic compass, sun compass or gyrotheodolite, and the button removed with a small part of the feature attached to it. Samples are trimmed and consolidated in the laboratory with a solution of 10% polyvinylacetate in acetone, or sodium silicate solution. Sediments and soft friable fired materials are sampled by insertion of a 2cm diameter plastic cylinder, onto which the direction of north is marked. Magnetometers used are sufficiently sensitive for only small samples (c. 1cm3) to be required; approximately fifteen samples are needed from each feature and it may be possible to select sampling location to minimise the visual impact if the feature is to be preserved.

Laboratory measurements

E.1.24 In the laboratory a spinner magnetometer is used to measure the remanent magnetisation of each sample (Molyneux 1971). The measurement indicates the relative strength and direction of the magnetic field of the sample. The stability of this magnetisation is then examined by placing the sample in alternating magnetic fields of increasing strength (2.5 to 100mT) and removing the magnetisation step-by-step. The demagnetisation measurements allow removal of any less stable magnetisations acquired after the firing or depositional event, leaving the magnetisation of archaeological interest. It can also be used to indicate the magnetic mineralogy of the samples using information relating to the field required to reduce the intensity to half its original value, known as the median destructive field (MDF); higher values are indicative of harder magnetic minerals such as haematite (Sternberg et al. 1999). The results of measurements of the direction of magnetisation of a group of samples are represented on a stereographic plot, which shows declination as an angle measured clockwise from north and inclination as a distance from the perimeter.

Statistical analysis

E.1.25 The magnetic directions from a number of samples expected to have the same date are combined to find a mean direction, the precision of which is defined using Fisherian statistics (Fisher 1953). The alpha-95 ($\alpha95$) represents a 95% probability that the true mean direction lies within a cone of confidence around the observed mean direction, and would be expected to be less than 5° for dating purposes. A value larger than this indicates that the magnetic directions of the samples are scattered and therefore do not all record the same magnetic field.

E.1.26 Samples observed to be discordant from the mean directional value are assessed using a statistical test defined by McFadden (1982) which shows that given the observed grouping of the N concordant observations, with resultant vector of length R, there is a probability P that an outlier from the same distribution will exceed an angle γ(1-P) from the mean of the concordant group, where

$$cos\gamma_{(1-P)} = 1 - \frac{(R+1)(N-R)}{\mathrm{R}}\left[\left(\frac{1}{1-(1-P)^{1/(N+1)}}\right)^{1/(N-1)} - 1\right]$$

E.1.27 Thus, with P = 0.05, if the outlier lies further than γ0.95 from the mean of the other N observations then it may be concluded with 95% confidence that the outlier is discordant with the other observations and therefore be removed from the analysis.

Calibration of dates

E.1.28 Once the mean ChRM direction has been obtained this is dated by comparing it with a calibration curve showing changes in the Earth's field over time. As the variation of the Earth's magnetic field is not predictable (Batt 1997), the pattern of change has to be established by independent dating, typically historical records, radiocarbon or dendrochronology. The British calibration curve is compiled from direct measurements of the field which extend back to AD 1576 in Britain, and from archaeomagnetic measurements from features dated by other methods. As the geomagnetic field changes spatially, data for the calibration curve can only be drawn from within an area approximately 1000km across and all magnetic directions must be corrected mathematically to a central location (Noel and Batt 1990). There is a single calibration curve for England, Scotland and Wales and directions are corrected to Meriden (ϕ = 52.43° N, λ = 1.62° W).

E.1.29 British archaeological dates are calibrated using the secular variation curve developed by Batt et al. (2017), using a Matlab tool developed by Pavón-Carassco et al. (2011). Additional global secular variation curves can also be used, such as ARCH3k.1 and CALS3k.3 datasets (Korte et al. 2009). The secular variation curves differ in terms of the datasets that have been used to construct them, for example: the ARCH3k.1 curve is a global database of archaeomagnetic data only, while the CALS3k.3 curve is also a global database of archaemagnetic data but incorporates lake sediment magnetic data. This results in subtly different calibrated age ranges being produced for the same magnetic directions.

Precision of dates

E.1.30 There are a number of factors that will influence the error margins of the dates obtained:

Differential recording of the field by different parts of the feature;

Disturbance of the material after firing/deposition;

Uncertainties in sampling and laboratory measurements;

Error margins in the calibration curve itself;

Uncertainties in the comparison of the magnetic direction with the calibration curve; and

Spatial variation of the geomagnetic field.

E.1.31 The precision of the calibration curve varies according to the archaeological period and so the precision of the date obtained will depend on the archaeological dates. As the geomagnetic field has occasionally had the same direction at different times, it is also possible to have two or more alternative dates for a single feature. In most cases the archaeological evidence can be used to select the most likely of these.

E.1.32 Given the number of different factors it is not possible to give a general feature for the precision of archaeomagnetic dates but there will be an error margin of at least ±50 years. It is important to note that since the method relies on the reliability of previously dated sites the calibration curve can be improved as more measurements become available. Features that cannot be dated or given broad age ranges now, may be datable in the future.

APPENDIX F RADIOCARBON DATING CERTIFICATES

Scottish Universities Environmental Research Centre
Rankine Avenue, Scottish Enterprise Technology Park, East Kilbride, Glasgow G75 0QF, Scotland, UK
Director: Professor F M Stuart Tel: +44 (0)1355 223332 Fax: +44 (0)1355 229898 www.glasgow.ac.uk/suerc

RADIOCARBON DATING CERTIFICATE
13 August 2019

Laboratory Code	SUERC-87797 (GU51887)
Submitter	Zoe Ui Choileain Oxford Archaeology East 15 Trafalgar Way Bar Hill Cambridgeshire CB23 8SQ
Site Reference	XNFGAP/ENF145594
Context Reference	861
Sample Reference	411
Material	Charcoal-roundwood : Calluna vulgaris/Erica sp
δ^{13}C relative to VPDB	-27.3 ‰
Radiocarbon Age BP	1052 ± 26

N.B. The above ^{14}C age is quoted in conventional years BP (before 1950 AD) and requires calibration to the calendar timescale. The error, expressed at the one sigma level of confidence, includes components from the counting statistics on the sample, modern reference standard and blank and the random machine error.

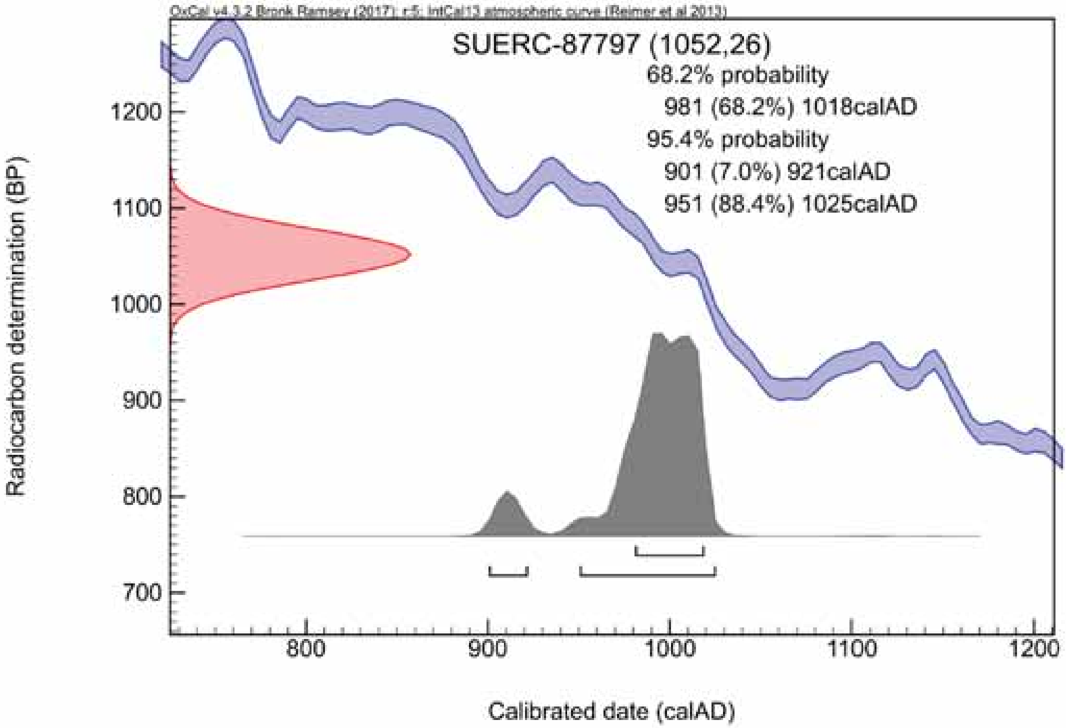
Samples with a SUERC coding are measured at the Scottish Universities Environmental Research Centre AMS Laboratory and should be quoted as such in any reports within the scientific literature. The laboratory GU coding should also be given in parentheses after the SUERC code.

