Post-Excavation Assessment

Lynnsport 4 & 5: Middle to Late Saxon Salterns on Land Adjacent to Greenpark Avenue, King's Lynn, Norfolk

Post-Excavation Assessment and Updated Project Design

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Post-excavation Assessment and Updated Project Design

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Summary

Between the 3rd April and 4th of May 2017, Oxford Archaeology East (OA East) conducted an archaeological excavation on land adjacent to Greenpark Avenue, King's Lynn, Norfolk (Lynnsport 4 & 5; TF 62897 20966). The site lies within an area of many salt producing sites (salterns) mapped by the NMP in the vicinity of King's Lynn.

This report includes the results of the initial phase of evaluation carried out between the 27th February and 3rd March 2017, comprising nine trenches. The trenches revealed archaeological remains at three locations on the site associated with salt-making during the Middle to Late Saxon period (Salterns 1-3). The remains of Saltern 1 in the western part of the site included a heavily truncated brine-boiling hearth. Nearby was found the heavily truncated remains of a clay-lined pit which probably represented a silt filtration unit associated with brine production. A layer of burnt deposit representing hearth waste tips, containing fragments of baked clay and slag was also revealed. The remains of Saltern 2 in the eastern part of the site included a large pit that appeared to contain a series of fuel waste tips from a brine-boiling hearth. Furthermore, a trench to the north of Greenpark Avenue uncovered part of the circuits of two circular gullies representing drainage channels for hayricks (Riley circles) of the early modern period.

The underlying geology, including the layer of buried peat, was mapped during previous ground investigation works as part of the development of the site. During the evaluation phase of the investigation OA East placed boreholes through the underlying natural tidal flat deposits and through the salterns (Salterns 1 & 2) revealed by the evaluation to the north of Greenpark Avenue. The results of these investigations were used to build a deposit model for the site for the subsequent excavation phase of works.

The excavation targeted Salterns 1 and 2, to the north of Greenpark Avenue, and the two hayricks. These works investigated the saltern mound deposits in the area to be impacted at depth by the proposed housing development. The topographical survey of the site, carried out during this phase of works, also revealed that further saltern remains (Saltern 4) probably lay in the northern part of the site and extended beyond its northern boundary. Further archaeological features were uncovered within each excavated mound, including silt filtration units for brine production. A series of shallow circular clay-lined pits were also revealed. These were interpreted as possible storage tanks for the concentrated brine produced by the filtration units. Nearby lay two large areas of burnt deposits. These comprised hearth waste material that was deposited in shallow rake-out pits or alternatively middens within depressions on the saltern mound. One of these hearth rake-out pits was probably associated with the heavily truncated hearth excavated adjacent to it during the evaluation phase. These features and deposits excavated in both salterns yielded Middle Saxon radiocarbon dates with some Thetford-type ware pottery sherds also recovered. Together these indicate a Middle to Late Saxon date for the salt-making activity on this site.

1 Introduction

1.1 Project Background

1.1.1 Between the 27th February and 4th of May 2017, Oxford Archaeology East (OA East) conducted the first phase archaeological evaluation and excavations on the Lynnsport development. The entire site comprises of five development areas; Lynnsport 1-5. The current project was commissioned by Lovell Partnerships Limited in respect to the proposed residential development of Lynnsport 4 and 5 on land adjacent to Greenpark Avenue, King's Lynn, Norfolk (TF 62897 20966; Fig. 1).

1.1.2 An archaeological evaluation was carried out prior to the excavation in order to establish the presence/absence of archaeological features and deposits. This evaluation consisted of nine trenches (Trenches 12-20; two 55m x 2m, five 50m x 2m, and two 40m x 2m). Significant (presumably) Late Saxon/medieval salt-making remains were encountered in three areas of the site (Salterns 1-3). These works were undertaken in accordance with a Written Scheme of Investigation (Brudenell 2016) prepared by OA East and approved by James Albone of Norfolk County Council Historic Environment Service (NCC/HES).

1.1.3 A further Written Scheme of Investigation (Brudenell 2017) was prepared by OA East (and approved by NCC/HES) detailing the further programme of two excavation areas required on the site to each mitigate the impact of the proposed development on two of the saltern mounds (Salterns 1 and 2) revealed by the initial phase of excavation. A third area was excavated to investigate two post-medieval hayrick gullies revealed by the evaluation trenching. These three separate areas (Areas A-C) totalled an area of 0.15ha.

1.1.4 This assessment has been conducted in accordance with the principles identified in English Heritage'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 within the urban reach of King's Lynn, *c*.1.5km east of the River Great Ouse (Fig. 1). The site covers 2.79ha on a flat area of ground at approximately 2.8-3.3m OD. The site is bounded by a drain to the south (the south edge of the former Salter's Road), woodland and recreation fields to the north, residential development along Columbia Way to the west, and ponds to the east. The site is bisected by Greenpark Avenue, which divides Lynnsport 4 (1.60ha; Plate 1) to the north, from Lynnsport 5 (1.19ha; Plate 2) to the south. Large areas of the site are currently covered by trees.

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 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.

1.2.3 An archaeological evaluation carried by OA East at Marsh Lane in 2015 (Webster 2015; MNF42716; TF 6352 2166; Fig. 2), 750m to the northeast of the site, also revealed peat immediately below the upper silts representing the Terrington Beds. The peat was

radiocarbon dated to the Early Iron Age (786 – 537 cal. BC 95.4% SUERC-61520 GU38211).

1.2.4 Previous ground investigation work undertaken for the site (nine window sample boreholes (WS1-9; Fig. 3) to *c.*15m below ground surface) revealed the Flandian sequence with the upper surface of the (presumably) Nordelph Peat recorded at depths of 1.7-2.95m below ground surface (Sheridan & Warner 2016). This peat was found to be between 1.3-2m thick, and extended beneath the entire site.

1.3 Archaeological and Historical Background

1.3.1 The following section is based on the desk-study and risk assessment for the site produced by Norfolk County Council (Norfolk Partnership Laboratory 2016) and desk-study produced for the Written Scheme of Investigation (Brudenell 2017) that detailed the archaeological potential of the site. A further desk-based assessment for the site produced as part of the ground investigation work by Richard Jackson Ltd was also consulted (Sheridan & Warner 2016). A map of the Norfolk Historic Environment Records (NHER) described in the summary is shown on Fig. 2. The following is a summary based on these reports and a related NHER search.

Prehistoric and Roman

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.*400m to the north (NHER 11990), and a Late Neolithic/Early Bronze Age arrow head *c.*250m to the south-west (NHER 5494)), much of this area was unsuitable for occupation during later prehistory and the Romano-British period, with any earlier traces of activity sealed beneath thick marine and freshwater Flandrian deposits (the arrow head 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 to medieval and post-medieval periods when the area was a saltmarsh environment.

Mid-Late Saxon

1.3.3 Significantly, excavations conducted by OA East in 2015 at Marsh Lane, 750m to the northeast of the site, revealed a medieval saltern (Clarke 2016; NHER 27899) with origins in the Late Saxon period. The remains and associated features on the site evidenced salt-making, evolving from the *c.*8th century through to the early medieval period. Salt-making was demonstrated to have ceased on this site by the mid-13th century. This is the earliest evidence of post-Roman salt-making from the North Lynn area of King's Lynn, and backdates the origins of salt production in this landscape by several hundred years. Other examples of the numerous saltern mounds mapped in the surrounding area, and documented to have been producing salt during the medieval and early post-medieval periods, may also prove to be older in origin.

Medieval and post-medieval

1.3.4 Of particular significance to this area are saltern mounds, of which some 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' process of salt extraction. An extensive swathe of saltern mounds is recorded at North Lynn that produced salt during the medieval and early post-medieval periods (Fig. 2; Albone *et al* 2007, 116). These not only reflect the importance of the

documented medieval salt industry at Lynn, but the location and progressive land reclamation along the medieval coast line, with the easterly inland examples postulated as being the earliest in the sequence (westerly migration occurring as sites were gradually abandoned in favour of locations further out in the channel as the estuary of the Great Ouse silted and the coastline changed).

1.3.5 The site lies toward the southern distribution of saltern mounds in North Lynn, although 11 have been recorded with a 500m radius of the site (e.g. NHER 27893-4, 27906-7, 27909-10). These are located immediately north, north-west, and south-west of the site. The salt-making industry declined during the post-medieval period, although 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.

1.3.6 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. Remnant ridge and furrow/ 'lazybedding' agricultural features and ditches have been identified immediately to the north and east of the site (NHER 2790-91), with further examples *c*.50m to the south (NHER 27865). These were recorded by aerial photography in 1947 and 1961. The examples to the east (NHER 27891) included ditches aligned approximately north-south and east-west, a rectangular enclosure with an apparent entrance on its southern side, and a D-shaped enclosure. This system may extend into the subject site.

Modern

1.3.7 The OS series maps from 1884 show the site north of Salter's Road. The plot was covered by a tree plantation/orchard, and was bisected by two north-east to south-west aligned field boundaries and a track. Up to seven buildings were depicted on the site between 1884-1958, most of which were are likely to be sheds or barns. Some or these are visible on aerial photographs taken in 1946, which show north-east to south-west aligned horticultural strips across the eastern part for the site and area of pasture and trees to the west.

1.3.8 Columbia Way appears on the OS maps from 1974, and Greenpark Avenue – which bisects the site east-west – is shown on the 2002 OS map.

1.4 Acknowledgements

1.4.1 The author would like to thank Lovell Partnerships Limited, particularly Darron Keen and Roger Bowers (site manager), for commissioning the work. Dr Matthew Brudenell managed the project and James Albone, Planning Archaeologist of Norfolk County Council (NCC) monitored the works. The field work was supervised by the author with the assistance of Malgorzata Kwiatkowska, Lindsey Kemp, Kathryn Blackbourn, Fergus Hooper, John Percival and Eben Cooper. The site survey was conducted by David Brown with the drilling of the window sampling borehole carried out by Christof Heistermann. The illustrations were produced by Séverine Bézie.

2 Project Scope

2.1.1 This report deals solely with the 2017 evaluation and excavation undertaken by OA East at Greenpark Avenue, King's Lynn, Norfolk. Relevant parts of the desk-based assessments produced for the site by Norfolk County Council and Richard Jackson Ltd (Norfolk Partnership Laboratory 2016; Sheridan & Warner 2016) as well as for the Written Scheme of Investigation for the excavation (Brudenell 2017) will be referred to during the assessment where appropriate.

3 Interfaces, Communications and Project Review

3.1.1 The Post-Excavation Assessment has been undertaken principally by Graeme Clarke (GC) and edited and quality assured in-house by Project Manager Matt Brudenell (MB) and Post-Excavation Publications Manager Elizabeth Popescu (EP). It will be distributed to the Client (Lovell Partnerships Limited) and James Albone (JA) from Norfolk County Council (NCC) for comment and approval.

3.1.2 Following approval of the Post-Excavation Assessment, further analysis will be conducted on those areas of the project identified in the Updated Project Design.

3.1.3 On completion of the anticipated further phases of excavation on Lynnsport 1-3, discussions will be had with the lead members of the project, with the aim of drawing the results and analysis of all the fieldwork phases together in an archive report and publication article. Following approval of the archive report, discussions will be had between GC, MB, and JA to progress the publication article. Input shall also be sought at this stage from EP. As a result of this meeting, a Publication Synopsis will be prepared.

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

4 Original Research Aims and Objectives

4.1 Introduction

4.1.1 The Written Scheme of Investigation produced for the excavation of Lynnpsort 4 and 5 (Brudenell 2017) identified a suite of research aims that were designed to provide a framework for the subsequent assessment and analysis of results.

4.2 Aims of the evaluation (Brudenell 2016)

4.2.1 The evaluation sought to establish the character, date, state of preservation, and extent of any archaeological remains within the development area. The scheme of works was designed to achieve the following:

- Provide sufficient coverage and exposure to enable excavation to establish the approximate form, date and purpose of any archaeological deposits, together with extent, localised depth and quality of preservation. It will also examine the deeper, Flandrian sequence of deposits at the site.
- Provide sufficient coverage and exposure to evaluate the likely impact of past land uses, and the possible presence of masking deposits.
- Provide sufficient coverage and exposure to provide information to construct an appropriate archaeological conservation/mitigation strategy, dealing with preservation, the recording of archaeological deposits, working practices, timetables and order of cost.
- Set results in the local, regional, and national archaeological context.

4.3 Local and site specific research objectives

4.3.1 The evaluation phase of the investigation identified remains relating to (presumably) Late Saxon/medieval salt-making activity and the investigation and understanding of these remains constitute the research aims of the overall project.

General aims of the project

4.3.2 The salterns revealed at land adjacent to Greenpark Avenue form part of the extensive swathe of saltern mounds recorded across North Lynn (Albone *et al* 2007, 116). The three previously unmapped mounds found in the 2017 evaluation add to the picture of a large, monumental-scale industrial landscape developing over the Mid-Late Saxon and medieval periods. Whilst most of the mapped mounds south of Edward Benefer Way now lie beneath industrial buildings and areas of post 1950's housing, many fall within open land in and around the Lynnsport sites, now coming forward for development through the planning process.

4.3.3 The investigation of the Greenpark Avenue salterns will form part of a wider project that examines salterns across the forthcoming development sites in North Lynn. Over the next three years, these investigations will provide an unprecedented window into the North Lynn saltern complex. They will establish the date and broad sequence of the mounds; establish the changing character, form, scale and configuration of salt-making structures, fixtures and features, and as a result chart (through archaeology) the rise and fall of the North Lynn salt-making industry. The overarching objectives will be set out elsewhere in a separate Project Design document, to be produced in consultation with NHES and other stakeholders, including Lovell, representative from King's Lynn and West Norfolk Borough Council and Historic England. At present, the aims/questions/themes being formulated, which will guide the investigations at Greenpark Avenue and others as the Project Designs develops, are as follows:

- 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.
- To obtain a better understanding of the salt-making process and identify any methodological or technological changes over time.

Saltern mounds and mound formation

4.3.4 Over what period did the mounds develop? Can we retrieve sufficient material to date mounds sequences and bracket their chronology?

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

4.3.6 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 for eastern/landward salterns?

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

Saltern fixtures and features

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

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

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

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

4.3.12 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

4.3.13 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?

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

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

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

Salterns and landscape change

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

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

4.3.19 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?

4.4 Regional Research Objectives

4.4.1 Following the completion of the assessment process, these questions have been revised in line with the development of the overarching Project Design (see Section 7 below). This will also contribute and feed into the following research frameworks:

- *Research and Archaeology: A Framework for the Eastern counties: 1. Resource Assessment* (Glazebrook 1997, East Anglian Archaeology Occasional Papers 3);
- *Research and Archaeology: A Framework for the Eastern counties: 2. Research Agenda and Strategy* (Brown & Glazebrook 2000, East Anglian Archaeology Occasional Papers 8); and
- *Research and Archaeology Revisited: A Revised Framework for the East of England* (Medlycott 2011, East Anglian Archaeology Occasional Papers 24).

5 Summary of Results

5.1 Introduction

5.1.1 The excavation revealed evidence for four salterns on the site (Salterns 1-4). Features and deposits associated with salt-making were excavated in two of the salterns (Salterns 1 and 2). The salt-making activity was found to belong to the Late Saxon period with the activity ceasing during the early medieval period.

5.1.2 Descriptions of the features identified and artefacts recovered are given in this section. Full context inventories for the evaluation and excavation phases of the investigation are presented in Appendices A.1 and A.3 respectively. The OA East borehole log into Saltern 2 is shown in Appendix A.2. A site layout plan is given as Fig. 3 with a topographical model of the site shown on Fig. 4. Feature locations with phasing for excavation Areas A, B & C are presented in Figs 5, 6 & 7 respectively. Detailed plans of silt filtration units **146** within Saltern 1 and **117** within Saltern 2 are shown as Figs 8 and 9 respectively. Selected sections are presented as Fig. 10.

5.2 Evaluation and borehole investigations (ENF 139746) (Fig. 3)

5.2.1 The initial evaluation phase revealed the substantial remains of two saltern mounds (Salterns 1 and 2) within Trenches 12 and 18 respectively of Lynnsport 4, to the north of Greenpark Avenue. Both these mounds consisted mainly of deposits derived from silt filtration and brine boiling processes indicative of the salt-making industry. The remains of a probable brine boiling hearth (**34**) and clay-lined water tank (**37**) were also revealed in Saltern 1 (Fig. 5). A pit (**47**) was also revealed cut into Saltern 2 that contained a series of burnt deposits with much fired clay that may also represent dumps of hearth waste (Fig. 8). The remains of a third saltern mound (Saltern 3) in Trench 17 of Lynnsport 5 appeared to extend mainly beneath the current Greenpark Avenue carriageway. Saltern 3 was comprised of yellow brown filtration waste silts. No datable artefacts were recovered from any of the saltern mound deposits.

5.2.2 Part of two ring gullies, probably representing drip gullies of post-medieval hayricks (Hayricks 1 (**24**/**26**) and 2 (**28**/**30**)) were revealed in Trench 15 (Fig. 7). The post-medieval date for these features was confirmed by a ceramic tobacco pipe-stem recovered from the fill of one of these features.

5.2.3 In addition to these remains, tree-pits were also identified in Trenches 15 (32) and 16 (**10**, **12**, **14**, **16**, **18**, **20** & **22**) of more recent date and probably associated with the orchard shown on historical maps that once extended across the site.

5.2.4 As part of the archaeological evaluation of the site, a borehole was drilled using the mechanical hand-auguring technique to sample a layer of buried peat for pollen analysis. The peat was known to lie at depth beneath the site between layers of tidal flat deposits. The underlying geology, including the layer of buried peat, was mapped in February 2016 during ground investigation works by Richard Jackson Ltd as part of the development of the site (WS1-9; Fig. 3; Sheridan & Warner 2016). The Oxford Archaeology borehole (WS10; Fig. 3) was placed on the natural tidal flat deposits at the western end of Trench 18. In addition, a single borehole was also drilled by Oxford Archaeology (WS11 & WS12; Fig. 3) using manual hand-auguring technique into Salterns 1 and 2 to determine the extent of the salt-making deposits making up these mounds. The saltern mounds were estimated to be *c*.50-60m in diameter, with the depths of Salterns 1 and 2 gauged to be 1.5m and 1.8m thick respectively. The results

of the borehole surveys were used to build a deposit model for the subsequent excavations.

5.2.5 The results of the evaluation are presented along with the excavation results below.

5.3 Excavations (ENF 141949) (Fig. 3)

5.3.1 The excavation targeted two 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. Excavation Area A (Plate 1) encompassed an area of 684m^2 of Saltern 1 and excavation Area C (Plate 3) encompassed an area of 401m^2 of Saltern 2. A part of Area A (262m^2) was extended further down to the formation level of the development which corresponded to the level of contact between the basal deposits of the mound and underlying saltmarsh deposits (approximately 2m OD). Similarly, the excavation of Area C also encompassed an area of impact of the development down to the level of saltmarsh deposits. These excavations investigated *in situ* salt-making features buried by the mound deposits as well as the mound deposits themselves.

5.3.2 In addition, the full extent of two hayrick gullies encountered in evaluation Trench 15 were encompassed within the 418m^2 extent of excavation Area B (Plate 2). The topographical survey of the site (Fig. 4), carried out during this phase of works, also revealed that further saltern remains (Saltern 4) probably lay in the northern part of the site and extended beyond its northern boundary.

5.3.3 The chronological site phasing presented below is largely based on stratigraphic relationships of salt-making features within the sequence of saltern mound deposits. Spatial associations of features and groups of features are also considered. This phasing has been combined with dating evidence provided by stratified pottery sherds and radiocarbon dates from charcoal and macrofossils recovered from features and deposits.

5.3.4 The sequence of each saltern mound's deposits commenced from a height of approximately 2m OD and directly overlay natural deposits of the intertidal saltmarsh environment. These layers extended to a maximum height of approximately 3.2m OD where the mound was overlain by subsoil and topsoil.

5.3.5 Four main periods of activity have been identified within the salterns:

- ***Period 1: Natural deposits***
- ***Period 2: Middle to Late Saxon (c.AD650 – 1066)***
- ***Period 3: Medieval (c.AD1066 – c.AD1500)***
- ***Period 4: Post-medieval/modern (c.AD1500 – present)***

5.4 Deposit model

5.4.1 The evaluation phase of the investigations grouped the deposits encountered beneath the site into ten geological units. These units were based on ground investigation works on the site in 2016 by Richard Jackson Ltd as part of the development of the site (WS1-9; Fig. 3; Sheridan & Warner 2016). This sequence of deposits was confirmed by boreholes drilled by OA East (WS10, WS11 & WS12; Fig. 3) using powered and manual hand-auguring techniques into the natural deposits and Salterns 1 and 2. Each deposit within the sedimentary sequence revealed by the boreholes was assigned a context

number to group the deposits revealed during the excavation phase of works. These groups are described stratigraphically in Table 1.

Period	Excavation group no.	Average Height of upper horizon (m OD)	Description	Geological unit	Approximate date range of deposits
1	50	-2.8	Firm grey silty clay with a little gravel content.	Kimmeridge Clay bedrock	-
	51	-1.4	Dense brown sand and gravel.	Palaeo surface deposits	Neolithic period
	52	0.3	Soft dark brown and reddish brown organic sandy silt.	Peat	Iron Age period
	53	2	Firm bluish grey silty clay with a little fine sand content.	Marine tidal flat deposits	Iron Age to Saxon periods
2	54	3.2	Loose layers of pale brown, brownish yellow and dark grey silts and sands.	Saltern 1	Middle to Late Saxon periods
	55	3.2	Loose layers pale brown, brownish yellow and dark grey silts and sands.	Saltern 2	
3	56	3.2	Firm light brown silty clay with a little fine sand content.	Freshwater marsh deposits	Medieval period
4	57	-	Soft orange brown sandy silt.	Subsoil	Post-medieval to modern
	58	-	Soft dark grey sandy silt with roots.	Topsoil	
	59	-	Firm dark brown, slightly gravelly Clay with roots and inclusions of brick, coal and concrete.	Made Ground	

Table 1: Deposit model

5.5 Period 1: Natural deposits (Groups 50-53)

Group 53: Marine tidal-flat deposits (saltmarsh)

5.5.1 Extending beneath Saltern 1 in Area A and Saltern 2 in Area B were natural deposits indicative of the mudflat and tidal creek environment of the saltmarsh exploited by the Middle to Late Saxon salt-making activities. The top of these deposits was encountered at a height of approximately 2m OD in both excavation Areas A and C (Fig. 10, Sections 77 and 75 respectively).

5.5.2 These deposits comprised a varied mix of pale yellow, green, orange, brown and grey silty sands (127 and 170 in Area A; 141 and 161 in Area C). A test pit excavated by mechanical excavator into these deposits in Area A revealed that below a height of approximately -1m OD these marine deposits became wet in conjunction with becoming grey coloured and with a greater clay content. In addition, organic remains frequently occurred within the waterlogged deposit, comprised of plant macrofossils.

5.6 Period 2: Middle to Late Saxon (*c*.AD650 – 1066)

Area A: Saltern 1 (Group 54; Fig. 5)

Summary

5.6.1 Two phases of salt-making activity were identified within this period. The earlier phase comprised silt filtration units cutting the saltmarsh deposits of Period 1. The later phase included a further filtration unit, clay-lined tanks and what appeared to be two hearth rake-out pits. Late Saxon Thetford-type Ware and probable Lincoln kiln-type pottery sherds were recovered from one of the clay-lined tanks and hearth rake-out pits. One of these rake-out pits was probably associated with the remains of hearth **34**, excavated in Trench 12 during the evaluation phase of the investigation. These groups of features occurred at successive levels within the saltern mound and were separated by layers of waste filtration silts. A thin layer of what may have been a possible buried soil horizon was also recorded stratigraphically between these two groups of features.

Primary salt-making phase – clay lined features

5.6.2 Evidence for salt-making activity commenced with a group of four clay-lined pits. These features, detailed in Table 2, represent the remains of silt filtration units for the production of concentrated brine as part of the salt-making process. These features were revealed to directly overlay and cut the undulating saltmarsh deposits.