Detailed descriptions of the methods employed by the SUERC Radiocarbon Laboratory can be found in Dunbar et al. (2016) *Radiocarbon 58(1) pp.9-23.*

For any queries relating to this certificate, the laboratory can be contacted at suerc-c14lab@glasgow.ac.uk.

Conventional age and calibration age ranges calculated by : B Tagney

Checked and signed off by : P. Naysmith



The radiocarbon age given overleaf is calibrated to the calendar timescale using the Oxford Radiocarbon Accelerator Unit calibration program OxCal 4.*

The above date ranges have been calibrated using the IntCal13 atmospheric calibration curve†

Please contact the laboratory if you wish to discuss this further.

* Bronk Ramsey (2009) *Radiocarbon 51(1) pp.337-60*
† Reimer et al. (2013) *Radiocarbon 55(4) pp.1869-87*

Scottish Universities Environmental Research Centre
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Director: Professor F M Stuart Tel: +44 (0)1355 223332 Fax: +44 (0)1355 229898 www.glasgow.ac.uk/suerc

RADIOCARBON DATING CERTIFICATE
13 August 2019

Laboratory Code	SUERC-87801 (GU51888)
Submitter	Zoe Ui Choileain Oxford Archaeology East 15 Trafalgar Way Bar Hill Cambridgeshire CB23 8SQ
Site Reference	XNFGAP/ENF145594
Context Reference	994-998
Sample Reference	413
Material	Charcoal-roundwood less than 5 growth rings : Quercus sp
$\delta^{13}C$ relative to VPDB	-24.4 ‰
Radiocarbon Age BP	939 ± 26

N.B. The above ^{14}C age is quoted in conventional years BP (before 1950 AD) and requires calibration to the calendar timescale. The error, expressed at the one sigma level of confidence, includes components from the counting statistics on the sample, modern reference standard and blank and the random machine error.

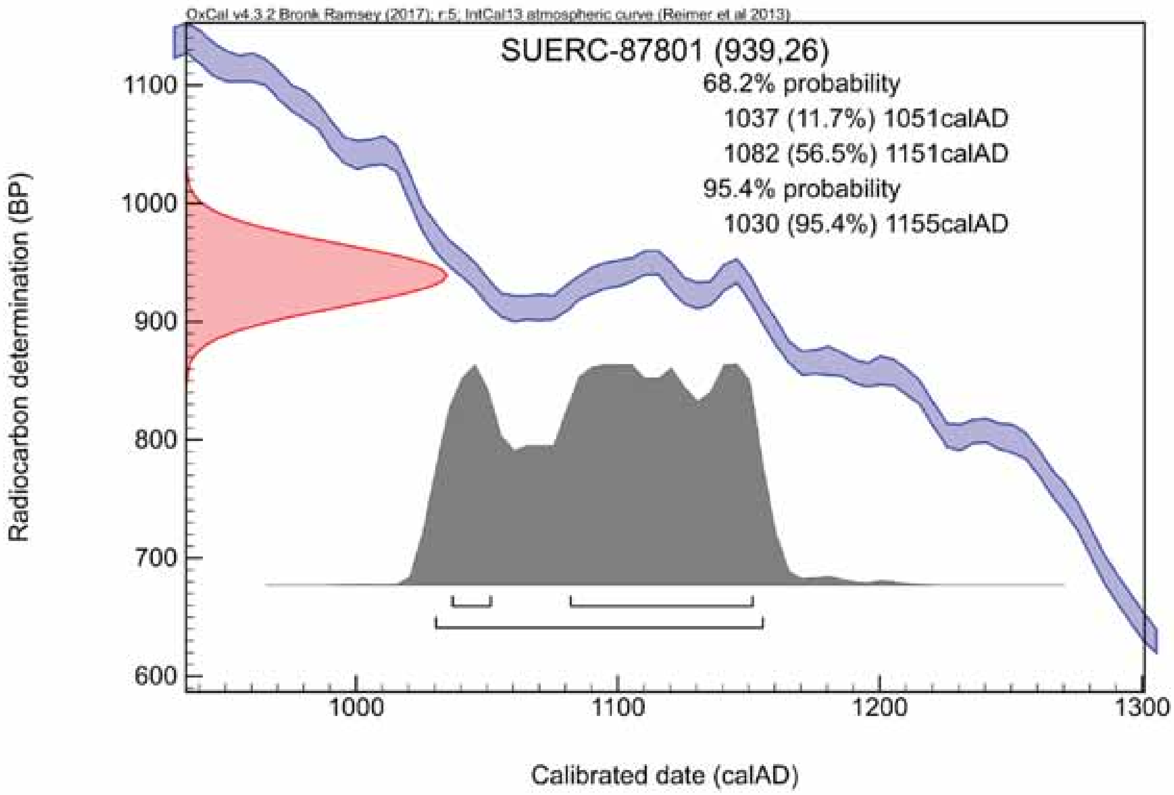
Samples with a SUERC coding are measured at the Scottish Universities Environmental Research Centre AMS Laboratory and should be quoted as such in any reports within the scientific literature. The laboratory GU coding should also be given in parentheses after the SUERC code.

Detailed descriptions of the methods employed by the SUERC Radiocarbon Laboratory can be found in Dunbar et al. (2016) *Radiocarbon 58(1) pp.9-23.*

For any queries relating to this certificate, the laboratory can be contacted at suerc-c14lab@glasgow.ac.uk.

Conventional age and calibration age ranges calculated by :

Checked and signed off by : P. Naysmith



The radiocarbon age given overleaf is calibrated to the calendar timescale using the Oxford Radiocarbon Accelerator Unit calibration program OxCal 4.*

The above date ranges have been calibrated using the IntCal13 atmospheric calibration curve†

Please contact the laboratory if you wish to discuss this further.

* Bronk Ramsey (2009) *Radiocarbon 51(1) pp.337-60*
† Reimer et al. (2013) *Radiocarbon 55(4) pp.1869-87*

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RADIOCARBON DATING CERTIFICATE
13 August 2019

Laboratory Code	SUERC-87802 (GU51889)
Submitter	Zoe Ui Choileain Oxford Archaeology East 15 Trafalgar Way Bar Hill Cambridgeshire CB23 8SQ
Site Reference	XNFGAP/ENF145594
Context Reference	1033
Sample Reference	423
Material	Charcoal-roundwood : Calluna vulgaris/Erica sp
$\delta^{13}C$ relative to VPDB	-27.6 ‰
Radiocarbon Age BP	952 ± 26

N.B. The above ^{14}C age is quoted in conventional years BP (before 1950 AD) and requires calibration to the calendar timescale. The error, expressed at the one sigma level of confidence, includes components from the counting statistics on the sample, modern reference standard and blank and the random machine error.

Samples with a SUERC coding are measured at the Scottish Universities Environmental Research Centre AMS Laboratory and should be quoted as such in any reports within the scientific literature. The laboratory GU coding should also be given in parentheses after the SUERC code.