5.6.3 The complete ground plan of one of these filtration units (**146**) survived (Fig. 6; Plate 4). This comprised a shallow sub-circular and flat-based filtration pit with a channel, up to 0.2m wide, at the eastern end leading to a deeper circular water tank with a concave base. The water tank element for a further three filtration units (**140**, **150** & **153**) were also excavated. Each filtration unit was lined with blue-grey clay up to 0.05m thick. The filtration unit elements contained brownish yellow sand or light greyish brown silty sand fills deposited after their disuse.

Unit	Maximum Dimensions (m)			Filtration Pit Dimensions (m)			Water Tank Dimensions (m)		Deposits		
	Length	Width	Depth	Length	Width	Depth	Diameter	Depth	Lining	Filtration Pit	Water Tank
140	-	-	-	-	-	-	0.6	0.25	139	-	138
146	1.96	1.16	0.36	1.2	1.16	0.08	0.8	0.36	147	148	149
150	-	-	-	-	-	-	0.5	0.15	151	-	152
153	-	-	-	-	-	-	0.7	0.17	154	-	155

Table 2: Group 1 filtration unit inventory

Filtration waste silt 69/92

5.6.4 The primary phase of filtration units was overlain by layer of filtration waste silt (69/92; excavated as 41 & 42 in evaluation Trench 12) to a maximum height of approximately 3.5m OD (Fig. 10, Section 77). This layer probably represents the resultant waste from silt filtration activity, as demonstrated by the primary phase of salt-making features, taking place directly on the level of the saltmarsh. The waste silt consisted of light brownish yellow silty sand.

Hearth waste deposits

5.6.5 Thin layers of burnt deposits (68, 90, 93 & 175) were observed overlying parts of waste silts 69/92. These deposits probably represent tips of hearth waste and provide evidence for the presence of hearths for the boiling of the concentrated brine produced by silt filtration units. Each deposit consisted of dark greyish brown sandy silt with frequent charcoal fragments. Layer 68 produced a single fragment (8g) of slag.

Possible buried soil

5.6.6 Waste silt 69/92 was also overlain by thin pale grey silty sand layer 171, up to 0.1m thick. This layer tipped steeply to the east across the full profile of the saltern deposits from a height of 3.2m-2.4m OD. This layer probably represents a period of soil formation and a pre-existing land surface. The upper horizon underlay a further layer of filtration waste silt (172).

Secondary salt-making phase – hearths, rake-out pits and clay lined features

5.6.7 This comprised a group of salt-making features including: the water tank element of a silt filtration unit (**70**); five clay-lined water tanks **73**, **76**, **80**, **99** & **102**; and two rake-out pits **83** & **128** for the disposal of fuel waste associated with brine-boiling hearths. The filtration unit and water tank features cut into waste silt deposits 69/92 at a height of approximately 2.5m OD. Rake-out pit **83** may have lain within a depression within the mound between two banks of the underlying filtration waste silt (69). The base was probably excavated further into the underlying filtration waste silts (69) and the underlying saltmarsh deposits of Group 53 to provide greater capacity to accommodate the hearth waste material. These remains were probably associated with hearth **34** revealed during the evaluation phase of the investigation, located at the southern end of the rake-out pit. The waste tips of rake-out pit **128** commenced at a level below that of the saltmarsh deposits of Group 53 indicating a pit was deliberately excavated to accommodate the waste from a further hearth. Layers of hearth waste were observed to extend up the pit's profile, separated by further layers of clean yellow sand and silt. These layers consisted of very thin lenses of probably water lain deposits that probably represent periods of disuse between each use of the associated hearth and its resultant burnt fuel waste products.

Hearth **34**

5.6.8 The heavily truncated remains of a hearth were encountered immediately below the subsoil of Trench 12 and excavated during the evaluation phase of the investigation. The hearth lay towards the western end of the trench at its point of greatest elevation of approximately 3.04m OD; the crest of Saltern 1. It comprised a sub-rectangular feature, 1.54m long, 0.96m wide by 0.19m deep (Fig. 10, Section 14). The surviving *in situ* fired clay hearth base (35; Plate 5), totalling 1974g, was recovered. These remains display organic material impressions and some remnant flattened surfaces. A circular area of more hardened green clay (39), that may represent vitrification due to intense heat within the hearth chamber, was observed on the inner wall. The hearth base was overlain by waste backfill deposit (36) which consisted of soft dark brownish grey sandy silt with inclusions of fired clay and charcoal.

Hearth rake-out pit **83**

5.6.9 This pit was located immediately to the northeast of hearth **34**, with which this feature was probably directly associated. It extended beyond the northern limit of the excavation. It was amorphous in plan that measured up to 6m in diameter and 0.8m

deep. It contained a series of burnt fuel waste deposits described stratigraphically below in Table 3 (Fig. 10, Sections 56 and 77; Plate 6).

Rake-out pit	Deposits		
	Fill	Max. thickness	Description
83	84	0.06	Mid brownish red sandy silt with occasional charcoal fragments
	85	0.09	Light to dark grey sandy silt with frequent fragments of charcoal and fired clay
	86	0.18	Dark grey sandy silt with occasional fired clay fragments
	87	0.13	Lenses of light greyish yellow and dark greyish brown sandy silt with frequent fragments of fired clay and charcoal
	88	0.08	Dark red and grey sandy silt with rare fragments of fired clay, charcoal and slag
	79	0.18	Dark greyish brown sandy silt with frequent fragments of charcoal and slag

*Table 3: Rake-out pit **83** deposits*

5.6.10 The basal fill (84) of rake-out pit **83** contained a fragment pelvis of a medium sized mammal. The overlying fill (85) produced a single sherd each of Late Saxon shelly ware (19g) and Thetford-type ware pottery (6g) dating to the *c.*10th century along with 261g of fired clay hearth-brick fragments and a fragment of tibia of a medium sized mammal. Backfill 85 also yielded a charred tuber fragment radiocarbon dated to 766-899 cal AD (88.3% SUERC-75156 GU45028). This was in turn overlain by fill 86 that also yielded three sherds (17g) of Thetford-type ware pottery, and 292g of fired clay fragments. A fired clay fragment has a thumb/nail impression and may have been a prop or spacer. Fill 87 also contained 464g of fired clay. The uppermost fill (79) contained 193g of baked clay with a smoothed surface indicative of lining and 485g of more amorphous baked sandy material with some clay and an iron nail (SF2). These fills also produced a total of 76g of slag.

Hearth rake-out pit **128**

5.6.11 A large area (approximately 8m x 4m) of burnt deposit (91) was also revealed on the eastern edge of the saltern. This deposit was equivalent to hearth waste deposit 40 uncovered by Trench 12 during the evaluation phase. A series of test pits (Test Pit Grids 1 & 2; Plate 7) were excavated into the deposit that revealed a sequence of further burnt waste tips that lay between 'clean' layers of yellow sand (Fig. 10, Section 66). This sequence extended down to a height of 1.5m OD and below the level of the natural saltmarsh deposits 127/170 (Section 77). Therefore, similarly to rake-out pit **83**, a pit (**128**) appeared to have been excavated in which to dispose of the fuel ash waste produced by a brine-boiling hearth. This waste pit was filled by these waste products which then continued to be tipped at this location resulting in a low midden of waste extending above beyond the edge of the pit cut. These deposits are described stratigraphically below in Table 4.

Rake-out pit	Deposits		
	Fill	Max. thickness	Description
128	129	0.14	Dark grey and black sandy silt with frequent fragments of charcoal
	130	0.13	Light brownish yellow silty sand

Rake-out pit	Deposits		
	Fill	Max. thickness	Description
	131	0.04	Dark grey and black sandy silt
	132	0.1	Mid yellowish brown clayey silt
	133	0.12	Light brownish yellow silty sand
	91	0.1	Dark greyish brown silty sand with frequent fragments of charcoal and fired clay

*Table 4: Rake-out pit **128** deposits*

5.6.12 The deposit sequence revealed three distinct tips of brine-boiling fuel waste (129, 131 and 91). Fill 91 produced 25g of fired clay with a flattened surface indicative of hearth lining and a single fragment (6g) of slag. Backfill 91 also yielded a fragment of charcoal (*Corylus avellana*) radiocarbon dated to 772-905 cal AD (76.9% SUERC-75162 GU45031). Intervening periods of abandonment or disuse of the site, that may be equated to the seasonal nature of the salt-making process, are indicated by the silting up of the pit by relatively clean silt and sand deposits (130, 132 and 133). These deposits were observed to be made-up of very thin lenses of material indicating they were lain by natural processes rather than dumps of filtration waste silts.

Brines storage Tanks

5.6.13 Five circular pits (**73**, **76** (Section 54; Plate 8), **80**, **99** & **102**) were placed in a linear arrangement from northwest to southeast across the extent of the saltern (Plate 9), immediately southwest of hearth **34** and hearth rake-out pits **83** and **128**. These features, detailed in Table 5, probably represent the remains of collection tanks for the storage of the concentrated brine produced by the filtration units as part of the salt-making process. These storage tanks would presumably have been placed next to brine-boiling hearths. When overlaying the results of the evaluation phase of the investigation, hearth **34** was found to be placed between tanks **73** and **80**. The cuts were lined with mid-dark brown clay up to 0.1m thick overlain by mid yellowish brown sand and silty sand backfill deposits. The clay-lining (74) of tank **73** produced a single translucent annular glass bead. The fill (82) of tank **80** contained a sherd (6g) of Theford-type Ware dating to the *c.*10th century.

Water Tank cut	Dimensions (m)			Deposits			
	Length	Width	Depth	Lining	Description	Disuse backfill	Description
73	1.7	1.6	0.35	74	Mid yellowish brown clay	75	Light yellowish brown silty sand
76	1.6	1.5	0.14	77	Mid brown clay	78	Mid yellowish brown sand
80	2.25	2.15	0.3	81	Pale brown clay	82	Yellow silty sand
99	1.7	1.6	0.27	100	Dark brown clay	101	Light yellowish brown sandy silt
102	1.6	1.52	0.22	103	Dark yellowish brown clay	104	Light yellowish brown sandy silt

Table 5: Water tank inventory

5.6.14 The heavily truncated remains of a further clay-lined water tank (**37**) were revealed in Trench 12, excavated into Saltern 1 during the evaluation phase of the investigation (Fig. 10, Section 13). Only the rectangular clay-lined base of the feature survived (38), up to 0.05m thick. The feature measured 1.4m long and 0.48m wide with a flat base to the cut revealed beneath the firm bluish grey clay.

Filtration Units

5.6.15 Evidence for a single clay-lined silt filtration unit (**70**) was revealed within this group. It comprised of a circular water tank element that measured 0.65m in diameter and 0.22m deep. A bluish grey clay-lining (71) 0.05m thick extended around the cut and contained a single mid brown sandy silt fill, deposited after its disuse.

Possible buried soil 89

5.6.16 A thin mid grey layer, possibly representing a weathered buried soil, was excavated in Test Pit 2 (Fig. 10, Section 55). This buried soil was observed to slope steeply northwards between heights of 2.7m-2.5m OD, overlying filtration waste 69/92, into what would presumably have been a large sub-circular depression in the surface of the saltern mound. The upper horizon underlay filtration waste silt (94) that apparently infilled this depression. This layer yielded a fragment of charcoal (*Salix* sp/*Populus* sp) radiocarbon dated to 855-985 cal AD (81.0% SUERC-75161 GU45030).

Filtration waste silt 94

5.6.17 This uppermost layer of filtration waste silt was recorded extending across (and into) what would have been a roughly circular depression in the northeastern part of Saltern 1. The deposit overlay the thin deposits (possible buried soil 89 and hearth waste 90 and 93 described above) that tipped steeply down into the depression. The deposit consisted of mid yellowish brown sandy silt, indicative of filtration waste deposits.

Area C: Saltern 2 (Group 55; Fig. 8)

Summary

5.6.18 Two phases of salt-making activity were identified within this period (Fig. 10, Section 75). The earlier phase comprised the water tank element of a silt filtration unit (**159**) cutting the saltmarsh deposits of Period 1. The later phase included two further filtration units (**117** & **156**) with filtration unit **117** producing Thetford-type Ware pottery dating to the *c.*10th century. No hearths were revealed in this excavation area. However, a hearth rake-out pit (**47**) similar to the two examples excavated in Saltern 1 was revealed during the evaluation phase of the investigation, excavated in Trench 18 to the north of the excavation area. These phases of activity occurred at successive levels within the saltern mound, separated by layers of waste filtration silts, of which one produced a further sherd of Thetford-type Ware pottery. As in Saltern 1 a thin band of possible buried soil was recorded stratigraphically between two of the phases. Layers of filtration waste (44 & 46) and hearth waste (45) were also recorded with the hearth rake-out pit in evaluation Trench 18, to the north of Area C.

Basal horizon deposit 142

5.6.19 The saltern mound deposit sequence commenced with a thin horizon of light grey silty sand with frequent charcoal flecks (142) up to 0.05m thick. It lay intermittently within the excavation area over the natural saltmarsh deposits (141/161) at a height of approximately 2m OD.

*Filtration Unit **159***

5.6.20 Cutting this basal horizon and the underlying saltmarsh deposits (141/161) were the remains of a single filtration unit (**159**) associated with salt-making at a height of 2.3m OD. The remains comprised a pit representing the water tank element of the filtration unit. It was up to 0.65m in diameter and 0.48m deep with a V-shaped profile a narrow flat base. Only the faint trace of a clay lining was revealed around the pit cut and was filled by mid brown sandy silt (160). No finds were recovered from this feature or any trace of the associated clay-lined filtration pit that would presumably once have been located adjacent to this pit.

Filtration waste silt 143

5.6.21 Filtration unit **159** and basal horizon deposit was overlain by a layer of waste filtration silt (143) that extended across the base of the saltern. This layer was in turn overlain by what appeared to be a buried soil horizon that demonstrated this waste silt was deposited in banks of material of varying thickness across the saltern mound's profile, to a maximum height of 3.2m OD. This layer probably represents the resultant waste from silt filtration activity, illustrated by filtration unit **159**, taking place directly on the level of the saltmarsh. The waste silt consisted of pale brown sandy silt that produced a single sherd (10g) of Thetford-type Ware pottery dating to the *c.*10th century.

Possible buried soils

5.6.22 Waste silt 143 was also overlain by a thin light grey sandy silt layer (144), up to 0.1m thick, and appeared to show evidence of leaching with an intermittent orange upper and lower horizon (Fig. 10, Section 75). This layer gradually thinned and disappeared towards the southern edge of the profile of the saltern mound at a height of 2.6m OD. As this thin layer extended to the north through the mound's profile however it was observed to rise sharply to the level of the topsoil horizon. This layer apparently reappeared below the topsoil horizon 3m further to the north (168) and descended to a height of 2.6m OD. This horizon therefore delineated the upper horizon of the banks of waste silt (143) produced by the earliest silt filtration units associated with the saltern. The upper horizon underlay a further layers of pale brown filtration waste silt and sand (145/169).

*Filtration Units **117** & **156***

5.6.23 The upper horizons of waste filtration silts 143 and 145 may have formed a pre-existing surface of the mound into which the later phase of filtration units were constructed. Evidence for two clay-lined silt filtration units (**117** & **156**) was revealed at a height of 2.6m OD.

5.6.24 One of these filtration units (**117**) was found to be of complete form (Fig. 9; Plate 10). This comprised a shallow sub-rectangular and flat-based filtration pit that measured 2.1m long and 0.2m deep. A 0.4m wide channel led from the eastern end of the filtration pit to a deeper sub-square water tank with a flat base that measured between 0.8-1.1m in diameter. The filtration unit was lined with bluish grey clay (118), up to 0.05m thick, that extended around the cut. The clay-lining contained a yellowish brown sandy silt fill within the filtration pit and water tank (119 & 120 respectively).

5.6.25 The clay-lining (118) of filtration unit **117** yielded a fragment of charcoal (*Maloideae*) that was radiocarbon dated to 684-878 cal AD (95.4% SUERC-75157 GU45029). Fill 119 yielded a single sherd (4g) of Thetford-type Ware pottery dating to the *c.*10th century.

5.6.26 The water tank element for a further filtration unit (**156**) was also excavated that measured up to 0.6m in diameter and 0.13m deep. This feature was also lined with blue-grey clay (157), up to 0.05m thick, and contained a mid yellowish brown sandy silt backfill.

Upper filtration waste silts

5.6.27 The upper series of waste silts commenced with layer 165 that overlay filtration units **117** and **156**. These silts may possibly also be equated to waste silt 162 recorded in Section 76 along the northeastern edge of the saltern mound. These deposits were overlain by the uppermost silts in the sequence along the southern (166) and eastern (163) edges of the saltern mound that consisted light greyish brown or pale brown silts and sands but with frequent flecks of charcoal also present indicative of brine-boiling activity producing burnt waste material. These silts extended to the topsoil horizon at a height of 3.2m OD.

*Hearth rake-out pit **47***

5.6.28 The remains of a large pit (**47**) containing layers of burnt waste material, presumably derived from a brine-boiling hearth, was excavated during the evaluation phase of the investigation. The pit lay towards the eastern end of the trench at its point of greatest elevation of approximately 3.04m OD; the crest of the mound of salt-making deposits comprising Saltern 2. The pit measured up to 3.9m in diameter and was found to be greater than the 1m depth the excavation allowed (Fig. 10, Section 15; Plate 11). The backfill (48) consisted of multiple layers of soft dark grey, red and yellow brown fine sandy silt. This burnt, ash like fill yielded 402g of fired clay displaying organic impressions and flattened surfaces indicative of lining and 70g of more amorphous fragments. These salt affected fragments displayed orange, pink and green hues with organic impressions.

5.7 Period 3: Medieval (*c.*AD1066 – 1250)

Marshland deposits (Group 56)

5.7.1 A layer of mid pinkish brown clayey silt was encountered in each area of the excavation. This deposit (67/174 in Area A; and 164/167 in Area C) was observed to overlie the leading edges of the deposits comprising Salterns 1 and 2 to a maximum height of 3.2m OD (Fig. 10, Sections 77 and 75 respectively). Outwith the footprint of each saltern mound the deposit was observed to directly overlie the underlying saltmarsh deposits of Group 53 (see Section 5.5) from a height of approximately 2m OD. A Period 4 horse burial, dated to the *c.*19th century, truncated this deposit in Area A. This deposit (176) was also revealed in Area B where it was cut by Period 4 Hayricks 1 and 2, dated to the *c.*19th century. The more cohesive, clayey and firm characteristics of this deposit without any visible structure suggest that this layer probably represents the gradual laying down of waterborne deposit in a low energy environment. This deposit therefore probably represents the more brackish/freshwater environment of the marshland that would have lain to the landward of the 'Old Seabank' from the later medieval period to modern times.

5.8 Period 4: Post-medieval/modern (*c.*AD1500 – present)

Summary

5.8.1 The circuits of two hayrick ring gullies (Hayricks 1 & 2), partly revealed by Trench 15 during the evaluation were wholly uncovered in Area B, and dated by finds from the feature fills to the *c.*19th century. The hayrick gullies were also observed to cut two shallow pits (**114** & **116**) that also contained finds dated to this period. A horse burial (**60**) dated to the *c.*19th century was revealed in Area A along with 11 modern post holes of a pre-existing fence line across the site, of which four (**63**, **65**, **95** & **97**) were excavated. A row of seven tree-pits (**10**, **12**, **14**, **16**, **18**, **20** and **22**) associated with the pre-existing orchard on the site were excavated in Trench 16 during the evaluation phase of the investigation.

Area A

*Horse Burial **60*** (Fig. 5)

5.8.2 A pit (**60**) was encountered, in the southwestern part of Area A, that contained the articulated skeletal remains of a horse (61) laid on the base of the cut. Part of a leg and the jaw were recovered for assessment. A small iron horseshoe (SF1) was recovered from the hoof of a type present from the 19th century onwards. The pit measured 3.2m in length, 1.2m wide and 0.12m deep. The overlying backfill (62) consisted of dark greyish brown clayey silt that yielded two sherds (134g) of 19th century pottery.

Fence line (Fig. 5)

5.8.3 A west-northwest to east-southeast linear alignment of 11 rectangular post holes was revealed along the northern boundary of the area. Four of these post holes (**63**, **65**, **95** & **97**) were excavated and measured between 0.9m-1m long by 0.35-0.5m wide and 0.25m-0.75m deep with square cut profiles. Each post hole contained fills (64, 66, 96 & 98 respectively) that consisted of dark greyish brown sandy silt. The fills of post holes **95** & **97** contained fragments of concrete and brick and the fill of post hole 65 yielded two sherds (4g) of 19th century pottery.

Area B (Fig. 7)

*Pits **114** & **116***

5.8.4 Two shallow rectangular pits (**114** & **116**) were observed to be truncated by the circuit of Period 4 Hayrick 1. Pit **114** measured 2.3m long by 0.45m wide and 0.15m deep, with an irregular profile. Pit **116** measured 3m long by 0.4m wide and 0.1m deep, also with an irregular profile. Both contained fills (113 & 115 respectively) consisted of dark brownish grey silt that contained small fragments of ceramic tobacco-pipe stem, moderate flecks of charcoal along with occasional fragments of burnt clay and slag. In addition, each pit fill contained a single sherd of 19th century pottery.

Hayricks 1 & 2

5.8.5 Located within Area B were the remains of two hayricks ('Riley circles'), each represented by a complete circular ring gully, cut into the natural marshland deposits (176) of Group 56. Hayricks 1 and 2 both measured *c.*10m in diameter respectively. Hayrick 1 was observed to truncate Period 4 pits **114** and **116** described above.

5.8.6 The gully segments (**107**, **109** (Fig. 10, Section 59) & **111**) excavated for Hayrick 1 measured between 0.35-0.4m wide and 0.25m deep with U-shaped profiles, with each

segment contained a single fill. The fills (106, 108 & 110 respectively) consisted of mid to dark brown silt with occasional flecks of charcoal and fragments of burnt clay. Fill 106 yielded a single fragment (21g) of flat tile dated to the post-medieval period.

5.8.7 Similarly, the gully segments (**125** (Section 63), **135** & **137**) excavated for Hayrick 2 measured between 0.25-0.3m wide and 0.05-0.5m deep with U-shaped profiles, with each segment contained a single fill. The fills (124, 134 & 136 respectively) consisted of mid to light brown silt with occasional flecks of charcoal and shell fragments. Fill 124 contained a near complete tobacco pipe-stem bowl dated to *c*.1680-1710.

5.8.8 Two sections of Hayricks 1 (**24=26**) and 2 (**28=30**) were excavated in Trench 15 during the evaluation phase of the investigation. The fills (25=27 & 29=31 respectively) were also found to contain small fragments of ceramic tobacco pipe-stem fragments of post-medieval date.

5.8.9 A single orchard tree-pit of modern date was revealed in Trench 15 within the circuit of Hayrick 1. Tree-pit **32** measured 0.5m in diameter and 0.1m deep with a single fill (33) that consisted of firm greyish brown sandy silt. This fill yielded a small fragment of post-medieval ceramic tobacco pipe-stem.

Evaluation Trench 16 (Fig. 3)

Orchard Tree-pits

5.8.10 This trench, to the east of Area B, revealed a row of seven orchard tree-pits on a north-south alignment. The tree-pits (**10**, **12**, **14**, **16**, **18**, **20** and **22**) measured 0.5m in diameter and 0.2m deep, with U-shaped profiles. The fills (11, 13, 15, 17, 19, 21 and 23 respectively) consisted of firm dark greyish brown sandy silt. The fill of tree-pits **18** and **22** contained small fragments of post-medieval ceramic tobacco pipe-stem.

Evaluation Trench 20 (Fig. 3)

Modern ditches

5.8.11 This Trench, to the southeast of Area B and south of Greenpark Avenue, revealed two modern ditches on a north-south alignment. Both ditches were observed to contain fills with much modern rubbish including brick, tile, glass and metal (not retained).

6 Factual Data and Assessment of Archaeological Potential

6.1 Stratigraphic and Structural Data

The Excavation Record

6.1.1 The written and drawn elements of the contextual record form the main components of the excavation data and are sufficient to form the basis of the site narrative. This record has good potential to further understand salt-making in the Middle to Late Saxon and medieval periods.

Condition of the Primary Excavation Sources and Documents

6.1.2 The records are complete and have been checked for internal accuracy (Appendix A). Written and drawn records have been completed on archival quality paper and are indexed. All paper archives have been digitised into the individual site Access database. Site drawings have been digitised in AutoCAD.

Type	Evaluation	Excavation
Context Register	2	4
Context numbers	48	176
Context records	48	173 (3 void records)
Trench Record sheets	9	0
Plan Registers	1	1
Plans at 1:10	0	1
Plans at 1:20	2	10
Plans at 1:50	7	2
Sections register sheets	1	1
Sections at 1:10	15	23
Sections at 1:20	0	3
Sections at 1:50	0	3
Sample Register sheets	1	11
Photo Register sheets	3	6
Digital photographs	44	83
Small finds register sheets	0	1

Table 6: Quantity of written and drawn records

6.1.3 All primary records are retained at the offices of OA East, Bar Hill. The site codes XNFGAL16 (evaluation) and XNFGAL17 (excavation) are allocated and all paper and digital records, finds and environmental remains are stored under these codes.

6.1.4 The site data is of sufficient quality to address all of the project's Research Objectives and form the basis of further analysis and targeted publication of the key features, finds and environmental assemblages.

Finds and Environmental Quantification

6.1.5 All finds have been washed, quantified and bagged. The catalogue of all finds has been entered onto an MS Access database. Total quantities for each material type are listed below.

Category	Weight (kg)
Iron	2 items. SF1 & 2
Bead	1 item
Pottery	0.21
CBM	0.02
Clay tobacco pipe	0.04
Baked clay	3.69
Slag	0.09
Animal and fish bone	1.09

Table 7: Finds quantification

6.1.6 Environmental bulk samples were collected from a representative cross section of feature types and deposits. Bulk samples (up to 40 litres each) were taken to analyse the preservation of micro- and macro-botanical remains as well as for finds retrieval. Soil monoliths were also taken from natural deposits underlying the mound and through

the deposit sequence of each saltern mound (Saltern 1 and 2) to sample for pollen and foraminifera remains. In addition sub-samples (1 litre each) were taken by context in conjunction with the soil monolith tins.

Sample type	*Salt Making Hearth*	*Hearth rake-out pit*	*Filtration Unit*	*Water Tank*	*Saltern Mound*	*Natural Features*	*Hayricks*	*Total*
Flotation	2	1	0	1	5	0	2	**11**

Table 8: Quantification of samples from evaluation by feature type

Sample type	*Salt Making Hearth*	*Hearth rake-out pit*	*Filtration Unit*	*Water Tank*	*Saltern Mound*	*Natural Features*	*Hayricks*	*Total*
Flotation		17	17	10	9	5		**58**
Soil monolith		2			3	1		**6**
Bulk sub sample		13			11	4		**28**

Table 9: Quantification of samples from excavation by feature type

Range and Variety

6.1.7 Features on the site included: Middle to Late Saxon salt-making hearths, silt filtration units, a clay lined water tank and associated hearth waste and silt filtration waste deposits forming the saltern mound.

Condition

6.1.8 The survival of the archaeological features within the saltern mound was on the whole good although there was some truncation of the upper mound deposits and features by the recent building footings.

6.2 Artefact Summaries

Iron (Appendix B.1)

Summary

6.2.1 A small fragment of an iron nail (SF2) was recovered from Period 2 hearth rake-out pit **83**, within Saltern 1. An iron horseshoe (SF1) was also found with the skeletal remains of Period 4 horse burial **60**.

Statement of Potential

6.2.2 The nail is corroded and broken and may be from an implement used to rake out the pit or a broken item thrown into the fire. Its presence is not likely to be significant and may not be related to salt making. The horseshoe appears to be of a type present from the 19th century onwards.

Bead (Appendix B.2)

Summary

6.2.3 One translucent glass annular bead was retrieved from the clay lining (74) of Period 2 brine storage tank **73**, within Saltern 1.

Statement of Potential

6.2.4 In shape and size it fits within the typology of the micro 'seed' glass beads that have been recovered from Anglo-Saxon cemetery sites in the wider region. Although an interesting additional Anglo-Saxon artefact to be recovered from the saltern, this item represents merely a casual dress item loss and is of no further significance to the understanding of the site.

Pottery (Appendix B.3)

Summary

6.2.5 Fourteen sherds of pottery weighing 208g were collected from nine contexts during the excavation. Eight sherds of the Late Saxon period represented six vessels. These sherds were recovered from: Period 2 brine storage tank **82** and hearth rake-out pit **83** associated with Saltern 1; and Period 2 filtration unit **117** and filtration waste deposit 143 within Saltern 2. The vessel fabrics were Thetford-type ware and a fine shelly ware which is probably a Lincoln product. Later 18th–19th-century pottery was also recovered from Period 4 features including horse grave **60**, post hole **65**, and pits **114** and **116**.

Statement of Potential

6.2.6 Most of the sherds were in the fine, hard fabric typical of Thetford itself, but there were two sherds from filtration unit **117** and filtration waste 143, both within Saltern 2, which were in similar but softer fabrics (both abraded) and these may be from elsewhere, perhaps also from Lincoln given the presence of Lincoln shelly ware. Although the evidence is limited, it seems likely that this small group is of 10th-century date.

6.2.7 This is similar to the findings at the nearby saltern site at Marsh Lane (Clarke 2016), but at that site there was early medieval material alongside the Late Saxon pottery. While the Late Saxon pottery from Marsh Lane was exclusively from Grimston, the Late Saxon material in the present group appears to be earlier. This dating is partly based on the presence of ?Lincoln Kiln-type pottery, which is dated to the later 9th to 10th centuries in Lincoln (Young *et al.* 2005), and the dominance of Thetford-type ware from Thetford itself, which was also producing pottery from the late 9th century. The lack of Grimston Thetford-type ware at this site may indicate that the saltern site went out of use before the 11th century. There is no ceramic evidence for any activity between the end of the saltern and the later 18th/19th century.

6.2.8 This small assemblage, when considered along with the slightly earlier 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.

Ceramic building material (Appendix B.4)

Summary

6.2.9 A single fragment (21g) of flat tile dating to the post-medieval flat tile was recovered from Period 4 Hayrick 1 excavated in Area B.

Statement of Potential

6.2.10 There is no further potential for this artefact other than aiding the dating of the hayrick.

Clay tobacco pipe (Appendix B.5)

Summary

6.2.11 Seven fragments (37g) of white ball clay tobacco pipe stem including a mouthpiece, and a single pipe bowl were recovered from Period 4 pits and ditches across the site. All fragments date to the 18th/19th-century.

Statement of Potential

6.2.12 There is no further potential for this assemblage other than aiding the dating of the post-medieval and modern features across the site.

Baked clay (Appendix B.6)

Summary

6.2.13 Archaeological work produced 364 fragments, 3693g, of fired clay, along with 1246g of uncounted fragments from samples. The assemblage was collected from Middle to Late Saxon disuse and refuse contexts largely relating to the salterns and their discard mounds. The assemblage was comprised of both 285 amorphous and 10 structural fragments (1246g and 2447g respectively). The latter group was made up of fragments of brick-like objects or hearth lining. Amongst the assemblage were also fragments of fired sand, which will have had a clay component, that is likely to be related to the style of salt production taking place on site. The fired clay was attributed to a single silty clay fabric with occasional fine mica and quartz inclusions, rare coarse angular flint or stone inclusions and common elongate organic impressions and voids suggesting burnt out grassy temper. Although the exact source of the clay or inclusions has not been proven for this assemblage, these are likely to have been naturally occurring in the local clay.

Statement of Potential

6.2.14 The fired clay assemblage taken as a whole is indicative of salt production in the later Saxon period; where the main process of salt collection was boiling the water used to wash beach sand of its mineral content. Little can be gleaned from the amorphous fragments beyond their quantity and spread through the site. Soft, silt bricks found *in situ* within the hearth at Wainfleet St Mary have led to the suggestion that they functioned as *ad hoc* stands for the lead brine boiling pans. Hand-made bricks were also recovered from the salt-workings excavated at Walpole St Peter, Norfolk (Clarke 2009) and nearby from Marsh Lane (Clarke 2016). This assemblage provides a further excavated example of baked-clay types associated with a medieval saltern. Comparison of the assemblage with these other salt-making sites will further aid in the interpretation of salt-making processes being conducted on the site.

Slag (Appendix B.7)

Summary

6.2.15 A total of six pieces of slag weighing 90g was collected from six contexts within Saltern 1 and associated with burnt waste tips from brine-boiling hearths.

Statement of Potential

6.2.16 Similar slags have been described for the neighbouring salt-making sites excavated at Marsh Lane (Clarke 2016, 65, 81 plate 3) and Hamburg Way (Timberlake 2008, 30) and probably represent a further example spatter accretions from brine-boiling hearths. The small quantity of slag remains recovered do not warrant any further analysis.

6.3 Environmental Summaries

Faunal remains (Appendix C.1)

Summary

6.3.1 The animal bone remains recovered from the site comprised: fragments of a medium mammal from Period 2 hearth rake-out pit **83** in Saltern 1; and Period 4 horse burial **60**. Fish remains were also recovered from Period 2 hearth rake-out pits **83** and **128**, brine storage tank **102** and filtration unit **146** in Saltern 2.

Statement of Potential

6.3.2 Further study of the fish remains from environmental samples, by a fish specialist, would provide further insight into dietary preferences and species availability. Overall, there is little research potential from the assemblage beyond the general taxonomic composition.

Ostracods (Appendix C.2)

Summary

6.3.3 Six sediment samples from Period 2 Saltern 1 and the underlying Period 1 tidal flat (Group 53) and overlying Period 3 marsh deposits (Group 56) were processed and examined for ostracods. Ostracods were found within all the samples, mostly in the flots, but large numbers of these were encountered within a sample taken from the clay lining of Period 2 filtration unit **146** within the primary phase of salt-making activity.

6.3.4 The only certainly autochthonous species to the saltern environment appears to be *Cyprideis torosa*, an ostracod which seems likely to be represented by an endemic population living within the filtration units of Saltern 1, and thereafter incorporated into the basal clay linings. The occurrence of *C. torosa* suggests the presence of salt water of variable but moderately high salinity between 7‰ - 30‰ (psi). The implication is that the sleeching water process produced water which was strongly saline, but not concentrated enough to be a proper brine. It is therefore possible that this water was subsequently (naturally) evaporated within another shallow tank to brine (>50‰ (psi)) before being boiled dry to crystalline salt within pans upon the saltern hearth.

6.3.5 The epifaunal mesohaline ostracod *Loxoconcha elliptica* appears most likely to be associated with the undisturbed littoral sediments of the tidal mudflats. The overlying (later) marshland deposits may be freshwater in origin, but ostracods within this are extremely sparse.

Statement of Potential

6.3.6 Molluscs are well-preserved in many samples and have the potential for further study. The saltern pits and tanks which are clearly important habitats for ostracods with quite distinct salinity tolerances. The occurrence of *Cyprideis torosa* within the filtration units may be worthy of a published note in the ostracodological literature. Future work undertaken upon these saltern sites should include provision for a more complete sampling strategy of the sediments

Environmental samples (Appendix C.3)

Summary

6.3.7 Fifty-two bulk samples were taken during excavations at the site, from deposits associated with Middle to Later Saxon salt-making. These included the remains of two

salterns with their component filtration pits, waste-mounds and hearths. A further thirty samples were taken for further specialist assessment and six monoliths were taken through sediment profiles.

Statement of Potential

6.3.8 The initial processing of sub-samples has produced assemblages of foraminifera and ostracods that have been submitted for analysis. The preservation of plant remains is very limited with no research potential.

Charcoal (Appendix C.4)

Summary

6.3.9 Following standard processing of bulk environmental samples and assessment, any >2mm size charcoal fragments were extracted for charcoal assessment, primarily to determine its suitability for providing radiocarbon dating material, but also to assess its potential for providing information on fuel use. The extremely low levels of charcoal recovered from the features directly associated with salt-making suggests that either other forms of fuel, other than wood/charcoal, were used during the activities, or that preservation of wood charcoal at the site is poor.

6.3.10 It is noticeable that the charcoal assemblages from Period 2 hearth **34** and hearth rake-out pits **83** and **128** within the secondary phase of salt-making activity of Saltern 1, comprised small round wood or twig fragments, rather than mature wood. The possible buried soil (89) was noticeably different in that it was dominated by oak fragments, including some over 10mm in size.

6.3.11 The sample taken from the lining of Period 2 filtration unit **117** within Saltern 2 also differed slightly and contained rare (non-twig/round wood) fragments of hawthorn-type and oak charcoal.

Statement of Potential

6.3.12 The extremely low levels of charcoal recovered from the features directly associated with salt-making means that any interpretation is extremely tentative.

Sedimentology, Pollen and Diatoms (Appendix C.5)

Summary

6.3.13 A sequence of saltmarsh, soils and filtration waste deposits below and within Saltern 2 (monolith <98>) contained sparse pollen and no identifiable diatoms. Pollen evidence showed the saltern was constructed on the upper saltmarsh during a period of potential relative sea-level fall. The filtration waste appears to have been colonised with plants typical of dune slacks as the saltern accumulated and a bioactive soil established. A clayey silt 'soil' intercalated within the saltern may represent a significant break in salt making, either caused by a freshwater/marine flood or simply a period of abandonment. Subsequent soil development supported a grazed grassland with alder carr.

6.3.14 The absence of pollen in the hearth waste of pit **83** means the fuel source for the salt making, probably either peat or charcoal, was not identified.

6.3.15 No identifiable diatoms were found in the clay lining of the filtration unit **146**, although a few foraminifera were present, hinting that it may have been sourced from mudflats but this is speculation.

6.3.16 Sedimentology adds to these interpretations and suggests that the ash pit (**83**) may have been covered between firings and the tips may act as individual heating events.

Statement of Potential

6.3.17 The pollen was sparse and no identifiable diatoms were found. Therefore, there is considered to be only limited research potential for these remains. It would be beneficial to combine the limited results of the current investigation with those of Marsh Lane (Clarke 2016). Foraminifera were incidentally observed in many samples that provide an additional paleoenvironmental tool for study (see also Section 8.6).

Radiocarbon dating (Appendix C.7)

Summary

6.3.18 Four samples of organic remains were selected from the environmental bulk samples of deposits from both the hearth rake-out pits and possible buried soil excavated in Saltern 1; and a filtration unit within Saltern 2 associated with the Middle to Late Saxon salt-making activities (Table 10).

Sample No.	Sample type	Cxt.	Cut	Saltern	Period	Feature type	Date	Certificate
70	Charred tuber fragment	85	83	1	2	Hearth rake-out pit	766-899 cal AD	88.3% SUERC-75156 GU45028
83	Charcoal *Corylus avellana*	91	128	1	2	Hearth rake-out pit	772-905 cal AD	76.9% SUERC-75162 GU45031
66	Charcoal *Salix* sp/ *Populus* sp	89	-	1	2	Buried soil?	855-985 cal AD	81.0% SUERC-75161 GU45030
90	Charcoal *Maloideae*	118	117	2	2	Filtration unit	684-878 cal AD	95.4% SUERC-75157 GU45029

Table 10: Radiocarbon dating results

7 Updated Research Aims and Objectives

7.1.1 The research aims and objectives identified for the project in Section 4 are re-examined below with summary statements outlining the potential further analysis and discussion of the remains encountered on the site in achieving these objectives.

7.2 Local and site specific research objectives

General aims of the project

7.2.1 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.

7.2.2 Significantly, the radiocarbon dates from feature fills and deposits within Salterns 1 and 2 demonstrate salt-making commenced along Salters Way during the Middle Saxon Period, possibly as far back as the 8th century. When considered along with the exclusively Late Saxon pottery types recovered from these salterns, these combined

date ranges would indicate the salt-making industry at this locality centred in the 9th century, overlapping the end of the Middle and beginning of the Late Saxon periods (Table 11). The lack of any later artefacts from the salterns indicate salt-making ceased at this locality before the 11th century.

7.2.3 To obtain a better understanding of the salt-making process and identify any methodological or technological changes over time.

7.2.4 The salt-making features within each group of features in both Salterns 1 and 2 mainly comprised clay-lined elements of water/brine holding features associated with the salt-making process for the locality (*e.g* Cope-Faulkner 2014; Clarke 2016). Filtration units were encountered from the base of the stratigraphic sequence of Saltern 1, cut into the underlying tidal-flat deposits. A group of large circular and shallow clay-lined pits were encountered in the secondary phase of salt-making activity, in the upper sequence of Saltern 1 that may represent an evolution in the salt-making process. These pits are of a morphology that appear not to have as yet been documented elsewhere. These possibly represent concentrated brine-storage tanks. A large rectangular clay-lined possible storage tank was revealed in the saltern excavated nearby at Marsh Lane, King's Lynn (Clarke 2016). They may also possibly represent shallow evaporation tanks to heighten the concentration of the brine before boiling in the hearths. This possibility was also suggested by the ostracod analysis (see Appendix C.2.30).

Saltern mounds and mound formation

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

7.2.6 The two excavated salterns yielded similar radiocarbon dates and pottery. It would appear that this group of salterns adjacent to Salters Way, along with unexcavated Salterns 3 and 4, are all broadly contemporary in date. The lack of any Grimston-type Late Saxon or later pottery (or other datable artefacts) from the saltern mounds indicate that the saltern site went out of use before the 11th century. The longevity of these salterns would therefore appear to be less than that of the saltern excavated to the north at Marsh Lane that continued in use to the early medieval period (Clarke 2016). Each saltern may represent the build up of *c*.100+ years of salt-making deposits, centred on the 9th century. It is possible the primary phases of salt-making activity for each mound may have extended back to the late 8th century. Further samples are recommended for radiocarbon dating of the primary deposits of Saltern 2 (see Section 8.5.1). A suggested outline chronology for Salterns 1 and 2 is given below in Table 11.

7.2.7 The table below highlights the differing date ranges yielded by radiocarbon samples and the suggested date range of the small Thetford-type ware pottery assemblage. However, the identification of the shelly sherds of pottery from filtration waste 143 and filtration unit **117** within Saltern 2 could only be tentatively identified as Lincoln Kiln-type ware pottery. Full archive reporting on the pottery will reconsider the assemblage with respect to the radiocarbon date results. The petrology of the possible Lincoln Kiln-type ware pottery may be further assessed by thin section to aid fabric identification (see Section 8.4.1).

Saltern 1			Saltern 2			Suggested chronology
Group	**Radio-carbon Date**	**Pottery Date range**	**Group**	**Radio-carbon Date**	**Pottery Date range**	
Filtration waste deposits 94	-	-	Hearth rake-out pit **47**	-	-	*c.* late 9th-early 10th century
Possible buried soil 89	855-985 cal AD					
-	-	-	Upper filtration waste silts 162 etc	-	-	*c.* 9th century
Secondary salt-making phase	772-905 cal AD & 766-899 cal AD	*c.*10th century?	Filtration units **117** & **156**	684-848 cal AD	*c.*10th century?	
Possible buried soil 171	-	-	Possible buried soil 144/168	-	-	*c.* late 8th or early 9th century?
Hearth (68 etc) and filtration (69 etc) waste deposits	-	-	Filtration waste silt 143	-	*c.*10th century?	
Primary salt-making phase	-	-	Filtration unit **159**	-	-	
-	-	-	Basal horizon deposit 142	-	-	

Table 11: Suggested outline chronology of Salterns 1 and 2

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

7.2.9 Thin grey bands were observed in plan and in section to undulate at intervals through the deposit sequence in both saltern mounds. These horizons were useful in mapping the sequences of mound waste. Similar thin horizons were observed during the excavation of the saltern at Marsh Lane that displayed leaching horizons indicative of buried soils. These bands possibly therefore indicate the evolving topography of the saltern mounds. The upper surfaces of the mounds may have been allowed to stabilise with plant growth periodically that may possibly imply periods of temporary abandonment of each saltern.

7.2.10 There was a sharp boundary between the saltern filtration waste deposit 143 and 'buried soil' 144, indicating a hiatus of some sort, possibly an erosive one. 'Buried soil' 144 does not have the characteristics of a soil profile and has more in common with alluvium. The lack of any marine indicators in the pollen profile suggests may have been deposited by an extreme flood of the River Gaywood. The lack of aquatic pollen hints this is perhaps a soil and the pollen reflects *in situ* vegetation. After deposition the flood sediments may have been colonised and an immature soil developed but there was no evidence of rooting or any macropedological features. The presence of *Glomus* also suggests a thin soil may have developed in periods of hiatus in the saltern's development (Appendix C.5).

7.2.11 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?

7.2.12 A filtration unit from the earliest phase of salt-making activity excavated at Marsh Lane was radiocarbon dated to 758-887 cal AD, a date broadly contemporary with the Lynnsport salterns. The Marsh Lane saltern is one of the most landward mapped examples of the group that extends westwards from it, across the present North Lynn (the 'North Marsh' of Gaywood), to The Wash. The group of four salterns recorded at Lynnsport 4 & 5 may also be considered to be landward examples, as these lie towards the southern edge of the North Marsh, adjacent to the ancient route of Salters Way. If the hypothesis is followed, these two salt-making examples would therefore imply salt-making in the North Marsh of Gaywood possibly commenced sometime in the latter part of the 8th century.

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

7.2.14 There was a paucity of artefacts in the deposits overlying and surrounding each of the excavated salterns before the appearance of hayricks and the horse burial in the later 18th century. This supports the documentary evidence (see Section 8.3.4) for the North Marsh of Gaywood to have been utilised exclusively as valuable salt-marsh pasture throughout the medieval and post-medieval periods.

Saltern fixtures and features

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

7.2.16 No structures were encountered on either of the excavated salterns. The remains of a single (presumably enclosed) brine-boiling hearth were excavated during the evaluation phase at the crest of Saltern 1. However, no structural features could be identified associated with this feature. As only a percentage of two of the salterns uncovered at Lynnsport 4 & 5 was excavated it remains a possibility that such structures lay out-with the excavation areas.

7.2.17 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?

7.2.18 Only the heavily truncated remains of a single hearth were excavated in the secondary phase of salt-making activity of Saltern 1. The hardened green inner wall of the surviving hearth base indicated this to probably be an example of the 'enclosed' hearth-type excavated at both the former Queen Mary's Nursing Home and Marsh Lane, King's Lynn (Cope-Faulkner 2014; Clarke 2016). Both these further examples dated from the

medieval period, and as such the hearth remains excavated on this site, although truncated, would appear to be a significant early example of this type of technology. Furthermore baked-clay brick fragments of a type also excavated at these nearby sites were recovered from two large depressions that appeared to be cut into the mound surface. Well stratified burnt hearth waste deposits were excavated in each pit. It appears that unlike the Marsh Lane example, where the hearth waste was tipped in layers over the mound surface, the hearth waste of Saltern 1 and 2 was at least partly discarded into pits, purposely excavated to clear away the waste products. There was a noted paucity of slag recovered from any of the features associated with brine-boiling.

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

7.2.20 Only two complete examples of filtration units were revealed during the excavations. Incomplete examples that consisted of the base of the circular collection tank ends were also uncovered. As described for Marsh Lane (Clarke 2016) these incomplete examples indicate the clay-lining was probably being recycled for the construction of later filtration units as each mound grew. The circular clay-lined bases of the collection tanks would be the most difficult part of the clay-lining to recover. The filtration unit revealed at the base of Saltern 1 (**146**) differed greatly in size and 'regularity' to the (presumed) later complete example (**117**) revealed in the middle of Saltern 2. This may possibly be indicative of an evolution in the 'formal' design of this characteristic salt-making feature over the Middle to Late Saxon period.

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

7.2.22 Seeds of freshwater taxa were recovered from the bluish-grey clay-linings of features suggests that the clay must have been sourced inland. There was only scant evidence of what was used to fuel the hearths, which is a common theme on saltern sites of this period (see also Marsh Lane; Clarke 2016).

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

7.2.24 No channels or creeks were identified in any of the excavation areas.

Salt-makers and social context

7.2.25 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?

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

7.2.27 The deposit sequence revealed in the hearth rake-out pits may possibly be used to indicate relative scale, duration and number of salt-making campaigns. Intervening periods of abandonment or disuse, that may be equated to the seasonal nature of the salt-making process, may possibly be indicated by the bands of relatively clean sand deposits lain between the burnt deposits. These deposits were observed to be made-up of very thin lenses of material indicating they were lain by natural processes rather than dumped. Bands of thin grey possible weathered buried soils also undulated through the mounds that may be used to suggest the structural build up of the mound over time. No associated settlement activity was revealed by the excavations.