Detailed descriptions of the methods employed by the SUERC Radiocarbon Laboratory can be found in Dunbar et al. (2016) *Radiocarbon 58(1) pp.9-23.*

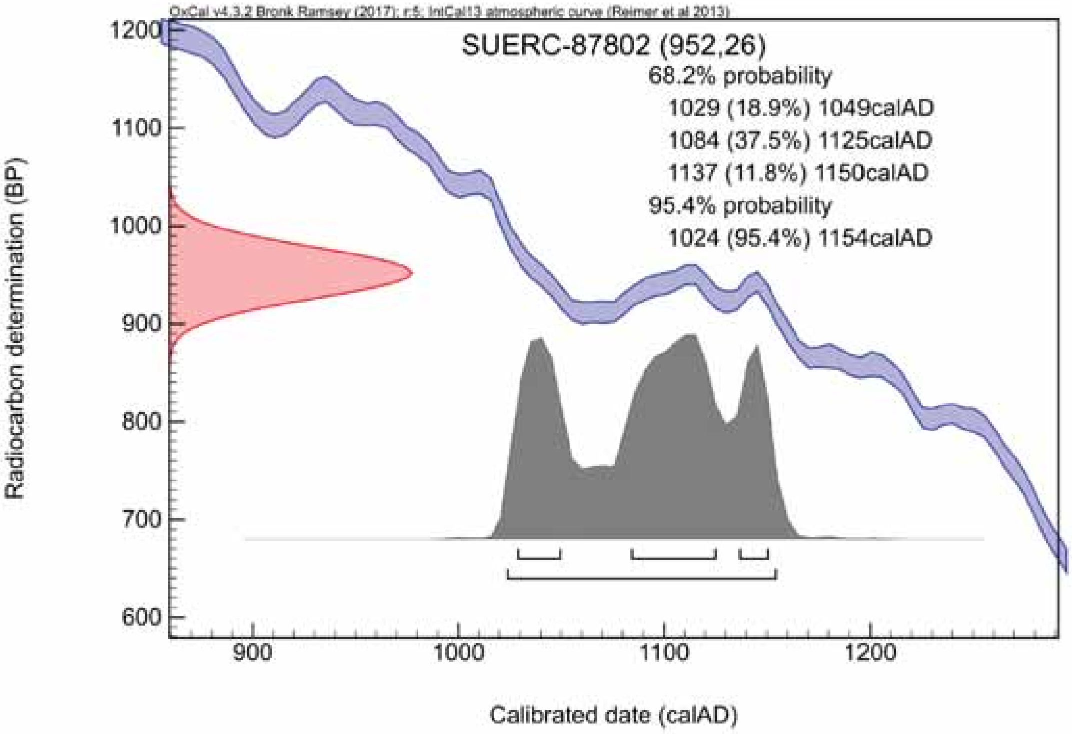
For any queries relating to this certificate, the laboratory can be contacted at suerc-c14lab@glasgow.ac.uk.

Conventional age and calibration age ranges calculated by : B Tagney

Checked and signed off by : P. Naysmith

University of Glasgow
The University of Glasgow, charity number SC004401

The University of Edinburgh is a charitable body, registered in Scotland, with registration number SC005336



The radiocarbon age given overleaf is calibrated to the calendar timescale using the Oxford Radiocarbon Accelerator Unit calibration program OxCal 4.*

The above date ranges have been calibrated using the IntCal13 atmospheric calibration curve†

Please contact the laboratory if you wish to discuss this further.

* Bronk Ramsey (2009) *Radiocarbon 51(1) pp.337-60*
† Reimer et al. (2013) *Radiocarbon 55(4) pp.1869-87*

APPENDIX G PRODUCT DESCRIPTION

Product number: 1
Product title: Publication report
Purpose of the Product: To disseminate the findings of the archaeological investigations to the local community
Composition: Published report, in accordance with the relevant journal and EH guidelines
Derived from: Analysis of site records, specialist reports and data and background research
Format and Presentation: EAA monograph series (together with Lynnsport 1-5)
Allocated to: GC, MB, EP
Quality criteria and method: Checked and edited by EP
Person responsible for quality assurance: EP
Person responsible for approval: EP
Planned completion date: (at earliest) 2021

APPENDIX H RISK LOG

H.1.1 The table below lists potential risks for the PX analysis work.

No.	Description	Probability	Impact	Countermeasures	Estimated time/costs	Owner	Date updated
1	Specialists unable to deliver analysis report due to over running work programmes/ ill health/other problems	Medium	Variable	OA has access to a large pool of specialist knowledge (internal and external) which can be used if necessary	Variable	GC MB LP	November 2019
2	Non-delivery of publication due to field work pressures/ management pressure on co-authors	Medium	Medium-high	Liaise with OA management team	Variable	GC MB LP	November 2019

Table 20: Risk log

APPENDIX I HEALTH AND SAFETY POLICY

I.1.1 All OA post-excavation work will be carried out under relevant Health and Safety legislation, including the Health and Safety at Work Act (1974). A copy of the Health and Safety Policy can be supplied. The nature of the work means that the requirements of the following legislation are particularly relevant:

- Workplace (Health, Safety and Welfare) Regulations 1992 – offices and finds processing areas
- Manual Handling Operations Regulations (1992) – transport: bulk finds and samples
- Health and Safety (Display Screen Equipment) Regulations (1992) – use of computers for word-processing and database work
- COSSH (1988) – finds conservation and environmental processing/analysis

APPENDIX J OASIS REPORT FORM

Project Details

OASIS Number	oxfordar3-371121		
Project Name	Late Saxon to Early Medieval Salterns on Land North of Greenpark Avenue, King's Lynn, Norfolk. Post Excavation Assessment and Updated Project Design		
Start of Fieldwork	04/02/19	End of Fieldwork	05/03/19
Previous Work	Yes	Future Work	No

Project Reference Codes

Site Code	ENF145594	Planning App. No.	Y/2/2018/2002
HER Number	ENF145594	Related Numbers	ENF143325 & ENF143326

Prompt	National Planning Policy Framework (NPPF)
Development Type	Public Building
Place in Planning Process	After full determination (eg. As a condition)

Techniques used (tick all that apply)

☐ Field Observation (periodic visits)	☐ Part Excavation	☐ Salvage Record
☐ Full excavation (100%)	☐ Part Survey	☐ Systematic Field Walking
☐ Full Survey	☐ Recorded Observation	☐ Systematic Metal Detector Survey
☐ Geophysical Survey	☐ Remote Operated Vehicle Survey	☐ Test Pit Survey
☒ Open-Area Excavation	☐ Salvage Excavation	☐ Watching Brief

Monument	Period
Saltern mound	Early Medieval (410 to 1066)
Filtration tank	Early Medieval (410 to 1066)
pit	Early Medieval (410 to 1066)
Hearth	Early Medieval (410 to 1066)

Object	Period
pottery	Early Medieval (410 to 1066)
slag	Early Medieval (410 to 1066)
Fired clay	Early Medieval (410 to 1066)

Project Location

County	Norfolk
District	King's Lynn and West Norfolk
Parish	King's Lynn
HER office	Norfolk
Size of Study Area	3.8 ha
National Grid Ref	TF 6278 2124

Address (including Postcode)
Land North of Greenpark Avenue, King's Lynn, Norfolk, PE30 2NB

Project Originators

Organisation	OA East
Project Brief Originator	James Albone (NCC/HES)

Project Design Originator	Graeme Clarke and Matt Brudenell (OA East)
Project Manager	Matthew Brudenell (OA East)
Project Supervisor	Toby Knight (OA East)

Project Archives

	Location	ID
Physical Archive (Finds)	Norwich Castle Museum	ENF145594
Digital Archive	Norwich Castle Museum	ENF145594
Paper Archive	Norwich Castle Museum	ENF145594

Physical Contents	Present?	Digital files associated with Finds	Paperwork associated with Finds
Animal Bones	☐	☐	☐
Ceramics	☒	☒	☒
Environmental	☒	☒	☒
Glass	☐	☐	☐
Human Remains	☐	☐	☐
Industrial	☒	☒	☒
Leather	☐	☐	☐
Metal	☐	☐	☐
Stratigraphic		☐	☐
Survey		☐	☐
Textiles	☐	☐	☐
Wood	☐	☐	☐
Worked Bone	☐	☐	☐
Worked Stone/Lithic	☐	☐	☐
None	☐	☐	☐
Other	☐	☐	☐