7.2.28 The lack of massive sand layers in the upper deposits suggest the pit was covered between firings and therefore ash dumps may act as a proxy for the number of firings, possibly even the number of years the pit was used for, if salt making was seasonal. Potentially the layers may be annual events, with a period of perhaps five years to six years perhaps represented by deposits recorded in monolith <73> (Appendix C.5).

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

7.2.30 No evidence for any activities other than salt-making was uncovered by the excavations.

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

7.2.32 See Section 8.3 below.

Salterns and landscape change

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

7.2.34 The ostracod species recorded within the waste sleeching silts dumped upon the mound were sparse and found to be freshwater-brackish species, the ratios of which suggest some degree of commonality in fauna between the tidal mudflats, the waste mound silts, and the material backfilling the saltern features such as the filtration pits and tank(s). Preservation of plant remains was poor from the site.

7.2.35 The saltmarsh soil developed above fine sands of a sandflat and this change of environment indicates a relative lowering of sea-level. If exposed to modern sea-levels, the site would be covered by virtually all tides, implying Late Saxon sea-levels were lower than today. The lowest pollen sample was characterised by plants of the upper saltmarsh dominated by grasses and the dandelion family and low tree pollen. The saltmarsh is therefore envisaged as predominantly grassy with herbaceous plants some of which would have been salt tolerant (Appendix C.5).

7.2.36 The salt making processes may have been abandoned due to flooding by sea-surges or large storms, for example storm surges in 1014, 1029 and 1099 (Simmons 2015). These surges may well have been made worse by sea-level rise during the 9th to 10th centuries (Appendix C.5).

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

7.2.38 The salt-making activity on the site clearly pre-dates the diversion of the Great Ouse to King's Lynn in the 13th century. Documentary evidence (see Section 8.3 below) demonstrates that prior to its diversion along the southern margins of Gaywoods North Marsh in 1425, the Gaywood River flowed through the central part of the North Marsh, to the north of the site.

7.2.39 The lower reaches of the River Gaywood were dammed and several mills stood on the North Marsh, the first probably dating to 1101 (Norfolk Mills website, accessed 11-10-2017), however, other undocumented mills may have existed along the River Gaywood (Appendix C.5).

7.2.40 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?

7.2.41 The date range for these 'landward' salterns on the southern margins of Gaywood's historical North Marsh, adjacent to Salters Way, 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 in the North Marsh. This reclamation may also have gradually converged on the pre-existing course of the River Gaywood.

7.3 Additional regional research objectives

7.3.1 Additional research aims have also been identified with reference to the Regional Research Agendas (Brown & Glazebrook 2000 and Medlycott 2011).

7.3.2 *Gaps in Knowledge (Brown & Glazebrook 2000, 25; 27)*

- *'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?'*

7.3.3 Industry (Medlycott 2011, 67)

- *'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).'*

7.3.4 *Economy (Brown & Glazebrook 2000, 31)*

- *'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.'*

7.3.5 *Economy (Brown & Glazebrook 2000, p31)*

- *'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.'*
- *'Within urban culture, as in the rural hinterland, the church with its organisation, its role in society and its economic power deserves special attention.'*

7.3.6 *Further considerations (Medlycott 2011, p69)*

- *'The Coastal Surveys have provided information on medieval saltern sites, as at Stow Maries, Essex.'*

8 Methods Statements for Analysis

8.1 Stratigraphic Analysis

8.1.1 Contexts, finds and environmental data will be analysed using an MS Access database. The specialist information, especially pottery and radiocarbon dating results, will be integrated to aid dating and complete more detailed phasing of the site. A full stratigraphic narrative will be produced and integrated with the results of the specialist analysis to form the basis of the archive report (see below). The archive report will include a site matrix and figures illustrating the accumulation of saltern deposits through the Middle to Late Saxon period.

8.2 Illustration

8.2.1 The existing CAD plans and sections will be updated with any amended phasing and additional sections digitised if appropriate. Report/publication figures will be generated using Adobe Illustrator.

Archive report figures

8.2.2 Additional drawings will be compiled for the archive report to include: inclusion of selected historical maps and aerial photographs relating to the saltern from Desk-Based Assessments for the site or gained through the further research; contour maps of each of the three phases of excavation; the inclusion of any relevant examples similar salt-making remains from other archaeological excavations as appropriate; and the inclusion of illustrations of the finds-types associated with salt-making at the site (see below).

Finds illustration

8.2.3 There are no finds from the current investigation requiring illustration. Finds recommended for photography will comprise selected items from both identified fabric types of the Late Saxon pottery and baked clay. This will include the brick-like objects from the hearth rake-out pits in the secondary salt-making phase of Saltern 1.

8.3 Documentary Research

8.3.1 Primary and published sources will be consulted where appropriate using the Norfolk Historic Environment Record, libraries and other archives and resources. A search will also be made of published and grey literature reports on comparable sites locally and nationally in order to place the site within its landscape and archaeological context. This evidence will be collated and where relevant reproduced in the archive report of this site and any subsequent publication.

8.3.2 A search of the NHER aerial photography record has been made as part of this phase of work with the findings detailed in Section 1.3.6 and 1.3.7. No further aerial photography evidence is required.

8.3.3 A historical map search was undertaken as part of the desk-based assessment for the Written Scheme of Investigation (Brudenell 2017) for the site by OA East. Relevent historic maps were also consulted for the desk-based assessments produced for the site's development by Norfolk County Council (Norfolk Partnership Laboratory 2016) and Richard Jackson Ltd (Sheridan & Warner 2016), summarised 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.

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

8.3.5 An online search was made of the catalogues held by the Norfolk Records Office, Norwich (http://www.archives.norfolk.gov.uk/), National Archives, Kew (http://www.nationalarchives.gov.uk/), and the British Library Manuscript Collections (http://www.bl.uk/reshelp/findhelprestype/manuscripts/msscollect/manuscriptscollections.html). The following records relating to Gaywood and the 'North Marsh' are recommended for consultation and inclusion within the archive report (Tables 12-14).

Norfolk Records Office catalogue reference no.	Description	Date of record
Title Deeds		
DCN 44/42/10	Records of the Dean and Chapter of Norwich Cathedral. Title Deeds. Conveyance by John de Glynton rector of church of Hevingham to John Page de Wymondham, for a sum of money of 3r. of salt meadow in Gaywood….	10 Dec. 1330
DCN 44/42/7	Records of the Dean and Chapter of Norwich Cathedral. Title Deeds. Agreement between prior of Lynn and Isabella once wife of John Curteys de Gaywood….	1295
BL/O/J3/70	Bradfer-Lawrence Collection. Title Deeds and Papers: part 3. Assignment by William the prior and the convent of Holy Trinity, Norwich, to John, bishop of Norwich, including fairs held yearly at Lynn or Gaywood, a market held weekly on Saturdays and one other day, and messuages and saltpans in Lynn and Gaywood….	1200-1214
DCN 43/18	Records of the Dean and Chapter of Norwich Cathedral. Documents of Title. Appropriation of church of St Margaret Lynn, chapels of St James and St Nicholas, church of Mintlynn and all tithes from the demesne of Gaywood...	17 May 1205
DCN 44/42/16	Records of the Dean and Chapter of Norwich Cathedral. Documents of Title. Conveyance by Alexander Fisher de Lynn, Simon Dikon de North Elmham and John Westhawe de Bittering Parva to Thomas Malyns de Gaywood, John Permonter burgess of Lynn, John Claydon, John Ashenden, Edward Mayn burgess of Lynn and John Wayke de Gaywood of one hill or saltern with house built on it called Bulcote with 2a. of land….	1432
DCN 44/42/17	Records of the Dean and Chapter of Norwich Cathedral. Documents of Title. Conveyance by prior William of Holy Trinity Norwich to Alexander Fisher de Lynn, Simon Diken de North Elmham and John Westhawe de Bittering Parva of 1a. of land in marsh of Gaywood abutting saltern called Bulcote…	3 Sep. 1432
DCN 44/42/19	Records of the Dean and Chapter of Norwich Cathedral. Documents of Title. Lease by prior William Spynk of St Margaret's church Lynn to Hewe Daye of Lynn of saltcote called Bulcote in marsh of Gaywood with grevas, hills etc….	1480
DCN 44/76/160	Conveyance by Adam de Yarmouth son of Simon de Yarmouth to church of Holy Trinity for his soul and those of ancestors of capital messuage in Lynn with homage and rents; saltpan with appurtenances….	Undated (13th century)
DCN 44/76/161	Inspeximus by R. bishop of Norwich of charter of Adam of Yarmouth by which Adam gave to God and church of Holy Trinity Norwich a capital messuage in Lynn, a salt pit, and land….	1268
Maps		
DN/TA137	Bradfer-Lawrence Collection. Maps and Plans. Map of Gaywood Inclosures.	1810

Norfolk Records Office catalogue reference no.	Description	Date of record
BL 38/19	Bradfer-Lawrence Collection. Maps and Plans. Tracing of Gaywood Inclosure Map.	1810
BL/SY 10	Bradfer-Lawrence Collection. Surveys, Reference Books and Plans. Sketch of Gaywood Common and Fairstead Green.	18th century
BL 55/1	Bradfer-Lawrence Collection. Maps and Plans. Sketch of Gaywood as in 1488.	1488
BR 276/1/767	F.W. Hornor and Son. Plans. Estate belonging to Dean and Chapter, Norwich, with table of reference naming pieces and giving acreages.	1816
CHC 11897	Records from the Church Commissioners. Title Deeds, Manorial Records, Maps and other records relating to the Dean and Chapter Estates. Maps. Gaywood, Chapter estate.	1788
DN/TER 71/5	Norwich Diocesan Archives. Glebe Terriers. Gaywood.	1613-1955
NRS 1122, 10B3	Norfolk Record Society Manuscripts. Survey by the chain of the bounds of the parish of Gaywood.	1784
Gaywood manorial records		
BL/MA 2/2	Bradfer-Lawrence Collection. Manorial Records. Manor of Gaywood. Gaywood dragge: typed transcript.	1486-1487
BL/MA	Bradfer-Lawrence Collection. Manorial Records. Manor of Gaywood: 13th century-20th century.	13-20th century
BL/MA 2	Bradfer-Lawrence Collection. Manorial Records. Manor of Gaywood: 15th century-20th century.	15-20th century

Table 12: Norfolk Records Office records recommended for consultation

National Archives catalogue reference no.	Description	Date of record
E 31/1/2/1051	191r Little Domesday Book, Gaywood, Norfolk	*c.*1086
SC 6/1141/1	Gaywood, &c.--lands of the See of Norwich	18 to 20 Edw II
Land adjacent to Kellokesmarsh, Gaywood		
KL/C50/645	King's Lynn Borough Archives. CORPORATION ESTATES: TITLE DEEDS; GAYWOOD. Piece of arable land with a marsh next to it called Kellokesmarsh and all the buildings: the arable land next to land sometime of Simon...	1437
KL/C50/650	King's Lynn Borough Archives. CORPORATION ESTATES: TITLE DEEDS; GAYWOOD. Same premises as KL/C50/645 Demise by Edith Wattes and others to Roger Drury, esquire, and others.	20 June 1484
KL/C50/647	King's Lynn Borough Archives. CORPORATION ESTATES: TITLE DEEDS; GAYWOOD. Same premises as KL/C50/645 Quitclaim by John Pigott, burgess, to John Norys, clerk.	1 Sept. 1464
KL/C50/648	King's Lynn Borough Archives. CORPORATION ESTATES: TITLE DEEDS; GAYWOOD. Same premises as KL/C50/645 Feoffment by Margery, late wife of Geoffrey Nores of Bylney, and others to John Brodde of Lynn, chaplain.	17 March 1474
KL/C50/652	King's Lynn Borough Archives. CORPORATION ESTATES: TITLE DEEDS; GAYWOOD. Same premises as KL/C50/645 Quitclaim by Robert Coote, son and heir of Richard Coote, gentleman, to the Alderman etc. of the Holy Trinity	10 March 1518

National Archives catalogue reference no.	Description	Date of record
	Guild.	
KL/C50/646	King's Lynn Borough Archives. CORPORATION ESTATES: TITLE DEEDS; GAYWOOD. Same premises as KL/C50/645 Demise by John Pye and Thomas Baker to Simon Body, John Pygot, and others.	8 August 1437
KL/C50/649	King's Lynn Borough Archives. CORPORATION ESTATES: TITLE DEEDS; GAYWOOD. Same premises as KL/C50/645 acquired by feoffment from John Welles, chaplain Feoffment by Edward Wattes, clerk, and others to Edith Wattes of Bryccham, widow of John Wattes, notary, and others.	28 August 1482
KL/C50/651	King's Lynn Borough Archives. CORPORATION ESTATES: TITLE DEEDS; GAYWOOD. Same premises as KL/C50/645, acquired by feoffment from Robert Drury Grant by Christopher Coote, gentleman, and others to Robert Gerves, Alderman, and the skevins and brethren of the Holy Trinity.	28 Nov. 1517
Lands in Gaywood marsh associated with hospital of St Mary Magdalen		
KL/C56/4	King's Lynn Borough Archives. Gaywood Hospital deeds and estate papers. 2 acres of arable land in Ghewud (Gaywood) marsh called Salthushill, lying between Middolcotehill and land of Adam de Gernmuth and abutting on the sea...	unknown
KL/C56/5	King's Lynn Borough Archives. Gaywood Hospital deeds and estate papers. 1d annual rent from a certain [piece of land] 4 feet wide in Damgate held by Peter Strac Grant by Laurence Outlaw (utlator) of Len...	1200-1250
KL/C56/13	King's Lynn Borough Archives. Gaywood Hospital deeds and estate papers. Piece of land in Geywode with the trees growing on it and now enclosed by hedges in breadth between Potekynesgrene on the south part and...	1463
KL/C56/14	King's Lynn Borough Archives. Gaywood Hospital deeds and estate papers. Same premises as KL/C56/13 Grant by John Dalman, prior, and Nicholas Runhalle to the hospital of the Blessed Mary Magdalen and the brothers there for their souls and the souls of their benefactors, 9	1467
KL/C56/16	King's Lynn Borough Archives. Gaywood Hospital deeds and estate papers. 3 acres of ground in Gaywood marsh on which a saltecote was sometime built, with a sandhill, groves and nattokkes, sometime in the hands of...	1534-1543
KL/C56/18	King's Lynn Borough Archives. Gaywood Hospital deeds and estate papers. 11 acres in Seche held of the manor of Gaywood Regis 5 acres near le goole in Geywood which Nicholas Brigges, late prior of the...	1468-1547
KL/C56/17	King's Lynn Borough Archives. Gaywood Hospital deeds and estate papers. ½ acre of ground in Gaywood abutting on land of William Clerke called the Asheyardes towards the north and on Holmes Lane towards the south...	1538-1606
Lands in Gaywood marsh, to the south of Salters Way		
KL/C50/641	King's Lynn Borough Archives. CORPORATION ESTATES: TITLE DEEDS; GAYWOOD. 7 acres of land in Geywod marsh, in breadth between land of the Prior of Lynn on the south part and Saltekotegate on the north...	1446-1606
KL/C50/642	King's Lynn Borough Archives. CORPORATION ESTATES: TITLE DEEDS; GAYWOOD. Same premises as KL/C50/641; land towards the west now of Edmund Wyghton Grant by John Codyngton, executor of the will of John Curson, late burgess, to Thomas Fuller, clerk	31 Dec. 1476
Lands in the North Marsh, to the north of Salters Way		
KL/C50/639	King's Lynn Borough Archives. CORPORATION ESTATES: TITLE DEEDS; GAYWOOD. 7 acres of land in Geywode marsh in breadth between land formerly of Adam de Gernemutha on the south part and Saltcotegate on the	1285-1286

National Archives catalogue reference no.	Description	Date of record
	north...	
KL/C50/636	King's Lynn Borough Archives. CORPORATION ESTATES: TITLE DEEDS; GAYWOOD. 2½ acres of land in the north marsh of Geywode, between land of the Prior of Lynn on the east part and land of William...	1465-1606
KL/C50/638	King's Lynn Borough Archives. CORPORATION ESTATES: TITLE DEEDS; GAYWOOD. Same premises KL/C50/636 Feoffment by John Tygo to Matilda Goodewyn, widow, and others.	21 April 1496
KL/C50/640	King's Lynn Borough Archives. CORPORATION ESTATES: TITLE DEEDS; GAYWOOD. Same premises KL/C50/636 Grant by Alexander Lomb to John Sturiun, innkeeper, of Lynn, reserving 6d annual rent.	21 Jan. 1290
KL/C50/637	King's Lynn Borough Archives. CORPORATION ESTATES: TITLE DEEDS; GAYWOOD. Same premises as KL/C50/636 Feoffment by John Oldemedewe and others to John Tigo, draper, John Bilney, glover, and Richard Tigo, tailor, burgesses.	3 Nov. 1480
C 1/1514/25	Tigo v Crybbe. Plaintiffs: John TIGO. Defendants: Richard CRYBBE.	1386-1558
KL/C50/643	King's Lynn Borough Archives. CORPORATION ESTATES: TITLE DEEDS; GAYWOOD. Piece of land called Turnecole in the Northmersh of Gaywode with the salterns, pasturage and nattokes between the river called Gaywoode Ee on the north...	15 July 1497
KL/C50/644	King's Lynn Borough Archives. CORPORATION ESTATES: TITLE DEEDS; GAYWOOD. Piece of land in the North marsh of Geywode anciently called Turnecoule with the salterns, pasturage, and nattokes between Geywood Ee on the north part...	1507-1606
KL/C50/653	King's Lynn Borough Archives. CORPORATION ESTATES: TITLE DEEDS; GAYWOOD. Piece of land called Upgongeacre in Geiwode marsh in breadth between land late of Richard Weston on the east and west parts, abutting on land...	30 Oct. 1460
KL/C50/656	King's Lynn Borough Archives. CORPORATION ESTATES: TITLE DEEDS; GAYWOOD. 4 acres of arable land (as in KL/C50/654) Grant by Philpott, Tracy and Caldecott to Pilton, Braibroke and Smyth Endorsed as the second [deed] relating to the 4 acres.	30 May 1464
KL/C50/654	King's Lynn Borough Archives. CORPORATION ESTATES: TITLE DEEDS; GAYWOOD. 4 acres of arable land in Geiwode marsh in breadth between land sometime of Thomas Malyns late William Scarlett's on the east part and land...	31 Oct. 1460
KL/C50/660	King's Lynn Borough Archives. CORPORATION ESTATES: TITLE DEEDS; GAYWOOD. Same premises as KL/C50/658, acquired together with Robert Genyns and Andrew Wolcy from the grant of Laurence Male Grant by Thomas Robertson, merchant of the staple town of Calais, and Robert Gerveys.	1515-1606
KL/C50/657	King's Lynn Borough Archives. CORPORATION ESTATES: TITLE DEEDS; GAYWOOD. 4 acres of arable land and Upgongacre in Geywode marsh (as in KL/C50/655) Grant by William Pylton and John Braybroke to Henry Baxster, pattenmaker, and John Ryccheman, burgesses, and appointment by….	7 Oct. 1469
KL/C50/659	King's Lynn Borough Archives. CORPORATION ESTATES: TITLE DEEDS; GAYWOOD. Same premises as KL/C50/658 Grant by John Baker, Wareyn, Yates and Langham to John Male of Sutton in Holland, yeoman, Robert Male, clerk, and Laurence Male of Sutton, John's son, 6 May 1484, and…..	1484
KL/C50/658	King's Lynn Borough Archives. CORPORATION ESTATES: TITLE DEEDS; GAYWOOD. 4 acres of land in Gaywode marsh in breadth between land of William Bawsey on one part and land of the Prior of Lynn on...	1479-1606

National Archives catalogue reference no.	Description	Date of record
KL/C50/655	King's Lynn Borough Archives. CORPORATION ESTATES: TITLE DEEDS; GAYWOOD. Piece of land Upgongeacre: the land on the west part now described as late Curson's and afterwards Williams Scarlett's…….	30 May 1464
KL/C50/661	King's Lynn Borough Archives. CORPORATION ESTATES: TITLE DEEDS; GAYWOOD. Same premises as KL/C50/658….	1527-1606
KL/C50/662	King's Lynn Borough Archives. CORPORATION ESTATES: TITLE DEEDS; GAYWOOD. Same premises as KL/C50/658….	22 March 1540
Lands in Gaywood near 'St Cateryns without estgate'		
KL/C50/663	King's Lynn Borough Archives. CORPORATION ESTATES: TITLE DEEDS; GAYWOOD. Messuage, orchard and adjoining pasture, 3 acres, near the east gates between the highway from Lynn to Gaywood on the south part and the Common...	20 Oct. 1548
KL/C50/664	King's Lynn Borough Archives. CORPORATION ESTATES: TITLE DEEDS; GAYWOOD. Same premises as KL/C50/663 Grant by the Mayor and burgesses to William Overend reserving 4d annual rent, 9 January 1549 Endorsed as 'now of William Pell, gent, 1672'.	1549-1672

Table 13: National Archive records recommended for consultation

British Library, Manuscript Collections catalogue reference no.	Description	Date of record
Add MS 42513, ff. 1-2	Gaywood Manor extent (fragment)	1266-1278

Table 14: British Library Manuscript Collection records recommended for consultation

Outline Bibliography

8.3.6 The following publications and grey literature reports are recommended for consultation and inclusion within the archive report bibliography (Table 15).

Albone, J, Massay, S., and Tremlett, S. 2007 *The Archaeology of Norfolk's Coastal Zone. Results of the National Mapping Programme. English Heritage project no. 2913. A Report for English Heritage*. Norfolk Landscape Archaeology/English Heritage

Armstrong, J. 1725 The history of the Ancient and Present State of the Navigation of the Part of King's Lynn and of Cambridge. (Historical maps pp 7, 14 & 73. Cambridge University Library Catalogue no. Cam.a.725.1)

Bannister, R.T. 1983 'Wrangle Toft', *Lincolnshire History and Archaeology* 18.

Beloe, E.M. 1899 *Our Borough Our Churches. King's Lynn, Norfolk.* Cambridge: Macmillan & Bowes. (Historical Maps 1, 2 & 3; & Plan 1. Cambridge University Library Catalogue no. RC.25.70)

Blomefield, F. 1808 *An Essay Towards A Topographical History of the County of*

Norfolk: Volumes 8 & 9 (London)

Bridbury, A.R. 1955 *England and the Salt Trade in the Later Middle Ages,* Oxford, Clarendon.

Chambers, J. 1829 *A General History of the County of Norfolk, Intended to Convey all the Information of a Norfolk Tour. Volume II.* Norwich and London.

Clarke, G. 2016 *A Late Saxon to Medieval Saltern at Marsh Lane, King's Lynn, Norfolk. Archaeological Excavation.* Oxford Archaeology East report 1820. Dated 30th June 2016 (unpublished)

Brown, P. (ed) 1984 *Domesday Book: Norfolk,* Phillimore, Chichester

Clarke, H. and Carter, A. 1977 *Excavations in King's Lynn 1963-1970.* Society for Medieval Archaeology Monograph Series No. 7.

Davies, G. 2010 *Early Medieval 'Rural Centres' and West Norfolk: A Growing Picture of Diversity, Complexity and Changing Lifestyles*, Medieval Archaeology, 54:1, 89-122,

Davies, G. 2011 *Settlement, economy and lifestyle: the changing social identities of the coastal settlements of West Norfolk, 450-1100 AD*. PhD thesis, University of Nottingham.

Cope-Faulkner, P 2014 *A Medieval Salt Making Complex in King's Lynn: Investigations at the Former Queen Mary's Nurses Home, 2002-2003*. Norfolk Archaeology XLVII (2014), 67-86

Crowson, A., Lane, T. and Reeve, J 2000 *Fenland Management Project Excavations 1991-1995*. Lincolnshire Archaeology and Heritage Reports Series No 3.

Hall, D., and Coles, J 1994 Fenland Survey. *An Essay in Landscape and Persistence.* English Heritage Archaeological Report 1, 143-145.

Hallam, H.E. 1960 'Salt-making in the Lincolnshire Fenlan during the Middle Ages', *Lincs. Architectural and Archaeological Society Reports and Papers* Vol 8, 85-112.