Digital Media		Paper Media	
Database	☒	Aerial Photos	☐
GIS	☐	Context Sheets	☒
Geophysics	☐	Correspondence	☐
Images (Digital photos)	☒	Diary	☐
Illustrations (Figures/Plates)	☒	Drawing	☐
Moving Image	☐	Manuscript	☐
Spreadsheets	☐	Map	☐
Survey	☒	Matrices	☐
Text	☒	Microfiche	☐
Virtual Reality	☐	Miscellaneous	☐
		Research/Notes	☒
		Photos (negatives/prints/slides)	☐
		Plans	☒
		Report	☒
		Sections	☒
		Survey	☒

Further Comments

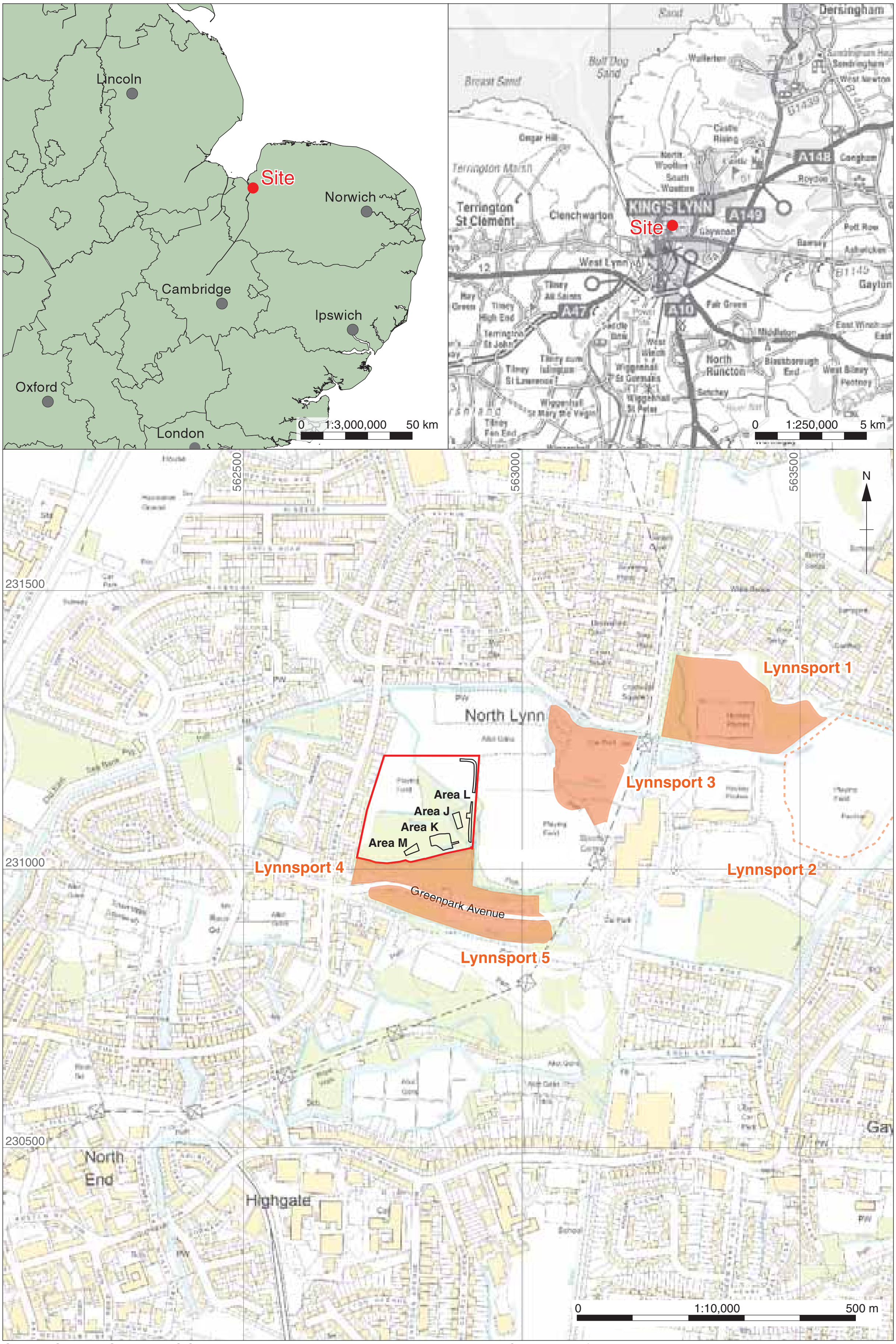


Figure 1: Site location map showing excavation areas (black) in development area (red) and adjacent Lynnsport sites (orange)

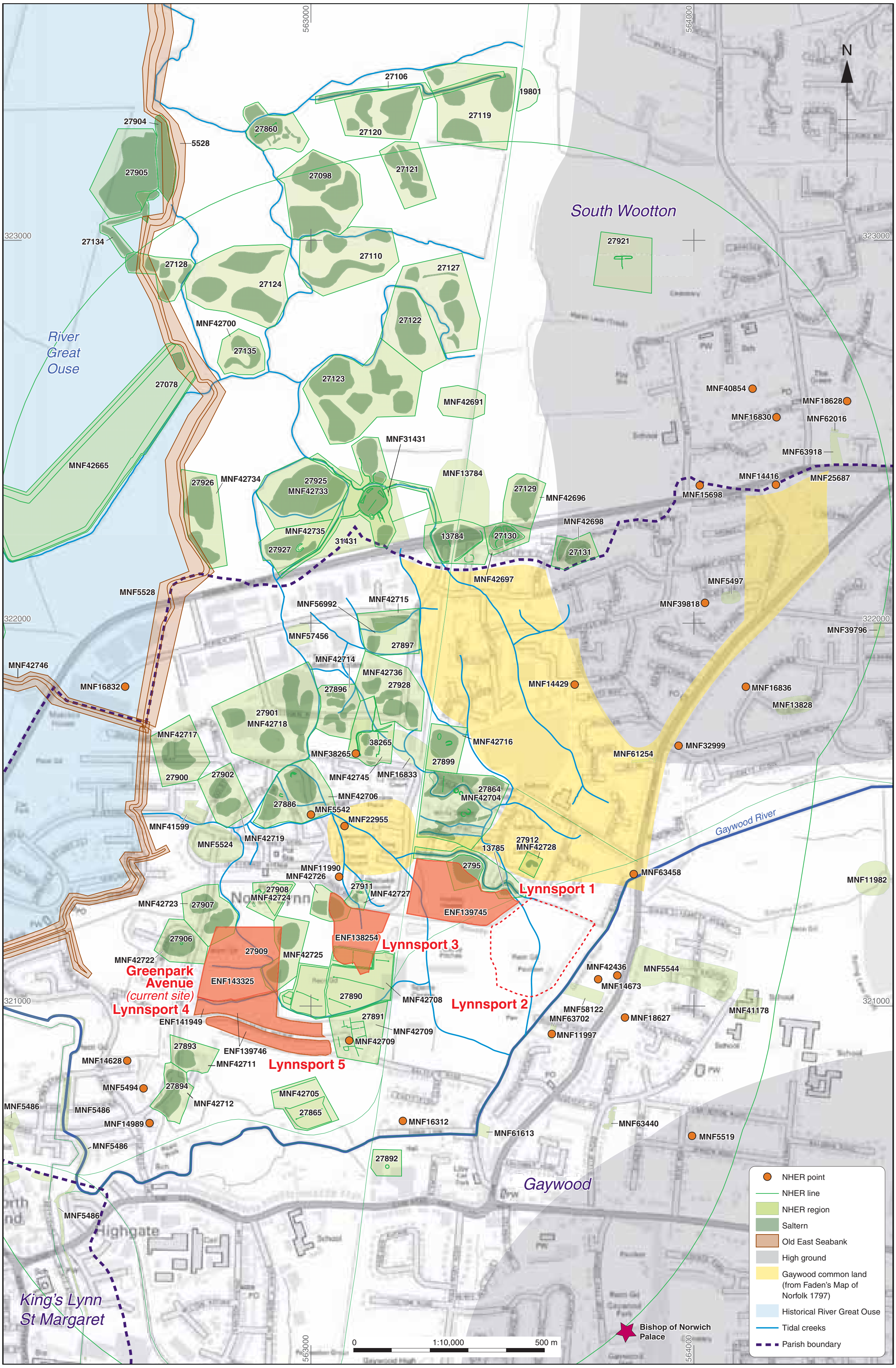


Figure 2: Map showing location of NHER records with NMP data (Copyright Historic England National Mapping Programme, licensed to Norfolk County Council). Sea banks & pre-existing tidal creeks mapped from historic photograph (NHER reference: TF62_TF6321_A_RAF_16Apr1946.tif). Site development areas shown in red.