Hankinson, S. 2005 'The Growth of King's Lynn' in Ashwin, T. and Davison. A. *An Historical Atlas of Norfolk,.* 80-81. Phillimore

Harrold, H. 1874 *Report on the Deeds and Records of the Borough of King's Lynn.* King's Lynn: Thew & Son. (Historical map on Plate H. Cambridge University Library Catalogue no. RC.25.70)

Healy, H. 1975 ' A Medieval Salt-making Site at Bicker Haven, Lincolnshire' in de Brisay, K.W. and Evans, K.A. (eds.). *Salt: The Study of an Ancient Industry. Report on the Salt Weekend held at the University of Essex September 1974.* Colchester Archaeological Group. p36

Healy, H. 1999 Healy, H., 1999. 'A Medieval Salt-making Site at Bicker Haven' in Bell, A., Gurney, D. and Healy, H. *Lincolnshire Salterns:*

Excavations at Helpringham, Holbeach St Johns and Bicker Haven. East Anglian Archaeology 89, 82-101.

Healey, R.H. 1977 Medieval Saltmaking. *South Lincolnshire Archaeol,* **1**, 4-5.

Hillen, H.J. 1907 *History of the Borough of King's Lynn. Volumes I and II.* Norwich

Hutcheson A.R.J. *The origins of East Anglian Towns: Coin Loss in the Landscape, AD 470-939.* Thesis submitted for the degree of Doctor of Philosophy in the School of History, University of East Anglia December 2009

Keen, L. 1988 'Coastal Salt Production in Norman England', pp133-180, in R. Allen Brown (ed), *Proceedings of the Battle Conference on Anglo-Norman Studies XI.* Woodbridge, The Boydell Press.

McAvoy, F. 1994 'Marine Salt Extraction: The Excavation of Salterns at Wainfleet St Mary, Lincolnshire' *Medieval Archaeology* XXXVIII, 134–63.

Miller, E. and Hatcher, J. 2014 *Medieval England. Towns, commerce and Crafts 1086-1348.* Routledge 2014 (First published 1995 by Longman Group Ltd).

Owen, D.M. 1980 'Bishop's Lynn: The First Century of a New Town?', pp141-153, in R. Allen Brown (ed), *Proceedings of the Battle Conference on Anglo-Norman Studies 2.* Woodbridge, The Boydell Press.

Owen, D.M. 1984a *The Making of King's Lynn, a Documentary Survey,* Records of Social and Economic History (New Series) 18, Oxford University Press.

Owen, D.M. 1984b 'Salt, sea banks and medieval settlement on the Lindsey coast', in N. Field and A. White (eds), *A prospect of Lincolnshire.* Lincoln. pp.46-9.

Owen, A.E.B 1975 *Medieval salting and the coastline in Cambridgeshire and North West Norfolk. In Salt. The study of an ancient industry.* Colchester Archaeological Group

Page, W. (Ed.) 1906 *A History of the County of Norfolk*: Volume 2. Published by Victoria County History, London

Rudkin, E.H 1975 Medieval Salt Making in Lincolnshire

Rudkin, E.H., and Owen, D.M. 1960 The medieval salt industry in the Lindsey Marshland, *Lincolnshire Archit Archaeol Soc Rep Pap,* **8**, 76-84.

Silvester, R.J. 1988 *The Fenland Project, Number 3: Norfolk Survey, Marshland and Nar Valley*. East Anglian Archaeology 45.

Taylor, W. 1844 The Antiquities of King's Lynn. Published by J. Thew, Kings Lynn

Timberlake, S 2008 *Plot 13, Hamburg Way, North Lynn Industrial Estate, King's Lynn, Norfolk. An Archaeological Evaluation.* Cambridge Archaeological Unit Report No. 832 (unpublished, dated May 2008).

Trimble, G.	2003	*An Interim Report on the Archaeological Evaluation at 103 St Peter's Road, West Lynn, Norfolk,* unpublished Norfolk Archaeological Unit report 795.
Waller, M	1994	The Fenland Project, Number 9: Flandrian Environmental Change in Fenland. East Anglian Archaeology, Cambridge County Council.
Webster, M	2015 a	*Marsh Lane East, King's Lynn, Norfolk. An Archaeological Evaluation*. Oxford Archaeology East Report No: 1799.
Webster, M	2015 b	*Marsh Lane, King's Lynn, Norfolk. Archaeological Watching Brief Repor*t. Oxford Archaeology East Report No: 1755.

Table 15: Outline research bibliography

8.4 Artefactual Analysis

8.4.1 All the artefacts and environmental remains have been assessed/analysed with recommendations for any additional work given in the individual specialist reports (Appendices B1-7). Further work is recommended as follows:

Iron:

- No further work other than incorporation into archive report.

Bead:

- No further work other than incorporation into archive report and any proposed publication.

Pottery:

- Photography of selected examples of each fabric type.
- Thin section of possible Lincoln kiln-type ware pottery.
- Full archive report that will also consider the pottery date range with respect to the radiocarbon date results and explore the significance of the possible Lincoln kiln-type pottery. Incorporation into any proposed publication.

Ceramic building material:

- No further work other than incorporation into archive report.

Clay tobacco pipe:

- No further work other than incorporation into archive report.

Baked clay:

- Photography of selected examples to include the brick-like objects from the hearth rake-out pits in Saltern 1.
- Incorporation into archive report and any proposed publication.

Salt-making slag:

- Incorporation into archive report and any proposed publication.

8.5 Ecofactual Analysis

8.5.1 All environmental remains have been assessed/analysed with recommendations for any additional work given in the individual specialist reports (Appendices C1-7). Further work is recommended as follows:

Faunal Remains:

- No further work on the horse or medium mammal remains other than incorporation into archive report.
- Further study of the fish remains from environmental samples, by a fish specialist, to provide further insight into dietary preferences and species availability. Incorporation into archive report and publication.

Ostracods:

- Full archive report, in which residues should be re-examined prior to any publication on the site to confirm the presence or absence of ostracods within the fractions not previously examined.
- The occurrence of *Cyprideis torosa* within these sleeching tank(s) of the filtration unit(s) may be worthy of a published note in the ostracodological literature.
- Incorporation into publication.

Environmental samples:

- No further work other than incorporation into archive report and any proposed publication.

Charcoal:

- No further work other than incorporation into archive report and any proposed publication.

Sedimentology, Pollen and Diatoms:

- The pollen was sparse and no further work is recommended on the samples from Saltern 1 or 2.
- No identifiable diatoms were found, therefore no further work is recommended.
- Foraminifera were incidentally observed in many samples and may provide an additional paleoenvironmental tool for deposits where the identification of a marine signal is required.
- Soil micromorphology of deposit ‘soil’ 144 is recommended. However, if this deposit proves be an alluvial deposit a radiocarbon date would be valuable (see below).
- Dating of the bottom and top of the lower saltmarsh deposit 142 would date both the inception of the upper saltmarsh and lowering of relative sea-level, and also date the inception of Saltern 2 (see below).
- Combine with pollen results (Boreham 2016) and diatom results (Hiller 2016) from the excavation of a saltern by OA East at Marsh Lane (750m to the north east).
- Incorporation into archive report and publication.

Radiocarbon Dating:

- A further suite of radiocarbon dates is required from selected layers of deposits within Saltern 2 to aid the reconstruction of the chronology of salt-making at this site. Bayesian analysis of the radiocarbon dating data may also be required. The further samples to be sent for dating comprise:

  1 x further sample taken from 'buried soil 144' within Saltern 2; and

  1 x further sample from basal layer 142 of Saltern 2.

8.6 Suggested additional Ecofactual Analysis

Foraminifera:

- Brief notes were made on the foraminifera and molluscs found to be present during the ostracod analysis (S. Timberlake, pers. comm.). Foraminifera were also present in many of the diatom preparations (Appendix C.5.40). The foraminifera represent a further potential resource for habitat assessment. Future work on these salterns should include a sampling strategy for foraminifera to be submitted for specialist study.

Ostracods:

- Future work undertaken upon these saltern site(s) should include provision for a more complete sampling strategy of the sediments, in particular the saltern pits and tanks which are clearly important habitats for ostracods with quite distinct salinity tolerances.

9 Report Writing, Archiving and Publication

9.1 Report Writing

9.1.1 A task list of further work recommended by specialists on the assemblages recovered during this phase of works, and to be incorporated within the overall archive report, is identified in Table 17. These tasks are for the analysis and reporting of this phase of work only. They will form part of the body of work for the completion of the overall archive report and publication for the Lynnsport project.

9.1.2 The archive report will be prepared, incorporating all the phases of fieldwork once complete. It is proposed that an article will be produced which summarises the results of all the excavations, including ENF139746 (Lynnsport 4 & 5 evaluation) and ENF141949 (Lynnsport 4 & 5 excavation), and focus on the key aspects of the site (see below).

9.2 Storage and Curation

9.2.1 Excavated material and records will be deposited with, and curated by, Norfolk County Council (NCC) in appropriate county stores under the Site Codes XNFGAL16 (evaluation) and XNFGAL17 (excavation) and the county HER codes ENF139746 (evaluation) and ENF141949 (excavation). A digital archive will be deposited with OA Library/ADS. NCC requires transfer of ownership prior to deposition (see Section 11). During analysis and report preparation, OA East will hold all material and reserves the right to send material for specialist analysis.

9.2.2 The archive will be prepared in accordance with current OA East guidelines, which are based on current national guidelines

9.3 Publication

9.3.1 It is proposed that the results of the project, incorporating all phases of fieldwork for Lynnsport 1-5, should be published in the EAA or Oxford Archaeology monograph series under the working title 'The Middle to Late Saxon & Medieval Salt-Making Industry of Gaywood's North Marsh. Excavations at Lynnsport, King's Lynn, Norfolk' by Graeme Clarke.

10 Resources and Programming

10.1 Project Team Structure

Name	Initials	Project Role	Establishment
Matthew Brudenell	MB	Project Manager	OAE
Elizabeth Popescu	EP	Post-Excavation and Publication Manager	OAE
Rachel Clarke	RC	Editor	OAE
Rachel Fosberry	RF	Environmental co-ordinator and archaeobotanist	OAE
Graeme Clarke	GC	Project Officer & Author; documentary research	OAE
Sue Anderson	SA	Pottery specialist	Freelance

Name	Initials	Project Role	Establishment
Frances Green	FG	Sedimentology, Pollen and diatom specialist	Freelance
Simon Timberlake	ST	Ostracod and foraminifera specialist	Freelance
Rebecca Nicholson	RN	Fish bone specialist	OAS
Severine Bezie	SB	Illustrator	OAE
James Fairbairn	JF	Finds photography	OAE
Katherine Hamilton	KH	Archive Supervisor	OAE

Table 16: Project team

10.2 Stages, Products and Tasks

Task No.	Task	Staff	No. Days
Project Management			
1	Project management	MB EP	3
2	Team meetings	MB EP GC	2
3	Liaison with relevant staff and specialists, distribution of relevant information and materials	GC MB RF	3
Stage 1: Stratigraphic analysis			
4	Integrate ceramic/artefact/radiocarbon dating with site matrix	GC	1
5	Update database and digital plans/sections to reflect any changes	GC	1
6	Finalise site phasing	GC	1
7	Add final phasing to database	GC	1
8	Compile group and phase text	GC	1
9	Compile overall stratigraphic text and site narrative to form the basis of the full/archive report	GC	4
10	Review, collate and standardise results of all final specialist reports and integrate with stratigraphic text and project results	GC	1
Illustration			
11	Prepare draft phase plans, sections and other report figures	SB	1
12	Select photographs for inclusion in the report	GC	0.5
13	Photography of selected pottery and baked clay examples for archive report & publication	JF	0.5
Documentary research			
14	Research into relevant medieval saltern sites	GC	2
15	Additional research into history of King's Lynn	GC	1
16	Visit Norfolk Heritage Environment Record (NHER)	GC	1
Artefact studies			
17	Late Saxon Pottery: archive catalogue, research, archive report	SA	2
Ecofact studies			
18	Fish remains: archive catalogue, further analysis, research, archive report	RN	1
19	Ostracod assemblage: archive report and publication synopsis	ST	2

Task No.	Task	Staff	No. Days
20	Foraminifera assemblage report and publication synopsis	ST	3
21	Pollen and diatom synthesis with Marsh Lane (Clarke 2016) for archive report and publication synopsis	FG	3
22	Radiocarbon dating: 2 x samples at *c.*£300 per sample	RF	-
Stage 2: Report Writing			
23	Integrate documentary research	GC	1
24	Write historical and archaeological background text	GC	1
25	Compile list of illustrations/liaise with illustrators	GC SB	0.5
26	Write discussion and conclusions	GC	1
27	Prepare report figures	SB	0.5
28	Collate/edit captions, bibliography, appendices etc	GC	1
29	Internal edit	RC/EP	1
30	Incorporate internal edits	GC	0.5
31	Final edit	RC MB	1
32	Send to NCC for approval	MB GC	0.5
33	Approval revisions	GC	0.5
Stage 3: Publication			
34	Produce draft publication	GC	5
35	Compile list of illustrations/liaise with illustrators	GC SB EP	1
36	Produce publication figures	GG SB	2
37	Internal edit	RC/EP	2
38	Incorporate internal edits	GC	0.5
39	Final edit	EP MB	1
40	Send to publisher for refereeing	EP	0.5
41	Post-refereeing revisions	GC/EP	2
42	Copy edit queries	EP	1
43	Proof-reading	GC MB EP	1
Stage 3: Archiving			
44	Compile paper archive	GC	1
45	Archive/delete digital photographs	GC	1
46	Compile/check material archive	GC/KH	2

Table 17: Task list

* See Appendix D for product details and Appendix E for the project risk log.

10.3 Project Timetable

10.3.1 Compilation of a final archive report is normally completed within one year of the approval of the Post-excavation Assessment and Updated Project Design. However, in this case, further phases of fieldwork are anticipated to be carried out on the plots of land within the development comprising Lynnsport 1-3, from 2017 at the earliest. Therefore submission of the archive report will be within one year of the approval of the Post-excavation Assessment for the final phase of works. Consequently, a publication proposal will be submitted to Norfolk Archaeology from 2019 at the earliest, with the aim of publishing an article on the Lynnsport saltern remains.

11 OWNERSHIP

11.1.1 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. It is Oxford Archaeology Ltd's policy, in line with accepted practice, to keep site archives (paper and artefactual) together wherever possible.

Appendix A. Context Summary with Provisional Phasing

A1 Evaluation

Trench 12							
General description					**Orientation**		E-W
Consists of soil and subsoil overlying Late Saxon/medieval deposits and features comprising Saltern 1 in the western part of the trench with natural deposit in the eastern part of the trench. Salt-making features include a brine boiling hearth and clay-lined water tank.					**Avg. depth (m)**		0.6
					Width (m)		2
					Length (m)		55
Contexts							
context no.	**type**	**Width (m)**	**Depth (m)**	**comment**	**finds**	**date**	**period**
1	Layer	-	0.2	Topsoil	-	-	-
2	Layer	-	0.4	Subsoil	-	-	-
3	Layer	-	-	Marsh deposit	-	-	-
4	Layer	-	-	Tidal flat deposit (saltmarsh)	-	-	-
34	Cut	0.96	0.19	Brine-boiling hearth	-	Late Saxon	2
35	Fill	-	0.19	Clay hearth base	-	Late Saxon	2
36	Fill	-	0.11	Disuse/backfill	-	Late Saxon	2
37	Cut	0.48	0.05	Water tank/storage tank	-	Late Saxon	2
38	Fill	-	0.05	Clay-lining	-	Late Saxon	2
39	Fill	-	0.02	Vitrified clay hearth base	-	Late Saxon	2
40	Layer	-	0.15	Hearth waste	-	Late Saxon	2
41	Layer	-	1.1	Filtration unit waste	-	Late Saxon	2
42	Layer	-	0.2	Filtration unit waste	-	Late Saxon	2

Trench 13							
General description					**Orientation**		NW-SE
Trench devoid of archaeology. Consists of soil and subsoil overlying natural marsh deposit.					**Avg. depth (m)**		0.6
					Width (m)		2
					Length (m)		40
Contexts							
context no.	**type**	**Width (m)**	**Depth (m)**	**comment**	**finds**	**date**	**period**
1	Layer	-	0.2	Topsoil	-	-	-
2	Layer	-	0.4	Subsoil	-	-	-
3	Layer	-	-	Marsh deposit	-	-	-
4	Layer	-	-	Tidal flat deposit (saltmarsh)	-	-	-

Trench 14		
General description	**Orientation**	E-W
Trench devoid of archaeology. Consists of soil and subsoil overlying natural marsh deposit.	**Avg. depth (m)**	0.5
	Width (m)	2

Trench 14							
					Length (m)		40
Contexts							
context no.	**type**	**Width (m)**	**Depth (m)**	**comment**	**finds**	**date**	**period**
1	Layer	-	0.3	Topsoil	-	-	-
2	Layer	-	0.2	Subsoil	-	-	-
3	Layer	-	-	Marsh deposit	-	-	-
4	Layer	-	-	Tidal flat deposit (saltmarsh)	-	-	-

Trench 15							
General description					**Orientation**		E-W
Consists of soil and subsoil overlying natural marsh deposit. Two post-medieval hayrick ring gullies and one modern orchard tree-pit were recorded cutting the natural deposit.					**Avg. depth (m)**		0.6
					Width (m)		2
					Length (m)		50
Contexts							
context no.	**type**	**Width (m)**	**Depth (m)**	**comment**	**finds**	**date**	**period**
1	Layer	-	0.2	Topsoil	-	-	-
2	Layer	-	0.4	Subsoil	-	-	-
3	Layer	-	-	Marsh deposit	-	-	-
4	Layer	-	-	Tidal flat deposit (saltmarsh)	-	-	-
24	Cut	0.25	0.2	Hayrick gully	-	Post-medieval/ modern	4
25	Fill	-	0.2	Hayrick gully	-	Post-medieval/ modern	4
26	Cut	0.25	0.2	Hayrick gully	-	Post-medieval/ modern	4
27	Fill	-	0.2	Hayrick gully	-	Post-medieval/ modern	4
28	Cut	0.25	0.2	Hayrick gully	-	Post-medieval/ modern	4
29	Fill	-	0.2	Hayrick gully	Ceramic tobacco pipe-stem	Post-medieval/ modern	4
30	Cut	0.25	0.2	Hayrick gully	-	Post-medieval/ modern	4
31	Fill	-	0.2	Hayrick gully	-	Post-medieval/ modern	4
32	Cut	0.5	0.1	Orchard tree pit	-	Post-medieval/ modern	4

Trench 15							
General description					**Orientation**		E-W
Consists of soil and subsoil overlying natural marsh deposit. Two post-medieval hayrick ring gullies and one modern orchard tree-pit were recorded cutting the natural deposit.					**Avg. depth (m)**		0.6
					Width (m)		2
					Length (m)		50
Contexts							
context no.	**type**	**Width (m)**	**Depth (m)**	**comment**	**finds**	**date**	**period**
33	Fill	-	0.1	Orchard tree pit	Ceramic tobacco pipe-stem	Post-medieval/ modern	4

Trench 16							
General description					**Orientation**		N-S
Consists of soil and subsoil overlying natural marsh deposit. Seven modern orchard tree-pits were recorded cutting the natural deposit.					**Avg. depth (m)**		0.6
					Width (m)		2
					Length (m)		50
Contexts							
context no.	**type**	**Width (m)**	**Depth (m)**	**comment**	**finds**	**date**	**period**
1	Layer	-	0.2	Topsoil	-	-	-
2	Layer	-	0.4	Subsoil	-	-	-
3	Layer	-	-	Marsh deposit	-	-	-
4	Layer	-	-	Tidal flat deposit (saltmarsh)	-	-	-
10	Cut	0.5	0.2	Orchard tree-pit	-	Post-medieval/ modern	4
11	Fill	-	0.2	Backfill/disuse	-	Post-medieval/ modern	4
12	Cut	0.5	0.2	Orchard tree-pit	-	Post-medieval/ modern	4
13	Fill	-	0.2	Backfill/disuse	-	Post-medieval/ modern	4
14	Cut	0.5	0.2	Orchard tree-pit	-	Post-medieval/ modern	4
15	Fill	-	0.2	Backfill/disuse	-	Post-medieval/ modern	4
16	Cut	0.5	0.2	Orchard tree-pit	-	Post-medieval/ modern	4
17	Fill	-	0.2	Backfill/disuse	-	Post-medieval/ modern	4
18	Cut	0.5	0.2	Orchard tree-pit	-	Post-	4

Trench 16							
General description					**Orientation**		N-S
Consists of soil and subsoil overlying natural marsh deposit. Seven modern orchard tree-pits were recorded cutting the natural deposit.					**Avg. depth (m)**		0.6
					Width (m)		2
					Length (m)		50
Contexts							
context no.	**type**	**Width (m)**	**Depth (m)**	**comment**	**finds**	**date**	**period**
						medieval/ modern	
19	Fill	-	0.2	Backfill/disuse	Ceramic tobacco pipe-stem	Post-medieval/ modern	4
20	Cut	0.5	0.2	Orchard tree-pit	-	Post-medieval/ modern	4
21	Fill	-	0.2	Backfill/disuse	-	Post-medieval/ modern	4
22	Cut	0.5	0.2	Orchard tree-pit	-	Post-medieval/ modern	4
23	Fill	-	0.2	Backfill/disuse	Ceramic tobacco pipe-stem	Post-medieval/ modern	4

Trench 17							
General description					**Orientation**		E-W
Consists of soil overlying Late Saxon/medieval deposits and features comprising Saltern 3 in the western part of the trench with natural deposit in the eastern part of the trench. No salt-making features were encountered.					**Avg. depth (m)**		0.3
					Width (m)		2
					Length (m)		50
Contexts							
context no.	**type**	**Width (m)**	**Depth (m)**	**comment**	**finds**	**date**	**period**
1	Layer	-	0.3	Topsoil	-	-	-
3	Layer	-	-	Marsh deposit	-	-	-
4	Layer	-	-	Tidal flat deposit (saltmarsh)	-	-	-
43	Layer	-	unknown	Filtration unit waste	-	Late Saxon	2

Trench 18							
General description					**Orientation**		E-W
Consists of soil and subsoil overlying Late Saxon/medieval deposits and a salt-making feature comprising Saltern 2 in the eastern part of the trench with natural deposit in the western part of the trench. The salt-making feature consisted of a brine boiling hearth's rake-out pit for the disposal of hearth waste.					**Avg. depth (m)**		0.55
					Width (m)		2
					Length (m)		50
Contexts							
context no.	**type**	**Width (m)**	**Depth (m)**	**comment**	**finds**	**date**	**period**
1	Layer	-	0.25	Topsoil	-	-	-
2	Layer	-	0.3	Subsoil	-	-	-
3	Layer	-	-	Marsh deposit	-	-	-
4	Layer	-	-	Tidal flat deposit (saltmarsh)	-	-	-
44	Layer	-	1.5	Filtration unit waste	-	Late Saxon	2
45	Layer	-	0.15	Hearth waste	-	Late Saxon	2
46	Layer	-	0.2	Filtration unit waste	-	Late Saxon	2
47	Cut	1.2	1	Hearth rake-out waste pit	-	Late Saxon	2
48	Fill	-	1	Backfill	-	Late Saxon	2

Trench 19							
General description					**Orientation**		E-W
Consists of soil overlying Late Saxon/medieval deposits comprising Saltern 2 in the westernmost part of the trench with natural deposit in the central and eastern parts of the trench.					**Avg. depth (m)**		0.3
					Width (m)		2
					Length (m)		55
Contexts							
context no.	**type**	**Width (m)**	**Depth (m)**	**comment**	**finds**	**date**	**period**
1	Layer	-	0.3	Topsoil	-	-	-
3	Layer	-	-	Marsh deposit	-	-	-
4	Layer	-	-	Tidal flat deposit (saltmarsh)	-	-	-
44	Layer	-	1.5	Filtration unit waste	-	Late Saxon	2

Trench 20							
General description					**Orientation**		E-W
Consists of soil overlying natural marsh deposit cut by two modern ditches with fills that contained modern rubbish including brick, tile, glass and metal (not retained).					**Avg. depth (m)**		0.3
					Width (m)		2
					Length (m)		50
Contexts							
context no.	**type**	**Width (m)**	**Depth (m)**	**comment**	**finds**	**date**	**period**
1	Layer	-	0.3	Topsoil	-	-	-
3	Layer	-	-	Marsh deposit	-	-	-
4	Layer	-	-	Tidal flat deposit (saltmarsh)	-	-	-

A2 Borehole WS10 log

GEOARCHAEOLOGICAL SERVICES

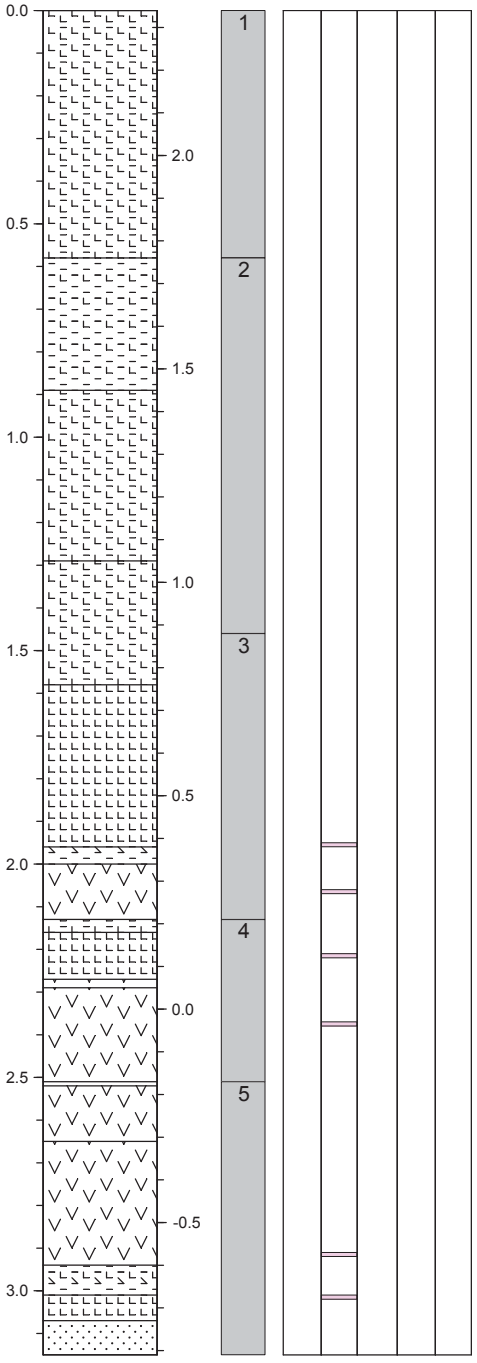
Oxford Archaeology

SUMMARY BOREHOLE RECORD

SITE NAME:	Green Park Avenue	SITE CODE: ENF139746	NG EASTING:	DATE:	02.03.17
BH NO:	WS10	ELEVATION: 2.34m OD	NG NORTHING:	LOGGER:	CH

Lithology Cores Subsamples Dating Description

Depth (m) mOD WPR P D M O



(0.00- 0.58) Silty clay: Firm dark brown (7.5YR 3/2) homogenous silty clay, rare charcoal and small red CBM fragments, rare white flecks below 0.55m. Lower contact diffuse

(0.58- 0.89) Clayey silt: Firm dark greyish brown (10YR 4/2) clayey silt, common small reddish brown mottles (20%). Lower contact clear

(0.89- 1.29) Silty clay: Stiff, slightly plastic, dark greyish brown (10YR 4/2) silty clay, common Fe mineralization (10-20%) and few rare black flecks (charcoal?)

(1.29- 1.58) Silty clay: Stiff to firm slightly plastic, dark greyish brown (10YR4/2) silty clay, common fine light bluish grey and reddish yellow mottles (20%). Lower contact diffuse

(1.58- 1.96) Clay: Firm grey (N 2.5/5), becoming bluish grey (5B 5/1) clay, common yellowish brown Fe mineralisation and small vertical root channels. Rare black organic inclusions , 4mm, frequent small dark grey mottles below 1.88m, weak organic odour. Lower contact clear

(1.96- 2.00) Organic clayey silt: Firm very dark greyish brown (2.5Y 3/2) organic rich silty clay. Common fine laminations (1-2mm) of light bluish grey clay silt and dark brown organic silt. Lower contact abrupt

(2.00- 2.13) Peat: Firm very dark brown (10YR 2/2) peaty organic silt, weakly stratified with frequent decayed plant remains

(2.13- 2.16) Silty clay: Soft greyish brown (2.5Y 5/2) silty clay. Clear lower contact.

(2.16- 2.27) clay: Soft bluish grey (10B 6/1) clay, common fine blackish inclusions (15%). Lower contact clear

(2.27- 2.29) Peat: Soft very dark brown to black (10YR 2/1) peaty organic silt

(2.29- 2.51) Peat: Firm very dark brown (10YR 2/2) turning black peaty organic silt, weakly stratified, frequent decayed plant remains

(2.51- 2.52) Peat: Friable, soft black peaty organic silt, common plant detritus (15%), diffuse lower contact

(2.52- 2.65) Peat: Spongy, friable, very dark brown (turning black) organic silt with plant detritus and woody frags (10%)

(2.65- 2.94) Peat: Soft dark brownish grey organic silt, clear lower contact

(2.94- 3.01) Organic clayey silt: Firm dark olive brown organic rich clayey silt, fine plant detritus (wood) common (15%), clear lower contact

(3.01- 3.07) Clay: Soft grey clay, abrupt lower contact

(3.07- 3.15) Sand: Loose medium to fine grey sand, laminated with lenses (10mm) of dark grey clayey sand

Notes: Power-augered with core retrieval to 2.51m bgl (cores 1-4), at which point the Makita failed. Continued with hand-auger fitted with a 1m gouge head to 3.15m (core no. 5), 10mm spit samples bagged and retained from the gouge head onsite.

Oxford Archaeology, Janus House, Osney Mead, Oxford OX2 0ES 31/03/2017

A3 Excavation

Area	Context	Cut	Group	Period	Category	Feature Type	Function
	50		50	1	layer	natural	bedrock geology
	51		51	1	layer	natural	palaeo surface
	52		52	1	layer	natural	peat
	53		53	1	layer	natural	tidal flat deposits
	54		54	2	layer	Saltern 1	deposits and features
	55		55	2	layer	Saltern 2	deposits and features
	56		56	3	layer	natural	marsh deposits
	57		57	4	layer	natural	subsoil
	58		58	4	layer	natural	topsoil
	59		59	4	layer	made ground	modern
A	60	60		4	cut	grave	horse burial
A	61	60		4	fill	grave	horse skeleton
A	62	60		4	fill	grave	grave backfill
A	63	63		4	cut	post hole	structure
A	64	63		4	fill	post hole	disuse
A	65	65		4	cut	post hole	structure
A	66	65		4	fill	post hole	disuse
A	67		56	3	layer	natural	marsh deposits
A	68		Saltern 1	2	layer	saltern mound	hearth waste
A	69		Saltern 1	2	layer	saltern mound	filtration waste
A	70	70	Saltern 1	2	cut	filtration unit	concentrated brine production
A	71	70	Saltern 1	2	fill	filtration unit	clay lining
A	72	70	Saltern 1	2	fill	filtration unit	disuse
A	73	73	Saltern 1	2	cut	tank	concentrated brine storage
A	74	73	Saltern 1	2	fill	tank	clay lining
A	75	73	Saltern 1	2	fill	tank	disuse
A	76	76	Saltern 1	2	cut	tank	concentrated brine storage
A	77	76	Saltern 1	2	fill	tank	clay lining
A	78	76	Saltern 1	2	fill	tank	disuse
A	79	83	Saltern 1	2	fill	pit	hearth waste
A	80	80	Saltern 1	2	cut	tank	concentrated brine storage
A	81	80	Saltern 1	2	fill	tank	clay lining
A	82	80	Saltern 1	2	fill	tank	disuse
A	83	83	Saltern 1	2	cut	pit	hearth rake-out pit
A	84	83	Saltern 1	2	fill	pit	hearth waste
A	85	83	Saltern 1	2	fill	pit	hearth waste
A	86	83	Saltern 1	2	fill	pit	hearth waste
A	87	83	Saltern 1	2	fill	pit	hearth waste
A	88	83	Saltern 1	2	fill	pit	hearth waste
A	89		Saltern 1	2	layer	surface (external)	buried soil
A	90		Saltern 1	2	layer	saltern mound	hearth waste
A	91	128	Saltern 1	2	fill	pit	hearth waste
A	92		Saltern 1	2	layer	saltern mound	filtration waste
A	93		Saltern 1	2	layer	saltern mound	hearth waste

Area	Context	Cut	Group	Period	Category	Feature Type	Function
A	94		Saltern 1	2	layer	saltern mound	filtration waste
A	95	95	Saltern 1	4	cut	post hole	structure
A	96	95	Saltern 1	4	fill	post hole	disuse
A	97	97	Saltern 1	4	cut	post hole	structure
A	98	97	Saltern 1	4	fill	post hole	disuse
A	99	99	Saltern 1	2	cut	tank	concentrated brine storage
A	100	99	Saltern 1	2	fill	tank	clay lining
A	101	99	Saltern 1	2	fill	tank	disuse
A	102	102	Saltern 1	2	cut	tank	concentrated brine storage
A	103	102	Saltern 1	2	fill	tank	clay lining
A	104	102	Saltern 1	2	fill	tank	disuse
A	105	80	Saltern 1	2	fill	tank	disuse
B	106	107	Hayrick 1	4	fill	gully	silting
B	107	107	Hayrick 1	4	cut	gully	drainage
B	108	109	Hayrick 1	4	fill	gully	silting
B	109	109	Hayrick 1	4	cut	gully	drainage
B	110	111	Hayrick 1	4	fill	gully	silting
B	111	111	Hayrick 1	4	cut	gully	drainage
B	113	114		4	fill	pit	disuse
B	114	114		4	cut	pit	unknown
B	115	116		4	fill	pit	disuse
B	116	116		4	cut	pit	unknown
C	117	117	Saltern 2	2	cut	filtration unit	concentrated brine production
C	118	117	Saltern 2	2	fill	filtration unit	clay lining
C	119	117	Saltern 2	2	fill	filtration unit	disuse
C	120	117	Saltern 2	2	fill	filtration unit	disuse
B	124	125	Hayrick 2	4	fill	gully	drainage
B	125	125	Hayrick 2	4	cut	gully	silting
A	127	0	53	1	layer	natural	tidal flat deposits
A	128	128	Saltern 1	2	cut	pit	hearth rake-out pit
A	129	128	Saltern 1	2	fill	pit	hearth waste
A	130	128	Saltern 1	2	fill	pit	silting
A	131	128	Saltern 1	2	fill	pit	hearth waste
A	132	128	Saltern 1	2	fill	pit	silting
A	133	128	Saltern 1	2	fill	pit	silting
B	134	135	Hayrick 2	4	fill	gully	silting
B	135	135	Hayrick 2	4	cut	gully	drainage
B	136	137	Hayrick 2	4	fill	gully	silting
B	137	137	Hayrick 2	4	cut	gully	drainage
A	138	140	Saltern 1	2	fill	filtration unit	disuse
A	139	140	Saltern 1	2	fill	filtration unit	clay lining
A	140	140	Saltern 1	2	cut	filtration unit	concentrated brine production
C	141		53	1	layer	natural	tidal flat deposits
C	142		Saltern 2	2	layer	surface (external)	buried soil
C	143		Saltern 2	2	layer	saltern mound	filtration waste deposits

Area	Context	Cut	Group	Period	Category	Feature Type	Function
C	144		Saltern 2	2	layer	surface (external)	buried soil
C	145		Saltern 2	2	layer	saltern mound	filtration waste deposits
A	146	146	Saltern 1	2	cut	filtration unit	concentrated brine production
A	147	146	Saltern 1	2	fill	filtration unit	clay lining
A	148	146	Saltern 1	2	fill	filtration unit	disuse
A	149	146	Saltern 1	2	fill	filtration unit	disuse
A	150	150	Saltern 1	2	cut	filtration unit	concentrated brine production
A	151	150	Saltern 1	2	fill	filtration unit	clay lining
A	152	150	Saltern 1	2	fill	filtration unit	disuse
A	153	153	Saltern 1	2	cut	filtration unit	concentrated brine production
A	154	153	Saltern 1	2	fill	filtration unit	clay lining
A	155	153	Saltern 1	2	fill	filtration unit	disuse
C	156	156	Saltern 2	2	cut	filtration unit	concentrated brine production
C	157	156	Saltern 2	2	fill	filtration unit	clay lining
C	158	156	Saltern 2	2	fill	filtration unit	disuse
C	159	159	Saltern 2	2	cut	filtration unit	filtration unit
C	160	159	Saltern 2	2	fill	filtration unit	disuse
C	161		53	1	layer	natural	tidal flat deposits
C	162		Saltern 2	2	layer	saltern mound	filtration waste deposits
C	163		Saltern 2	2	layer	saltern mound	filtration waste deposits
C	164		56	3	layer	natural	marsh deposits
C	165		Saltern 2	2	layer	saltern mound	filtration waste deposits
C	166		Saltern 2	2	layer	saltern mound	filtration waste deposits
C	167		56	3	layer	natural	marsh deposits
C	168		Saltern 2	2	layer	surface (external)	buried soil
C	169		Saltern 2	2	layer	saltern mound	filtration waste deposits
A	170		53	1	layer	natural	tidal flat deposits
A	171		Saltern 1	2	layer	surface (external)	buried soil
A	172		Saltern 1	2	layer	saltern mound	filtration waste deposits
A	173		Saltern 1	2	layer	saltern mound	filtration waste deposits
A	174		56	3	layer	natural	marsh deposits
A	175		Saltern 1	2	layer	saltern mound	hearth waste deposits
B	176		56	3	layer	natural	marsh deposits

Table 18: Context inventory

Appendix B. Finds Reports

B.1 Iron

By Carole Fletcher

Introduction

B.1.1 Within a horse burial (**60**) the backfill of which produced 19th century pottery, a relatively small iron horseshoe (SF1) was recovered from the hoof of the skeletal animal. The horseshoe appears to be of a type present from the 19th century onwards. A small fragment of an iron nail (SF2) was recovered from rake out pit **83**. The fragment is corroded and broken and may be from an implement used to rake out the pit or a broken item thrown into the fire. Its presence is not likely to be significant and may not be related to salt making.

B.1.2 Due to the late date of the horseshoe and the fragmentary nature of undated nail from the rake out pit **83**, the ironwork may be deselected before archive deposition.

Catalogue

B.1.3 SF1: Heavily corroded, near complete iron (Fe) horseshoe with much of the left heel having been lost through corrosion. The condition of the ground surface of the horseshoe is poor, on the bearing surface are the remains of three nails, two on the right quarter and a single nail on the left branch. The nails appear to be standard horseshoe nails of a type still used in the 21st century. Two calkins survive, one slightly off-centre at the toe, the second partway along the right heel. 19th century or later. Maximum width 111mm, length toe to heel 115mm, width at toe 23mm, narrowing to 13mm at surviving end of right heel. Thickness 12-15mm. Horse burial **60**, 61.

B.1.4 SF2: Incomplete corroded fragment of small iron (Fe) nail, tapering square shank, broken a short distance below the flattened wedge-shaped head. Surviving height 15mm, shank 5 x 5mm below head, tapering to 4 x 4mm at surviving end. Head 7mm wide, 5mm thick. Rake out pit **83**, 79.

B.2 Bead

By Mary Andrews

Summary

B.2.1 One translucent glass annular bead was retrieved from the clay lining (74) of storage tank **73** within Saltern 1. It measures 2mm approx. in diameter and is colourless under light. It is likely to be composed of soda-lime silica; colourless beads are noted by Guido 1999 as being relatively scarce in the Roman period yet having a minor revival during the 5th and 6th century AD. In shape and size it fits within the typology of the micro ‘seed’ glass beads from the Anglo-Saxon cemetery sites of Hatherdene Close, Cherry Hinton (ECB4258) and North-west Ely (ECB4948).

Methodology

B.2.2 The bead was retrieved from the >2mm residue of sample <64> and examined under a binocular microscope. The bead is well preserved so no further conservation action was required.

B.3 Pottery

By Sue Anderson

Introduction

B.3.1 Fourteen sherds of pottery weighing 208g were collected from nine contexts during the excavation. Table 19 shows the quantification by fabric; a summary catalogue by context is presented as Table 21.

Description	Fabric	Date range	No	Wt/g	eve	MNV
Thetford Ware	THET	L.9th–11th c.	7	43		5
Late Saxon shelly ware	LSSH	L.9th–11th c.	1	19	0.10	1
Total Late Saxon			*8*	*62*	*0.10*	*6*
Pearlware	PEW	L.18th–19th c.	1	2		1
Refined white earthenwares	REFW	L.18th–20th c.	3	7		3
Late slipped redware	LSRW	L.18th–19th c.	2	137		2
Total modern			*6*	*146*		*6*
Totals			**14**	**208**	**0.10**	**12**

Table 19: Pottery quantification by fabric

Methodology

B.3.2 Quantification was carried out using sherd count, weight and estimated vessel equivalent (eve). All fabric codes were assigned from the author's post-Roman fabric series, which includes East Anglian and Midlands fabrics, as well as imported wares. Post-medieval wares were identified based on Jennings' (1981) descriptions. Form terminology follows MPRG (1998). The catalogue was input directly into an MS Access database, which forms the archive catalogue.

Pottery by period

Late Saxon

B.3.3 The eight sherds of this broad period represented six vessels. The sherds were recovered from: a brine storage tank (82) and hearth rake-out pit (85, 86) associated with Saltern 1; and a filtration unit (119) and filtration waste deposit (143) within Saltern 2. The vessels were in two main fabrics, which were probably broadly contemporary with each other. These were Thetford-type ware, and a fine shelly ware which is probably a Lincoln product (most likely Lincoln Kiln-type ware; Young *et al.* 2005, 47–62).

B.3.4 Only the shelly ware sherd was a fragment of rim, a rounded wedge type from a jar of 140mm diameter. One Thetford-type ware sherd was decorated with rouletting.

B.3.5 None of the Thetford-type ware in this group was of the most local Grimston Thetford-type ware, which appears to have started production in the 11th century. Most of the sherds were in the fine, hard fabric typical of Thetford itself, but there were two sherds from contexts 119 and 143 which were in similar but softer fabrics (both abraded) and these may be from elsewhere, perhaps also from Lincoln given the presence of Lincoln shelly ware. Although the evidence is limited, it seems likely that this small group is of 10th-century date.

Modern

B.3.6 Four contexts contained pottery of later 18th–19th-century date, horse grave fill 62, post-hole fill 66, and pit fills 113 and 115. The group included small pieces of factory-made whitewares (PEW, REFW) including one with blurred blue decoration externally (sponged or transfer-printed), and two base fragments of slipped redware bowls, one with reddish slip decoration over the white slip background.

Pottery by context

B.3.7 Table 20 shows the distribution of fabrics by context.

Area	Context	Cut	Group	Period	Type	Fabrics	Spot date
A	62	**60**	-	4	Horse burial backfill	LSRW REFW	19th c.
A	66	**65**	-	4	Post hole	PEW REFW	19th c.
A	82	**80**	Saltern 1	2	Brine storage tank	THET	10th c.?
A	85	**83**	Saltern 1	2	Hearth rake-out pit	THET LSSH	10th c.?
A	86	**83**	Saltern 1	2	Hearth rake-out pit	THET	10th c.?
B	113	**114**	-	4	pit	REFW	19th c. +
B	115	**116**	-	4	pit	LSRW	L.18th-19th c.
C	119	**117**	Saltern 2	2	Filtration unit	THET	10th c.?
C	143	-	Saltern 2	2	Filtration waste deposit	THET	10th c.?

Table 20: Pottery by context

B.3.8 All Late Saxon were recovered from waste deposits in Salterns 1 and 2, with later material from pits, a post-hole and an animal burial.

Assessment

B.3.9 The assemblage contains two separate groups, one dating to the 10th century and the other to the later 18th–19th century. This is similar to the findings at the nearby saltern

site at Marsh Lane (Clarke 2016), but at that site there was early medieval material alongside the Late Saxon pottery. While the Late Saxon pottery from Marsh Lane was exclusively from Grimston, the Late Saxon material in the present group appears to be earlier. This dating is partly based on the presence of ?Lincoln Kiln-type pottery, which is dated to the later 9th to 10th centuries in Lincoln (Young *et al.* 2005), and the dominance of Thetford-type ware from Thetford itself, which was also producing pottery from the late 9th century. The lack of Grimston Thetford-type ware at this site may indicate that the saltern site went out of use before the 11th century.

B.3.10 There is no ceramic evidence for any activity between the end of the saltern and the later 18th/19th century. There was no redeposition of earlier material. The post-medieval pottery is all of English origin and typical of the later 18th and 19th centuries.

Context	Sample	Fabric	Type	No	Wt/g	MNV	Form	Rim	Decoration	Notes	Spot date
62		LSRW	B	1	131	1	bowl		white slip int		L.18-19
62		REFW	D	1	3	1			transfer-printed/sponge blue		19+
66		PEW	U	1	2	1					L.18-19
66		REFW	U	1	2	1					19+
82		THET	U	1	6	1					10?
85		LSSH	R	1	19	1	jar	rounded wedge		Lincoln (LKT)? - fine shell, occ large pieces, bivalve, in silty matrix, sparse sand ; reduced	10?
85		THET	D	1	6	1			diamond rouletting		10?
86		THET	U	3	17	1					10?
113		REFW	U	1	2	1					19+
115		LSRW	B	1	6	1	bowl		white slip & red trailed slip?		L.18-19
119	85	THET	U	1	4	1				soft	10?
143		THET	U	1	10	1				soft, brownish ext	10?

Table 21: Pottery catalogue (see Table 19 for key to fabrics)

B.4 Ceramic building material

By Ted Levermore

Assemblage

B.4.1 Archaeological works produced a single fragment, 21g, of ceramic building material (CBM). It is a post-medieval flat tile from the disuse fill (106) of Hayrick 1 (**107**) excavated in Area B. It is made in a yellow silty clay with common rounded voids, probably from leeched calcareous material. There is little to be gleaned from this fragment.

Methodology

B.4.2 The assemblage was quantified by context, fabric and form and counted and weighed to the nearest whole gramme. Fabrics were examined using a x20 hand lens and were described by main inclusions present. Width, length and thickness were recorded where possible. Woodforde (1976) and McComish (2015) formed the basis of reference material for identification and dating.

B.4.3 The quantified data and fabric descriptions are presented on an Excel spreadsheet held with the site archive.

Further work/recommendations

B.4.4 The assemblage has been fully recorded and described. The report should be incorporated into the archive report and updated, where necessary.

B.4.5 There are no fragments that require illustration or photography. This assemblage is of no significance and should be discarded.

B.5 Clay tobacco pipe

By Carole Fletcher

Introduction

B.5.1 Seven fragments of white ball clay tobacco pipe stem including a mouthpiece, and a single pipe bowl were recovered from pits and ditches across the site (Table 22). Terminology used in this report is taken from Oswald's simplified general typology (Oswald 1975, 37–41) and Crummy and Hind (Crummy 1988, 47-66). Stem borehole analysis has not been undertaken.

Assessment

B.5.2 Of the material recovered, only the Oswald type 9 pipe bowl, c.1680-1710 (Oswald 1975, 37–41) from gully **124** is datable beyond the broadest of date ranges, from the introduction of tobacco until the 19th century, although it may possibly be dated by association with other finds, such as pottery, recovered from the features. It is likely that all the clay pipe material is of a similar date. The stem fragments vary from 15mm to 42mm long and all are circular or slightly oval in section, with the stem fragments from ditch **28** and pit **32** being discoloured by burning. The clay pipe does little other than to indicate the consumption of tobacco on or near the site. The plain and fragmentary

nature of the assemblage means it is of little significance. This statement acts as a full record and the clay tobacco pipe stem may be deselected prior to archive deposition.