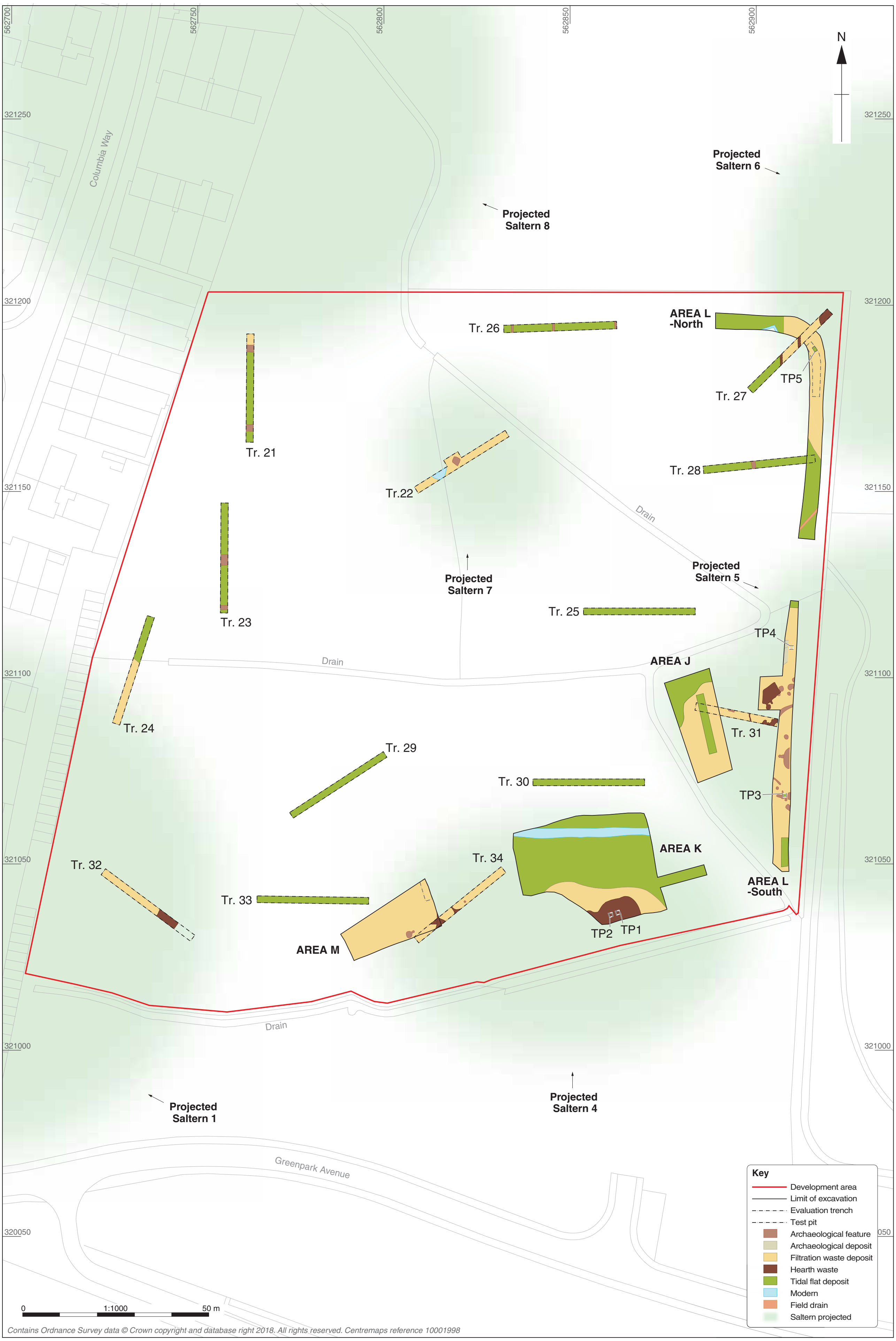


Figure 3: All excavation areas plan showing evaluation trenches

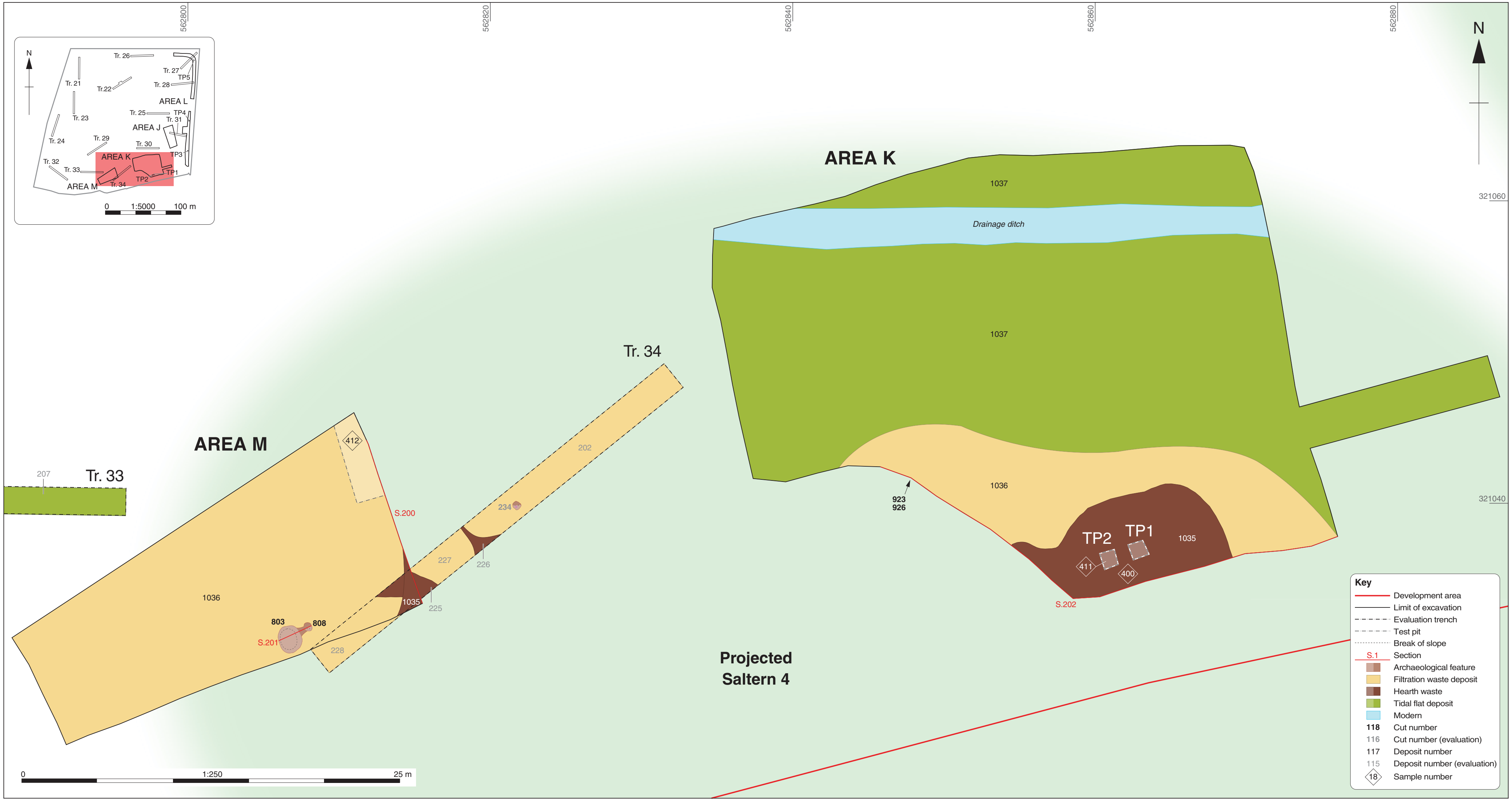


Figure 4: Detailed plan of Areas K and M (Saltern 4) with evaluation trenches

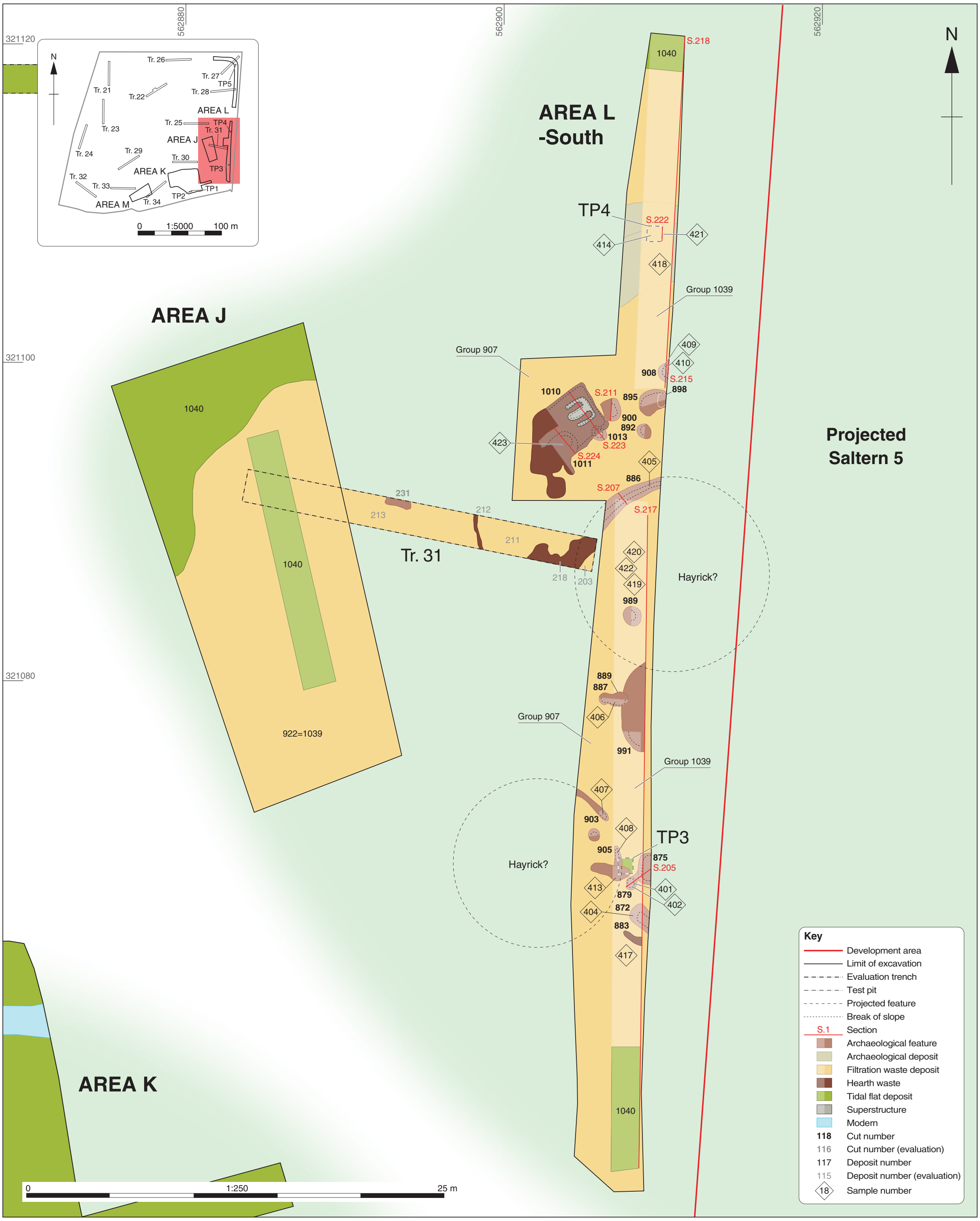