Context	Cut	Group	Period	Form	No of pipe stem fragments	No of complete bowls or fragments	Desc.	Weight (kg)	Date
19	**18**	Orchard tree-pit	4	Pipe stem	1		Plain pipe stem fragment	0.002	Not closely datable
23	**22**	Orchard tree-pit	4	Pipe stem	1		Plain pipe stem fragment	0.002	Not closely datable
29	**29**	Hayrick 2	4	Pipe stem	1		Plain pipe stem fragment	0.004	Not closely datable
33	**32**	Orchard tree-pit	4	Pipe stem	2		Plain pipe stem fragment	0.002	Not closely datable
115	**116**	-	4	Pipe stem	1		Plain pipe stem fragment	0.003	Not closely datable
115	**116**	-	4	Pipe stem	1		Mouthpiece-stem fragment	0.001	Not closely datable

Context	Cut	Group	Period	Form	No of pipe stem fragments	No of complete bowls or fragments	Desc.	Weight (kg)	Date
124	**125**	Hayrick 2	4	Bowl Oswald type 9		1	Near complete bowl of Oswald type 9, with only a small piece of rim missing at the front of the bowl and showing short section of rouletting at the back of the bowl. Oval flat heel, no surviving stem. Seams on bowl are smooth	0.016	c.1680-1710
Total					**6**	**1**		**0.037**	

Table 22: Clay pipe

B.6 Baked clay

By Ted Levermore

Introduction

B.6.1 Archaeological work produced 364 fragments, 3693g, of fired clay, along with 1246g of uncounted fragments from samples. The assemblage was collected from Middle to Late Saxon disuse and refuse contexts largely relating to the salterns and their discard mounds. The assemblage was comprised of both 285 amorphous and 10 structural fragments (1246g and 2447g respectively). The latter group was made up of fragments of brick-like objects or hearth lining. Amongst the assemblage were also fragments of fired sand, which will have had a clay component, that is likely to be related to the style of salt production taking place on site.

Introduction

B.6.2 The assemblage was quantified by context, fabric and form and counted and weighed to the nearest whole gramme. Fabrics were examined using a x20 hand lens and were described by main inclusions present. Fired clay collected from sampled that weighed below 1g were not assessed.

B.6.3 The quantified data and fabric descriptions are presented on an Excel spreadsheet held with the site archive. Summaries of the catalogue can be found in Tables 23 and 24.

Fabrics

B.6.4 The fired clay was attributed to a single silty clay fabric with occasional fine mica and quartz inclusions, rare coarse angular flint or stone inclusions and common elongate organic impressions and voids suggesting burnt out grassy temper. Although the exact source of the clay or inclusions has not been proven for this assemblage these are likely to have been naturally occurring in the local clay. The poor sorting of the inclusions suggests minimal paste preparation, although organic matter (chaff?) was probably included in the recipe. It was fired to a mid to dark orange and some fragments were quite friable.

B.6.5 A small fraction of the assemblage was fired sandy material with common mica and quartz and clay or sand pellets. These fragments were more reminiscent of a fine sand than a fine clay, although there must be a small clay contingent binding the fragments. These fragments are probably a by-product of the sand-washing process used to produce salt in the Late Saxon to Medieval periods.

Assemblage

B.6.6 The fired clay was collected from eight contexts from the evaluation Trenches 12 and 18 and excavation area A. The assemblage will be discussed, by type, below.

Amorphous fired clay

B.6.7 Three contexts produced amorphous fired clay (285 fragments, 1246g). These were fragments that could only be attributed to a fabric group. These fragments provide little information beyond indicating the historic presence of kilns, ovens, or hearths or domestic. However, the amorphous fragments from contexts with structural material are likely to have originated from the same objects as the latter. The amorphous portion of the assemblage is summarised below.

Cxt.	Cut	Trench/ Area	Feature Type	Form	Notes	Count	Weight (g)
35	**34**	12	Closed Hearth	Lining?	Rounded fragments of sandy fired clay	25	164
35	**34**	12	Closed Hearth	Lining? Briquetage?		99	288
36	**34**	12	Closed Hearth	Briquetage? Hearth Objects/Lining?	amorphous fragments with organic material impressions. Greenish/Grey surfaces - reduced or salt-related?	106	239
48	**47**	18	Pit	Briquetage? Hearth Objects/Lining?	Orange. Organic impressions. Fragments associated with the lining fragments from this context.	23	54
48	**47**	18	Pit	(blank)	Salt affected fragments. Higher fired or denser fabric, unclear due to size. Pink and Green hues.	5	16
79	**83**	A	Test Pit 2	Hearth/Saltern Waste?	Fragments of baked sandy material, some clay present, but largely just lightly baked very fine sand. Is this just very sandy clay or evidence of the sand used for salterns?	27	485
Grand Total						**285**	**1246**

Table 23: Summary catalogue of amorphous fired clay

Structural fired clay

B.6.8 The majority of the fired clay, by weight, recovered from the site was characterised as structural (10 fragments, 2447g). These are fragments with identifiable characteristics or diagnostic forms; these are fragments of hearth lining and brick-like objects. The diagnostic and structural fragments were collected from hearth **35**, trench 12, and from the refuse dump, pit **83**, that contained the rake-out from the salterns and contained both production refuse and structural material. As such the fragments are fragmentary and slightly abraded, although the fabric was also quite friable. Table 23 summarises the catalogue and contains descriptions of the fragments assessed.

Cxt.	Cut	Trench/ Area	Feature	Object Class	Object Form	Notes	Count	Weight (g)
35	**34**	12	Closed Hearth	Hearth related	Lining?	Rounded fragments of sandy fired clay	25	164
35	**34**	12	Closed Hearth	Hearth related	Lining? Briquetage?	Fragments off fired clay with some remnant flattened surfaces or hints towards being lining/hearth fragments	34	222
36	**34**	12	Closed Hearth	Hearth related	Briquetage? Hearth Objects/Lining?	amorphous fragments with organic material impressions. Greenish/Grey surfaces - reduced or salt-related?	106	239
36	**34**	12	Closed Hearth	Hearth related	?	Largish fragments of fired clay with flattened surfaces, with organic material impressions. Greenish/Grey surfaces - reduced or salt-related?	20	658
48	**47**	18	Pit	Hearth related?	Briquetage? Hearth Objects/Lining?	Orange. Organic impressions. Fragments associated with the lining fragments from this context.	25	96
48	**47**	18	Pit	Hearth related?	Lining?	Fragments of fired clay briquettes/clay lining with flattened face and irregular reverse. Generally squared off and hand formed.	4	290
48	**47**	18	Pit	Hearth related?	?	Salt affected fragments. Higher fired or denser fabric, unclear due to size. Pink and Green hues.	5	16
79	**83**	A	TEST PIT 2	Hearth related?	?Hearth/Saltern Waste	Fragments of baked sandy material, some clay present, but largely just lightly baked very fine sand. Is this just very sandy clay or evidence of the sand used for salterns?	27	485

Cxt.	Cut	Trench/ Area	Feature	Object Class	Object Form	Notes	Count	Weight (g)
79	**83**	A	TEST PIT 2	Hearth related?	Lining?	Fragments with a smoothed an slightly reduced surface, irregular reverse and very friable	2	193
85	**83**	A	Pit	Hearth related?	?Hearth Brick	Fragments of brick with greenish colouration on surfaces and orange core made in the same kind of silty clay with sandy inclusions. No full measurement survives; present thickness is 40mm. On the CBM/Fired Clay boundary as it is not as high fired as CBM.	4	261
86	**83**	A	Pit	Hearth related?	Briquetage? Prop or Spacer?	Large fragments of orange fired clay, similar to? lining fragments from (48) and elsewhere. Organic impressions, quite high fired. Brick-like. One fragment has thumb/finger impression - could be a prop or spacer?	4	252
86	**83**	A	Pit	Hearth related?	?	Flattened fragments of fired clay fired lighter than other material. Smoothed? Surfaces. Probably from an object or something structural	5	40
87	**83**	A	Pit	Hearth related?	Hearth brick? Lining?	Fragments of thick lining or brick-like object made in the orange silty fabric of other material recovered. Fragment has thumb/finger impression, probably from forming or pressing into place	3	464
91	**128**	A	Pit	Hearth related?	?	Fragment with flattened surface, poss. a prop or spacer. Made in the sandy based fabric but quite well fired and solid	1	25
Grand Total							**364**	**3693**

Table 24: Summary catalogue of structural fragments and fired clay objects

Assessment

B.6.9 The fired clay assemblage taken as a whole is indicative of salt production in the later Saxon period; where the main process of salt collection was boiling the water used to wash beach sand of its mineral content. Little can be gleaned from the amorphous fragments beyond their quantity and spread through the site. They do little more than to suggest the scope of the activity through their bulk. The structural fragments and the diagnostic objects paint a better picture of the industry taking place, however the material is very fragmentary. Nevertheless, the features on this site combined with this material evidence provide certain evidence for salt production.

Recommendations for further work

B.6.10 The assemblage has been fully assessed and described. This report should be included in the full report and the catalogue with the archive. The amorphous fragments are recommended for discard.

B.6.11 Further work to compare and link this site to others in the area, and therefore identify the significance of the site, should be undertaken. The material is of limited potential and should therefore be reported on in terms of other sites, such as Marsh Lane. Specialist knowledge should be sought from the author's of the finds reports from those sites.

B.7 Salt-making slag

By Graeme Clarke

Introduction

B.7.1 A total of 6 pieces of slag weighing 90g was collected from six contexts within Saltern 1 and associated with burnt waste tips from brine-boiling hearths (Table 25).

Nature of the Assemblage

B.7.2 The assemblage comprises a mix of slag formed by the high temperatures within brine-boiling hearths. The slag is comprised of pale cream to rusty brown light weight vesicular lumps. This slag is of a type found in the saltern excavated at Marsh Lane, King's Lynn (Clarke 2016).

Distribution

B.7.3 The slag appears to be deposited, along with spent fuel other hearth debris, in rake-out pits or simply tipped nearby to the brine-boiling hearths, as they were continually cleared out during each salt-making campaign.

Period	Feature type	Feature	Context	Description	Quantity	Weight (g)
2	Hearth waste layer	-	68	Vesicular lumpy concretion	1	8
2	Hearth rake-out pit	83	79	Vesicular lumpy concretion	1	36
			84	Vesicular lumpy concretion	1	17
			85	Vesicular lumpy concretion	1	5
			86	Vesicular lumpy concretion	1	18
1	Hearth rake-out pit	128	91	Vesicular lumpy concretion	1	6
Total					6	90

Table 25: Quantity and weight of slag by feature

Assessment

B.7.4 As described for Marsh Lane (Clarke 2016, 65, 81 plate 3) and Hamburg Way (Timberlake 2008, 30) these vesicular concretions are suggestive of accretions of spatter from the boiling brine solutions.

Further Work

B.7.5 The small quantity of slag remains recovered from the salt-making features do not allow for any detailed analysis.

Appendix C. Environmental Reports

C.1 Faunal remains

By Hayley Foster

Introduction

C.1.1 This animal bone assessment details the analysis of the faunal remains recovered from the site. The material dates to the Middle to Late Saxon (context 84 and 85) and the Post-medieval/modern periods (context 61) with all of the remains derived from Area A. The assemblage was very small in size, recovered by hand-collection and from environmental samples. The number of recordable fragments totalled 12 for mammal and the species represented included horse (*Equus caballus*) and medium mammal. Fish remains were also recovered from five contexts from the Middle to Late Saxon phase (79, 86, 91, 104, and 148) from environmental samples.

Methodology

C.1.2 The method used to quantify this assemblage was based on that used for Knowth by McCormick and Murray (2007) which was modified from Albarella and Davis (1996).

Identification

C.1.3 Identification of the faunal remains was carried out at OA East. References to Hillson (1992), Schmid (1972), von den Driesch (1976) and Cohen & Serjeantson (1996) were used where needed for identification purposes.

Ageing

C.1.4 Ageing was carried out with epiphyseal fusion, as no loose mandibular teeth or mandibles were recovered. The state of epiphyseal fusion is determined by examining the metaphysis and diaphysis of a bone.

Gnawing, butchery and burning

C.1.5 Gnawing marks made by carnivores and rodents were noted where present. For all identified bones and non-countable bone butchery marks were recorded where present. Burning on bones was simply recorded as either burnt/blackened, calcined or singed.

Results of analysis

C.1.6 Table 26 details the small amount of mammal remains recovered from the site. Contexts 84 and 85 were from pits from Area A dating to Late Saxon/early medieval period. Both fragments were unidentifiable to species, yet both were categorised as medium mammal. The horse remains from context 61 were from a pit that contained elements that were articulated on the base of the cut.

Context	Cut	Group	Period	Species	Element	Number of Fragments
61	60	-	4	Horse	Tibia	3
61	60	-	4	Horse	Phalanx 1	1

Context	Cut	Group	Period	Species	Element	Number of Fragments
61	60	-	4	Horse	Phalanx 2	1
61	60	-	4	Horse	Astragalus	1
61	60	-	4	Horse	Calcaneum	1
61	60	-	4	Horse	Metatarsal	1
61	60	-	4	Horse	Femur	1
61	60	-	4	Horse	Mandible	1
84	83	Saltern 1	2	Medium Mammal	Pelvis	1
85	83	Saltern 1	2	Medium Mammal	Tibia	1

Table 26: Number of identifiable specimens (NISP) by element and species

C.1.7 All long bones recovered had fused epiphyses, indicated that very young animals were not present. There were no other remains that could be used to determine age or sex of species. The fragment from context 85 was completely calcined suggesting possible roasting or cooking. The horse remains were in particularly poor condition, taphonomically the bone was porous, fragile and fairly weathered. There was no evidence of gnawing or butchery noted.

C.1.8 Fish remains included bone from five contexts. Remains were mainly made up caudal vertebrae. Other remains included thoracic vertebrae and a hyoid arch which was recovered from context 91. Context 79 consisted of the most fish remains with six vertebrae (mostly caudal) in good condition. The remains resemble those from the family Gadidae, which consists of cods and haddocks. With the absence of a fish reference collection, it would be recommended that further analysis be conducted in the future, to obtain a more accurate classification. There were several small calcined fragments from context 91 (from samples) in the form of a fish caudal vertebral body and three very small unidentifiable fragments, probably from small mammals.

C.1.9 The lack in diversity in the species that were recovered allows for very few interpretations to be made on diet and husbandry. The articulated horse remains were interesting as horse burials have previously been noted in Norfolk, at Sedgeford (Cross, 2012). These burials are believed to carry a ritual element whether for fertility, luck, or feasting significance (*ibid*). The fish remains provide evidence of a successful sampling strategy, as they would not have been recovered with hand-collection solely.

Recommendations

C.1.10 The assemblage is very small in size and due to the modern nature of the horse remains, recommendations for further retention would not be required, however further study of the fish remains from environmental samples, by a fish specialist, would be suggested to provide further insight into dietary preferences and species availability. Overall, there is little research potential from the assemblage beyond the general taxonomic composition.

C.2 Ostracods

By Simon Timberlake

Introduction

C.2.1 Six sediment samples from Saltern 1 and the underlying tidal flat and overlying marsh deposits were processed and examined for ostracods. Ostracods were found within all the samples, though mostly in the flots, but large numbers of these were encountered within sample <87>, the base and clay lining of the 'filtration unit', a tank used for 'sleeching' or washing-out (extracting) the salt from the silts.

C.2.2 Brief notes were made on the foraminifera and molluscs present, and these have been used simply to support the information provided by the ostracod analysis.

Methodology

C.2.3 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 >0.5mm <1mm fraction was collected to recover the larger juvenile and adult valves and carapaces where present. 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.2.4 An initial assessment of the six flot samples and single residue sample with ostracods in it (from <87>) involved a count then removal of all the identified valves and carapaces into separate numbered petri dishes awaiting full analysis. 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.2.5 The numbers of male and female adult valves and carapaces were counted, and wherever possible those of the sexually dimorphic later instars also.

C.2.6 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 27.

C.2.7 Some information was recorded on the accompanying foraminifera and mollusc fauna. However, these notes were intended purely to be an indication of the palaeoenvironment, and as such these generic identifications require confirmation.

Results (see Table 27)

C.2.8 An initial assessment of the samples revealed the presence of ostracods within all six contexts. Ostracods were moderately well preserved in all, but were best preserved and also most abundant within sample <87> (147) – the clay (base) or lining of the filtration tank on Saltern 1. These assemblages were of very low diversity, and almost all the species euryhaline brackish to freshwater in nature. Both adults and juveniles (carapaces and valves) were identifiable, therefore it seemed possible to determine the likelihood of autochthoneity. Due to the preservation and numbers of ostracods present a much more comprehensive analysis of sample <87> (both flot and residue fractions)

was possible – in all probability this has provided us with a good indication of the salinity and environment of the filtration (i.e. sleech processing) tank.

C.2.9 Some 1133 ostracods were counted within a sub-sample of 5.98 g of <87> (consisting of 1g from a flot weighing 8.69 g plus 4.98 g from the residue of 111.34 g). Just over 82% (935) of these ostracods consisted of the 'smooth' polymorph form of the brackish to hypersaline tolerant species *Cyprideis torosa* (Jones 1850); the population of which was made up of 457 adults (238 carapaces and 219 valves – >60% of which were female) and 469 juveniles (225 carapaces and 244 valves – some of which were sexually dimorphic). The above population structure is a good indication of an autochthonous species. In contrast, *Limnocythere inopinata* (Baird 1843) was represented just by juveniles (193 juvs. of which 126 were carapaces and 68 were valves). All these were recovered from the flot fraction, and are likely to be allochthonous, though nevertheless well-preserved and probably therefore proximal to this environment. Just two juvenile valves of the mesohaline ostracod *Loxoconcha elliptica* were recorded alongside two juvenile carapaces of the oligohaline *Candona* ? *candida*. Large numbers of marine foraminifera were noted, most of which were rotaliines (most likely *Elphidium* sp. a littoral-shelf genus) but numbers of other forams were also present (*Lagena* sp. etc.). The presence here of small terrestrial gastropods such as *Cochilocopa* sp. probably relates to the surface environment of the saltern mound itself, whilst brackish water snails such as *Hydrobia ventrosa* are more likely be associated with the surrounding saltmarsh.

C.2.10 Some 34 ostracods were counted within the total flot (0.83 g) from <88> sampled from the backfill sediment (148) of the filtration pit on Saltern 1. This consisted of just 20 'smooth' polymorph *Cyprideis torosa* (1 adult valve and 19 juveniles (most of them carpaces)), 4 *Limnocythere inopinata* (1 adult valve and 3 juveniles), 1 *Loxoconcha elliptica* juvenile, 4 *Candona* sp. juveniles, and 5 juveniles of *Cypria opthalmica* (another oligohaline species). In some respects the species pattern of this assemblage is similar to <87>, although the ostracods are in in much lower abundance and not wholly autochthonous, either to the filtration pit brines or to the sediment backfill. Nevertheless the backfill clearly does contains some element of the tank fauna (see Figs C.2.1-4). Once again very large numbers of marine rotaliine foraminifera were noted, including *Elphidium* sp., presumably as foraminiferal tests washed-out from the marine silts. A wide range of terrestrial molluscs were provisionally identified: *Cochilocopa* sp., *Oxychilus* sp., *Columella* sp. and *Vertigo pygmaea* (marshland habitat) alongside large numbers of the saltmarsh species *Hydrobia ventrosa*.

C.2.11 Sample <89> taken from the backfill sediment (149) of the filtration tank contained 17 ostracods (present within the total flot weighing just 0.74 g). This consisted of 10 'smooth' *Cyprideis torosa* (6 adults (2 carapaces and 4 valves) and 4 juveniles), 3 *Limnocythere inopinata* juveniles, 2 *Loxoconcha elliptica* juveniles, 1 *Loxoconcha rhomboidea* juvenile and 1 *Candona* sp. juvenile. From the numbers present, population structure and condition of preservation it would appear that these ostracods are allocthanous to the sediment backfill of the tank, but may have originated within the brackish saltmarsh environment of the saltern. Shallow-water marine foraminifera were similarly abundant, consisting of rotaliines such as *Elphidium* sp., but rarely including others such as *Lagena* sp.

C.2.12 A sample <108> taken from the unworked silts of the Group 53 tidal flat deposits (170) was marginally different. This contained 37 ostracods within the total flot of 0.5 g. Marginally the most abundant ostracod present was *Loxoconcha elliptica* (Brady 1868) which was represented by 11 individuals (4 adults (2 carapaces + 2 valves) and 4 juveniles) and is perhaps most typical of the sandy-muddy mudflat littoral palaeoenvironment located just seaward of the salterns. *Loxoconcha rhomboidea* with

quite similar habitat preferences was represented here by just 2 adults and a juvenile. By contrast *Cyprideis torosa* is noticeably sparse (1 adult and 2 juveniles), being an ostracod which in this environment is more closely associated with the salterns and brine tanks. *Limnocythere inopinata* (6 juveniles) is likewise allochthonous to the mudflats, as were the freshwater (oligohaline) ostracods *Candona candida* (10 juveniles) and *Cypria opthalmica* (4 juveniles). The latter are present here in larger numbers, suggesting freshwater inlets close by. The tidal flat/ submerged saltmarsh context of these sediments is confirmed by the paucity of terrestrial snails and by greatly increased numbers of satmarsh species (*Hydrobia ventrosa*), as well as by a large and more diverse assemblage of marine foraminifera; again mostly rotaliines such as *Elphidium* sp. and *Ammonia* sp. and miliolines such as *Triloculina* sp, and rarely the planktonic foram *Globigerina* sp.

C.2.13 Sample <109> was taken from context 69 within the Group 54 waste silts; presumably mud excavated from the tidal flats (above) which had been leached of salt within the filter tanks and then dumped to make up the saltern mound. Once again ostracods were recovered from the whole flot sample (weight 0.72 g), but these proved to be sparse. Just 13 ostracods were counted, marginally dominated by *Loxoconcha elliptica* (4 well-preserved juveniles), with 1 juvenile *Cyprideis torosa*, 2 juvenile *Limnocythere inopinata*, 3 juvenile *Candona* sp., 2 juvenile *Herpetocypris reptans* (less brackish mesohaline) and a juvenile *Cypria opthalmica*. As with the backfill sediments we are looking at a mixed-up and transported population of ostracods, their overall sparsity and dominance by littoral species confirming a tidal flat origin comparable to sample <108>. A similar range of marine foraminifera was present, whilst the presence of terrestrial snails confirms the subsequently emergent and much drier conditions of the mound.

C.2.14 Sample <123> (67) was taken from the overlying marsh deposits (Group 56) which were presumed to be less saline and now naturally re-worked marine silts. The distinct absence of brackish and more saline-tolerant ostracods within this sample would appear to support this, as did the indications of freshwater-loving species. Only 7 ostracods were recorded from this flot sample weighing 2.121 g. These consisted of *Cypria opthalmica* (5 adult carapaces (4 female and 1 male)) and 3 juvenile *Limnocythere inopinata* (these were abraded and therefore may have been re-deposited). Neither species are certainly autochthonous, yet the exclusive presence of terrestrial marshland snails such as *Vertigo pygmaea* points to the absence of saline conditions. Nevertheless, the foraminiferal assemblage dominated by *Elphidium* sp. indicates the marine origins of the underlying silt.

Comparison of species count patterns for the tank, tidal flats and waste silts

C.2.15 Despite big differences in ostracod abundance and population structures (adults: juveniles + males:females) between samples, a certain commonality in species count patterns links the fauna at the base of the filtration unit **146**, and likewise the tidal mud flats (170) and waste filtration silts (69). It is conceivable also that traces of the faunal pattern of the tidal mud flats may be seen within the tank itself (sample <88>).