Figure 5: Detailed plan of Area J and southern part of Area L-South (Saltern 5) with evaluation trenches

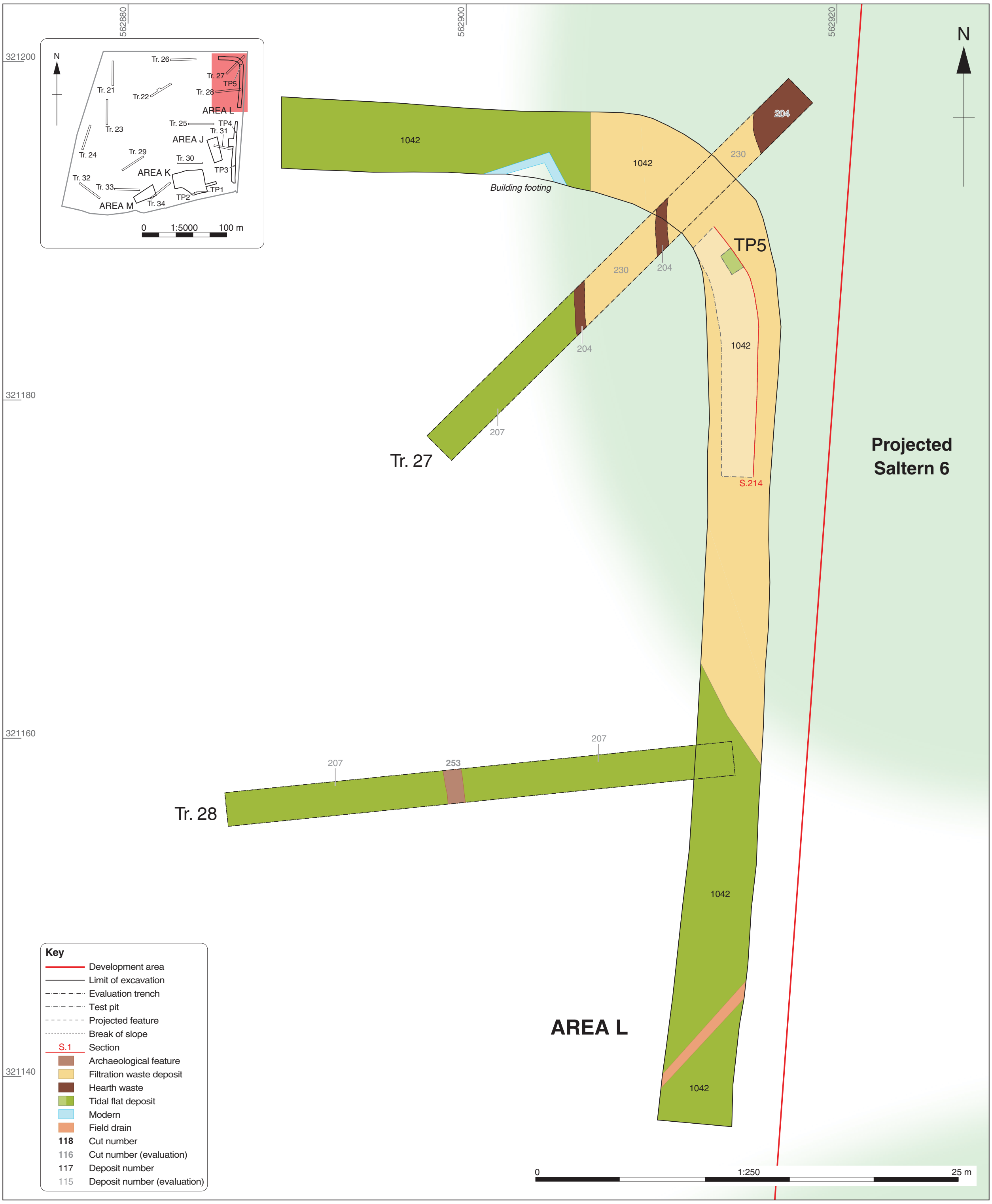


Figure 6: Detailed plan of northern part of Area L-North (Saltern 6) with evaluation trenches

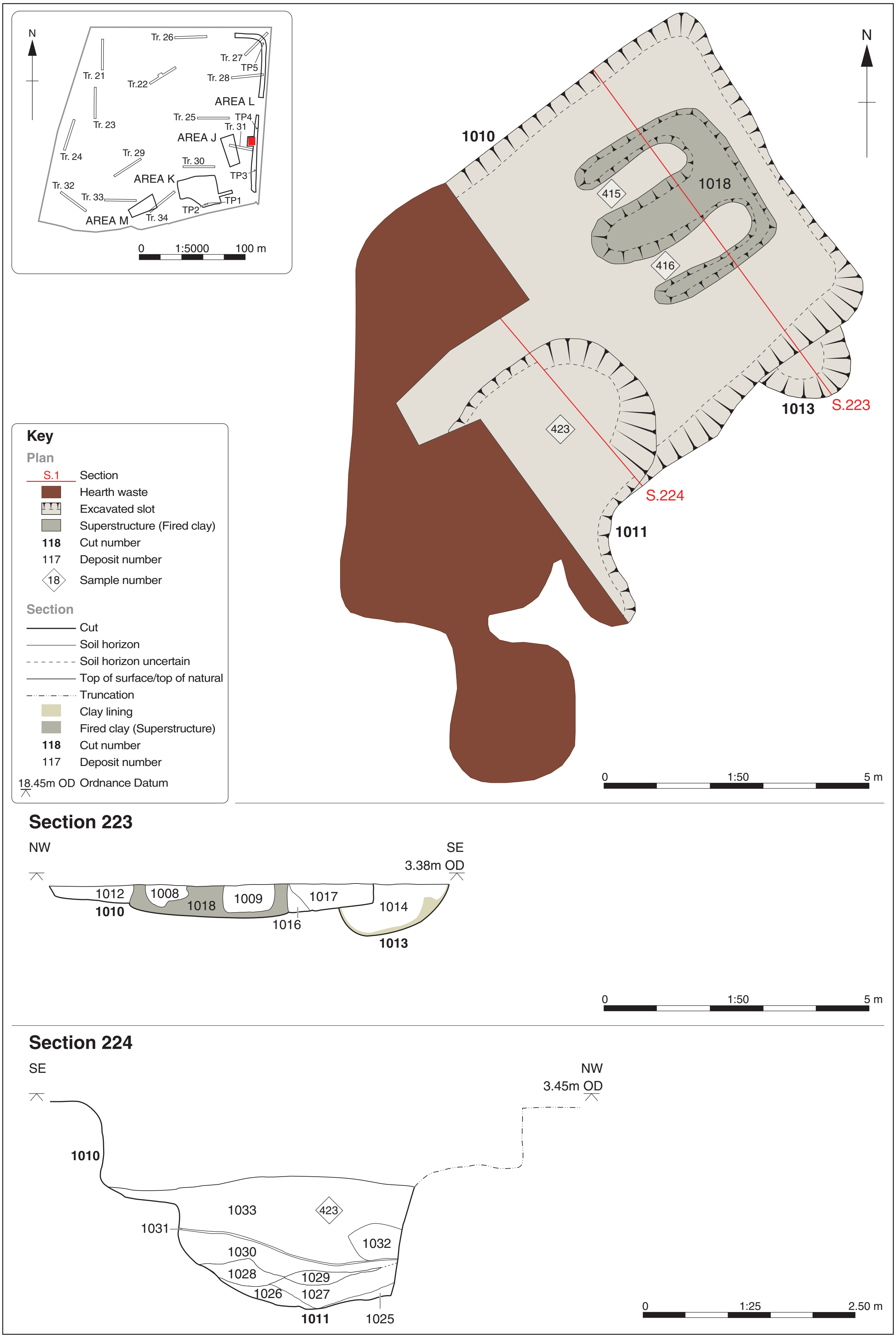


Figure 7: Detailed plan of hearth **1010** and associated features in Area L-South with selected sections

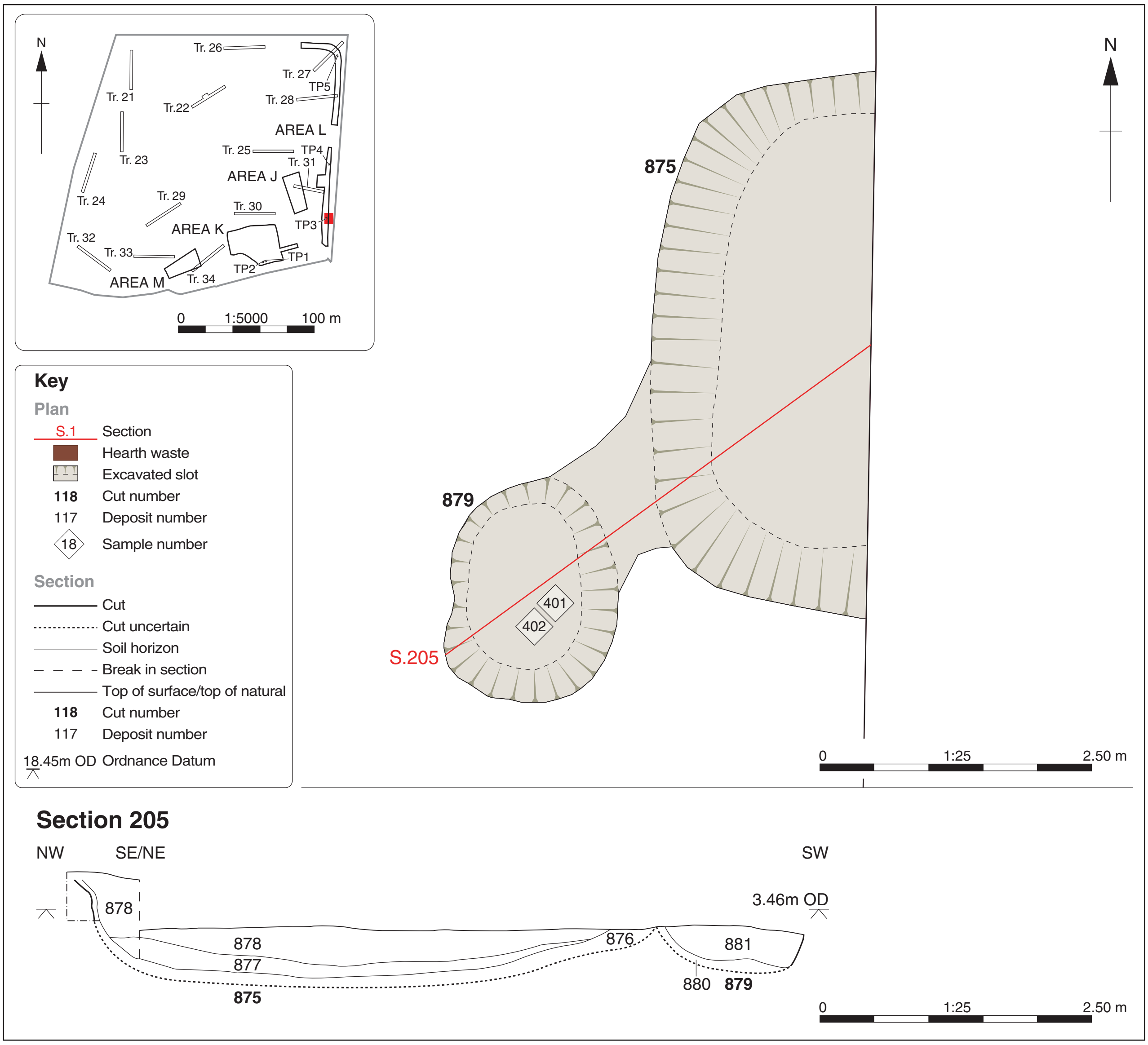


Figure 8: Detailed plan and section of filtration tank **875** in Area L

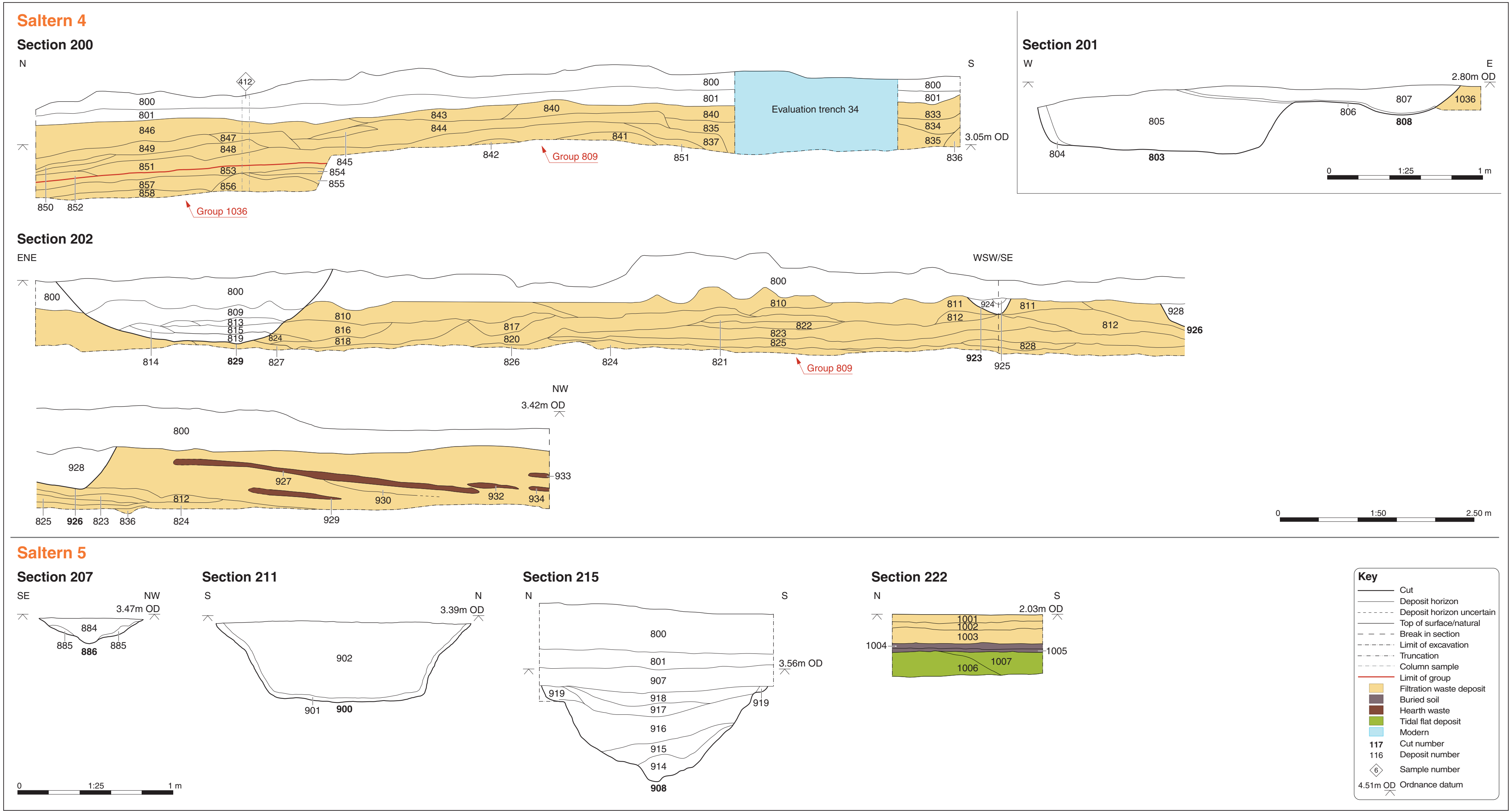


Figure 9: Selected sections

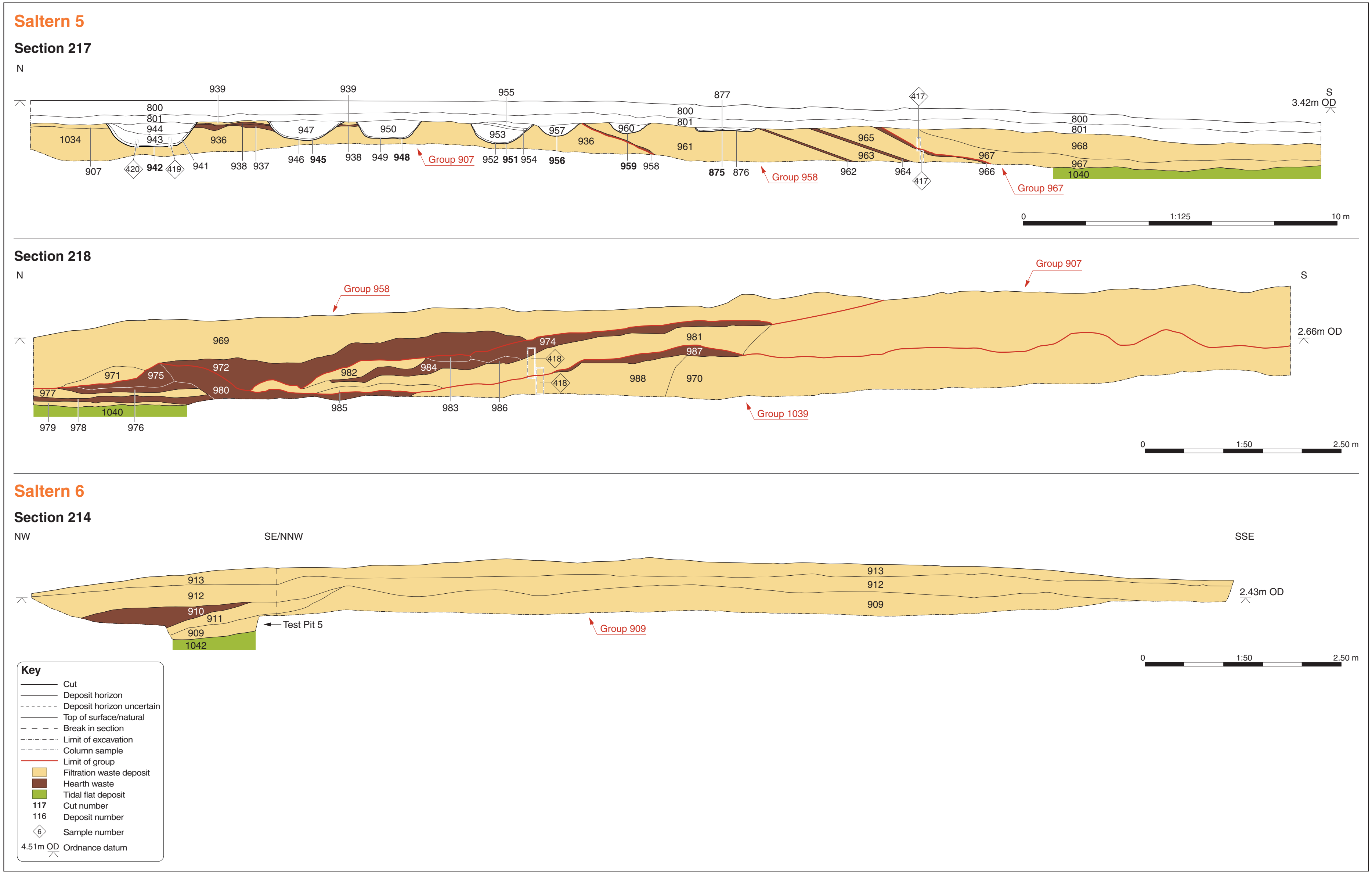


Figure 10: Selected sections

Plate 1: Area K, looking south showing hearth waste (Group 1035)

Plate 2: Area M: Filtration tank **803**, looking north

Plate 3: Area M, Section 202

Plate 4: Area J, Section 216

Plate 5: Area L-South: Initial strip, looking south

Plate 6: Area L-North: Initial strip, looking south

Plate 7: Area L-South: Filtration tank **908**, looking east

Plate 8: Area L-South: Filtration tank **872**, looking east

Plate 9: Area L-South: Test Pit 4, looking east, showing basal horizon deposit 1004/1005

Plate 10: Area L-South: Hearth **1010**, looking south-west

Plate 11: Area L-South: Hearth **1010**, looking north-east

Plate 12: Area L-South: Hearth rake-out pit **1011**, looking south-west

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