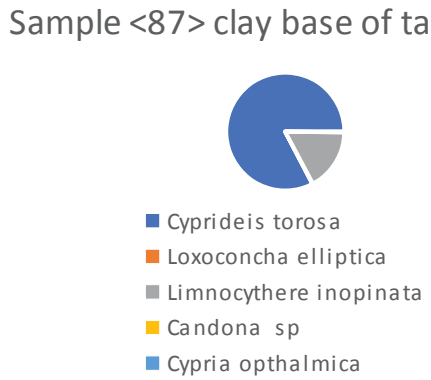


Fig. C.2.1 Ostracod species count pattern for sample <87>

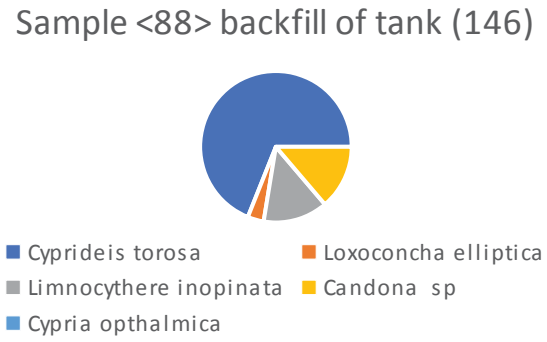


Fig. C.2.2 Ostracod species count pattern for sample <88>

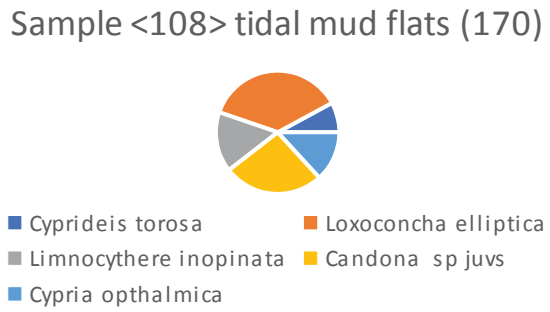


Fig. C.2.3 Ostracod species count pattern for sample <108>

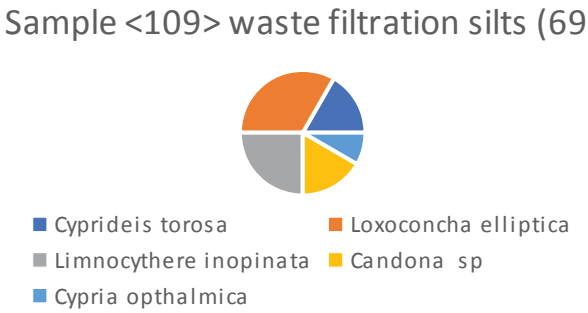


Fig. C.2.4 Ostracod species count pattern for sample <109>

genus/ species	<87> (147) clay lining of filt unit Saltern 1 (FLOT)	<87> (147) clay lining of filt unit Saltern 1 (>0.5mm) RESIDUE	<88> (148) backfill of filt pit Saltern 1 (FLOT)	<89> (149) backfill of filt tank Saltern 1 (FLOT)	<108> (170) Gp 53 tidal flat deposits (FLOT)	<109> (69) Gp 54 waste silts (FLOT)	<123> (67) Gp 56 overlying marsh (FLOT)	salinity	water temp	pH/ O_2	water flow / depth	substrat	NOTE: sample assess
Cyprideis torosa	498 (Adult: 17♀C 16♂C/ 16♀V 24♂V; Juv: 16♀43♂ + 237v/129c)	437 (Adult: 129♀ 76♂C 108♀71♂V; Juvs:19♀ 18 ♂ + 7v)	20 (Adult: 1♂V; Juvs 9♀C 6♂C +2v/ 1c)	10 (Adult: 2♀C/ 3♀V 1♂V; Juv: 3c 1v	3 (Adult 1♂V; Juv: 2♂)	1 (Juv♀V)		euryhaline (2‰ - 40‰) 'smooth' shell A+ juv so >7‰ sal	eurytherm (4-19ºC)	pH 7-8.5	<30m brackish-tidal	sandy-mud or algae	autocth populate Saltern 1 + tidal flats
Limnocythere sp. cf *inopinata*	193 (Juvs: 2♀3♂C/ 2♀V 1♂V + 121c/ 64v)		4 (1 Adult V; Juv: 2c/ 1v)	3 (Juv v)	6 (Juvs: 4 c/1v)	2 (Juv c)	3 (Juv v)	brackish euryhaline <10.7‰ 'smooth' juv	polytherm	eutrop	perm + shallow lake/ estuar	soft muddy + invert faeces	allocth populate but close by
Loxoconcha elliptica	2 (Juv v)		1 (Juv c)	2 (Juv v)	11 (Adult: 2C/ 2V; Juvs:6c/1v)	4 (Juvs: 1c/ 3v)		brackish mesohaline 7-19‰	4-19ºC	pH 7-8	brackish water flow/ tidal	epifauna mussel + sandy/ muddy	allocth populate close by
Loxoconcha rhomboidea?				1 (Juv v)	3 (Adult: 2C; Juv 1)								possibly *L. elliptica*
Candona candida?	2 (Juv c)	1 (Juv v)	4 (Juv v)	1 (Juv c)	10 (Juvs: 9c/ 1v)	3 (Juvs: 2c/ 1v)		oligohaline (<5.3‰)	oligotherm (<13ºC)	pH 5-10 eutrop	perm shallow slow	muddy bottoms	poorly preserved allocth
Herpetcypris reptans?						2 (Juvs: 1v/1c)		mesohaline (0.5-6‰)		eutrop	perm – imperm flow water	muddy bottoms algae	allocth
Cypris sp. cf *opthalmica?*			5 (Juv v)		4 (Juvs: 3c/1v)	1(Juv v)	5 (Adults: 4♀C/ 1♂C)	oligohaline (<5.8‰)	stenotherm (2.2-8.4ºC)	oligotr low pH	stagnant to slow flow	epifauna muddy bottom	later marsh FW envir
SNAILS	*Cochilocopa* sp(terrestrial)	*Cochilocop Hydrobia* (saltmarsh)	terrestrial marsh + saltmarsh		*Hydrobia ventrosa* echinoid sp	terrest snails	terrestrial snails only						
Total ostracods	695 together =	438 **168** per g	34 **41** per g	17 **23** per g	37 **74** per g	13 **18** per g	7 **3+** per g						

Notes: 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. Cyprideis torosa (smooth polymorph 'C.littoralis') may be an endemic population to the brine (sleeching) tank(s).

Table 27: Ostracod fauna from samples <87> (flot + >0.5mm fraction), <88> <89> <108> <109> and <123> (all flots) associated with Saltern 1 filtration tank, waste silts, tidal flat and later marsh deposits from the site.

Assessment

C.2.16 The relatively poor recovery of ostracods within five of the six samples has meant that any interpretation of this assemblage needs to be qualified with the statement that any further examination of the residue samples may reveal further ostracods, particularly within the smaller instar range. In the course of processing these samples the OAE archaeobotanist recovered most of the ostracods from the flot fractions, although in theory (at least) most of the adult valves and carapaces and instars should have passed through the sieves into the residues. Sometimes this does not happen, for a variety of different reasons, in which case the ratios and indices of abundance shown may well be correct. However, it would still be worth re-examining these residue fractions (if they exist) prior to any publication on this site using the current data. Ultimately the final resolution concerning presence /absence of a fully autochthonous species will depend upon a full and comprehensive examination and count of all the dry-sieved fractions within the ranges: 63-125 micron; 125-250 micron; 250-500 micron and >500 microns. Nevertheless the results reported here still look sensible in terms of what they say about the salinity ranges and habitat preferences of the identified fauna.

C.2.17 Probably the most interesting observation is the discovery of a 'smooth shelled' high salinity tolerant polymorph of the ostracod *Cyprideis torosa* referred to as '*C.littoralis*' (Kilyeni & Whittaker 1974). This appears to be very abundant and evidently autochthonous to the habitat of the filtration tank, and is perhaps an endemic population to this feature. This was recorded as being 'from' the clay lining of the filtration unit (147), yet there seems little doubt given our current knowledge of this brackish to hypersaline tolerant species (see Brasier 1980; Frenzl *et al.* 2012; Bloomer *et al.* 2016), that it was instead a living community inhabiting the waters of the tank and present in large numbers *upon its bottom surface*.

C.2.18 Clearly this population would have been periodically depleted as the saline water was tapped off, yet these ostracods would quickly have replenished their numbers, with the species living in some sort of balance below the level of the sediment sieve or filter. Indeed these tank(s) may well have been the origin of, or at least an important source for the allocthonous ostracod assemblage(s) which included this same smooth-shelled polymorph of *Cyprideis* sp., and which encountered as juveniles and occasionally as adult ostracods within the dumped waste filtration silts of the salterns, and of course within the silts backfilled into the tanks and pits. Periodic re-lining the tanks would likewise have resulted in the inclusion of the microscopic dead and moulted shells of these creatures into the clay base.

C.2.19 Given the considerable interest shown amongst ostracodologists in the phenomenon of salinity tolerance and polymorphism (i.e. the presence or absence phenotypic-genotypic noding) within the shells of living/ fossil *Cyprideis torosa*, the occurrence of this 'smooth shelled' population of C. torosa in what is presumed to be strongly saline water inside of a sleeching or holding tank at this medieval saltern has potential as a new habitat record for the species. In that sense the sample is important as holding research-worthy material.

C.2.20 It might also be useful at this point to mention some analogous naturally-occurring micro-habitats within which salt tolerant *Cyprideis torosa* ostracods have been found. These include brackish to saline water springs which have been studied within the karst landscape at Muǵla in Turkey. Here, both *C. torosa* and *Loxoconcha elliptica* were found to have colonised isolated inland niche habitats in the form of cold, alkaline salt-water springs where they appear to have adapted to yearly variations in salinity ranging between 7‰ - 19‰ (Altmsaçh *et al.* 2015). The ability of this ostracod to tolerate a very

wide range of salinities (including some extremes) during its life cycle might be considered unusual.

C.2.21 These ostracods are clearly useful as environmental indicators in the archaeological excavation of saltern sites, confirming the feature's immediate environment (i.e. the contents of the tank), and quite possibly also its industrial purpose.

C.2.22 When discussing the use of the tank(s) it should note that the normal salinity tolerance range recorded for this particular ostracod is between 2‰ - 40‰ (Bloomer *et al.* 2016); implying that the species will survive and thrive within saline water (30‰ - 50‰) but not in brine (>50‰). The suggestion therefore is that the filtration (i.e. sleeching) process used here was only producing saline water, rather than a solution concentrated enough to be considered brine. It seems possible in this case that the water was being tapped off into another tank in order to evaporate it naturally, prior to boiling this (i.e. the resultant brine) in lead or ceramic pans upon the saltern hearth.

C.2.23 The other six ostracod species within these samples, present as juveniles and therefore allochthonous to the environment of their deposition, might yet provide a useful window into the broader environment of these saltern mounds; the surrounding saltmarsh, freshwater creek inlets, and seaward of the mounds the littoral mudflats (from which the silt used for sleeching was probably gathered).

C.2.24 Although present in very low numbers, the ostracod *Loxoconcha elliptica* may be a species marginally autochthonous to the environment of these tidal mudflats. Their habitat preferences include sandy/ muddy sediments and brackish water tidal flow conditions typical of estuaries, where this ostracod lives epifaunally on mussel colonies.

C.2.25 *Limnocythere inopinata* juveniles were present within all of the samples examined, though no adults were recorded. It would appear therefore that this species is probably allochthonous, although well-preserved juvenile carapaces occur in large numbers within the base of the filtration unit tank (sample <87>). This suggests that the species was present either within the supply of water or within the sediments inserted for sleeching. Like C. torosa this species shows similar genotypic/ phenotypic variability in the form of hollow noding upon its shells as a response to environmental change – particularly to variations in salinity (Yu Yin *et al.*1999). Brasier (1980, 139) was of the opinion that noding in the shells was induced by low salinity, furthermore that these nodes first appeared in the immature (juvenile) valves. 'Smooth shelled' (i.e. un-noded) juveniles of L. *inopinata* appear to be the only polymorph form of this species recorded within the Lynnsport samples, and as such may be indicators of an increasingly saline environment.

C.2.26 Apart from the one sample taken from the overlying freshwater marshland deposits in which adult *Cypria opthalmica* were recorded, the presence of juveniles of *Candona candida, Herpetocypris* sp. and *Cypria* sp. represent ostracods 'washed-in' to these sediments by the tide and by currents of fresh to slightly brackish water flowing into the sea from rivers and freshwater creeks. The salinity tolerance range of all these species lies below 6‰, and as such it is very difficult to imagine them as living assemblages representative of the mudflat silts or saltmarsh deposits which were contemporary with the salterns.

C.2.27 It is feasible that freshwater was used for the sleeching process, though this would not make a lot of sense if the salterns all lay within the tidal zone. The only reason for this might be if it was the preferred method which was found to maximise the solution / uptake of salt from the silt; this perhaps being more efficient than using salty water that was already at 10‰ - 30‰ salinity.

Summary

C.2.28 The only certainly autochthonous species to the saltern environment appears to be *Cyprideis torosa*, an ostracod which seems likely to be represented by an endemic population living within the filtration unit (sleeching tank) of Saltern 1, and thereafter incorporated into its basal clay lining.

C.2.29 The occurrence of this 'smooth shell' polymorph of *C. torosa* suggests the presence of salt water of variable but moderately high salinity between 7‰ - 30‰ (psi). The implication is that the sleeching water process produced water which was strongly saline, but not concentrated enough to be a proper brine. It is possible therefore that this water was subsequently (naturally) evaporated within another shallow tank to brine (>50‰ (psi)) before being boiled dry to crystalline salt within pans upon the saltern hearth.

C.2.30 The ostracod species recorded within the waste sleeching silts dumped upon the mound and backfilled into the abandoned tanks are sparse in number and lack diversity, being clearly allochthonous to the sedimentary environment, and most likely washed-in from nearby. These were freshwater-brackish species, the ratios of which suggest some degree of commonality in fauna between the tidal mudflats, the waste mound silts, and the material backfilling the early medieval saltern features such as the filtration pits and tank(s).

C.2.31 The epifaunal mesohaline ostracod *Loxoconcha elliptica* appears most likely to be associated with the undisturbed littoral sediments of the tidal mudflats.

C.2.32 The overlying (later) marshland deposits may be freshwater in origin, but ostracods within this are extremely sparse.

Future Work

C.2.33 If the residues from these six samples still exist they should be re-examined prior to any publication on the site to confirm the presence or absence of ostracods within the fractions not previously examined.

C.2.34 Ideally any future work undertaken upon these saltern site(s) should include provision for a more complete sampling strategy of the sediments, in particular the saltern pits and tanks which are clearly important habitats for ostracods with quite distinct salinity tolerances.

C.2.35 The occurrence of *Cyprideis torosa* within these sleeching tank(s) may be worthy of a published note in the ostracodological literature.

C.3 Environmental samples

By Rachel Fosberry

Introduction

C.3.1 Fifty-two bulk samples were taken from the site, from features and deposits associated with Middle to Later Saxon salt-making. These included the remains of two salterns with their component filtration pits, waste-mounds and hearths. A further thirty samples were taken for further specialist assessment and six monoliths were taken through sediment profiles.

C.3.2 The purpose of this assessment is to determine whether environmental indicators such as foraminifera, mollusc and plant remains are present, their mode of preservation and

whether they are of interpretable value with regard to the salt-making industry and subsequent land use.

Methodology

C.3.3 For an initial assessment, two buckets (approximately 20 litres) of each of the samples (where available) was processed by tank flotation using modified Siraff-type equipment for the recovery of charred 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. 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. 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 Tables 28-31. 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.

Quantification

C.3.4 For the purpose of this initial assessment items that cannot be easily quantified such as charcoal, foraminifera and ostracods and seeds have been scored for abundance:

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

Results

Period 1: Natural deposits

C.3.5 Two samples were taken from natural tidal flat deposits (53 and 170) beneath Salterns 1 and 2 in Areas A and C respectively (Table 28). Both samples contain abundant foraminifera and deposit 170 also contains ostracods, mollusc shells including mud-snails (*Hydrobia* sp.), untransformed seeds of goosefoot (*Chenopodium* sp.) and small vitrified charcoal fragments.

Sample No.	Context No.	Volume processed (L)	Flot Volume (ml)	Charcoal est vol (ml)	Charcoal suitable for ID/C14?	Charred roots/stems	Molluscs density/diversity	Hydrobia sp.	Untransformed Seeds	charred seeds	Forams	Ostracods	FAS	Lemna sp.	Fired clay	Charcoal
59	53	16	30	0	no	0	0	0	0	0	++++/2	0	0	0	0	0
108	170	18	2	<1	no	0	++/2	+	+	0	+++/2	++	0	0	+	+

Table 28: Group 53 samples

Period 2: Middle Saxon (c.AD650 – 850)

Area A: Saltern 1 (Group 54)

Primary phase of salt-making deposits

C.3.6 Deposits sampled include the disuse fills and lining of four clay-lined pits (**140**, **146**, **150** & **153**) that represented silt filtration units for the production of concentrated brine as part of the salt-making process, filtration waste silt 69, hearth waste deposits 68 and 90 and possible buried soil 89 (Table 29). Molluscs are present in all of the samples with

frequent density and moderate diversity. Foramnifera are frequent in most of the samples and ostracods and duckweed (*Lemna* sp.) seeds occur most frequently in the filtration units. Untransformed seeds are common in the hearth waste deposits and include brambles (*Rubus* sp.), goosefoots (*Chenopodium* sp.). elderberry (*Sambucus nigra*) and nettles (*Urtica diocia*). Unidentified charred plant material in the form of roots and/or stems were recovered from hearth waste deposits and may represent fuel.

Sample No.	Context No.	Feature No.	Feature Type	Function	Volume processed (L)	Flot Volume (ml)	Charcoal est vol (ml)	Charcoal suitable for ID/C14?	Charred roots/stems	Molluscs density/diversity	Hydrobia sp.	Untransformed Seeds	charred seeds	Forams density/diversity	Ostracods	FAS	Lemna sp.
66	89	-	surface (external)	buried soil	5	15	10	Yes – good	0	+++/6	+	+	+	++ +/2	+++	0	0
51	69	-	saltern mound	filtration waste	16	30	<1	no	0	+++ +/5	++	+	0	++ +/2	0	+	0
109	69	-	saltern mound	filtration waste	20	2	<1	no	0	+++/4	0	++	0	++ +/2	++	0	0
94	139	140	filtration unit	clay lining	16	5	0	no	0	++/4	++	0	0	++/1	0	0	+
87	147	146	filtration unit	clay lining	18	120	0	no	0	+++ +/4	+++	0	0	++++ +/2	+++ +	0	0
92	154	153	filtration unit	clay lining	6	1	0	no	0	+++/4	0	0	0	++/3	0	0	+
84	138	140	filtration unit	disuse	17	10	<1	no	0	++/5	++	0	0	++/1	0	0	0
95	138	140	filtration unit	disuse	17	2	<1	no	0	+++/3	++	0	0	++ +/2	0	0	0
88	148	146	filtration unit	disuse	17	10	0	no	0	+++/6	+++	++	0	+++ +/3	+++	0	0
89	149	146	filtration unit	disuse	15	5	0	no	0	+++/6	+++	0	0	++ +/2	++	0	+
91	152	150	filtration unit	disuse	14	5	0	no	0	++/2	0	0	0	++ +/2	+	0	+
93	155	153	filtration unit	disuse	16	5	0	no	0	+++/5	0	0	0	++ +/4	++	0	+
50	68	-	saltern mound	hearth waste	18	60	3	yes	0	+++/6	0	++	0	0	0	+	0
55	68	-	saltern mound	hearth waste	9	1	0	no	0	+++/5	0	+++	0	++ +/3	+	0	0
56	68	-	saltern mound	hearth waste	8	2	<1	no	0	++/3	+	++	0	++ +/2	0	0	+
57	68	-	saltern mound	hearth waste	8	25	2	poss	+++	+++/5	+	++	0	0	0	++	0
58	68	-	saltern mound	hearth waste	8	2	<1	no	0	++/4	+	+	0	++/2	0	0	+
67	90	-	saltern mound	hearth waste	6	10	3	yes	++	++/4	++	+	0	++/1	0	0	0

Table 29: Samples from primary phase of salt-making deposits

Secondary phase of salt-making deposits

C.3.7 Samples were taken from the water tank element of silt filtration unit **70**, five clay-lined water tanks **73**, **76**, **80**, **99** & **102**; and two rake-out pits **83** & **128** (Table 30). Similar results were obtained as from the primary phase of deposits, samples in that molluscs and foraminifera are abundant or frequent in most of the samples although there is a noticeable reduction in foraminifera in the hearth waste deposits. Duckweed seeds are limited to the clay linings of tanks **80**, **99** and **102**. Fuel ash slag is more frequent in the samples of the secondary phase of deposits, particularly from hearth waste in pit **128** and may be indicative of the burning of seaweed as fuel. The two rake-out pits **83** and **128** have produced small charred plant assemblages; Fill 129 of pit **128** contains charcoal, an unidentified bud, two legumes that are possibly wild pea (*Lathyrus* sp.) and a single seed of spike-rush (*Eleocharis* sp.). A charred berry, possibly an elderberry, is also present in the sample from fill 91 along with a single barley (*Hordeum vulgare*)

grain. Pit **83** produced a single charred grass (Poaceae) seed in fill 79, four grass seeds in fill 86 and a wheat (*Triticum* sp.) grain in fill 88.

C.3.8 Untransformed seeds are more common in the samples from this group of features and include frequent elderberry, nettles and bramble seeds as well as hawthorn (*Crategus monogyna*) seeds; such taxa are indicative of hedgerows but it is not possible to ascertain whether the seeds are contemporary or later intrusions. Seeds of at least three species of sedges (*Carex* spp.) came from the various fills of pit **83**.

Sample No.	Context No.	Feature No.	Feature Type	Function	Volume processed (L)	Flot Volume (ml)	Charcoal est vol (ml)	Charcoal suitable for ID/C14?	Charred roots/stems	Molluscs density/diversity	Hydrobia sp.	Untransformed Seeds	charred seeds	Forams density/diversity	Ostracods	FAS	Lemna sp.
52	71	70	filtration unit	clay lining	4	1	0	no	0	+/5	0	+	0	++/2	+	0	0
53	72	70	filtration unit	disuse	16	5	<1	no	0	++/6	+	++	0	++ +/2	+	0	0
60	79	83	pit	hearth waste	15	50	<1	poss	0	++/4	0	+++	+	0	0	0	0
69	84	83	pit	hearth waste	17	50	5	no	+++	++/2	0	0	0	0	0	+	0
70	85	83	pit	hearth waste	9	40	2	yes	++++ +	+	0	0	0	0	0	+	0
71	86	83	pit	hearth waste	9	25	2	poss	0	+/3	0	++	+	0	0	+	0
72	87	83	pit	hearth waste	10	5	<1	no	0	++/7	+	++	0	++ +/2	0	+	0
61	88	83	pit	hearth waste	18	80	<1	poss	+	+/4	0	+++	+	0	0	++	0
68	91	128	pit	hearth waste	5	45	5	no	0	+++/4	++	+	0	0	+	+++ +	0
81	91	128	pit	hearth waste	9	5	0	0	0	++/3	+	++	0	0	0	+	0
82	91	128	pit	hearth waste	8	20	0	0	0	+/2	0	++	0	0	+	++	0
83	91	128	pit	hearth waste	9	60	30	Yes – good	++	+/3	0	+	+	0	0	++	0
124	91	128	pit	hearth waste	5	2	0	no	0	++/4	++	+	0	++/2	0	++	0
125	91	128	pit	hearth waste	4	25	<1	poss	0	+/3	+	+++	0	++/1	0	+	0
136	91	128	pit	hearth waste	7	15	<1	poss	+	+/2	0	+	0	++/1	0	0	0
137	91	128	pit	hearth waste	6	15	3	Yes-good	0	+/2	0	0	0	0	0	+	0
138	91	128	pit	hearth waste	7	30	2	poss	0	+/4	0	++	0	++/1	0	++	0
139	129	128	pit	hearth waste	13	110	30	yes	+++	+/3	0	0	+	++/1	0	++	0
64	74	73	tank	clay lining	18	10	<1	no	0	+/4	+	+	0	++/2	0	0	0
62	77	76	tank	clay lining	18	5	0	no	0	++/5	++	++	0	++++ +/2	+	0	0
80	81	80	tank	clay lining	18	10	0	no	0	++/5	+	+	0	+++ +/2	++	0	+
75	100	99	tank	clay lining	16	1	<1	no	0	+/5	+	0	0	++++ +/2	0	+	+
77	103	102	tank	clay lining	14	1	<1	no	0	+++/5	++++	0	+	+++ +/2	++	0	+
65	75	73	tank	disuse	18	20	0	no	0	++/6	+	++	0	++ +/2	0	0	0
63	78	76	tank	disuse	19	5	<1	poss	0	++/5	++	+++	0	+++ +/3	+	0	0
79	82	80	tank	disuse	18	2	<1	poss	0	++/5	+	+	0	+++ +/2	+	0	0
76	101	99	tank	disuse	9	1	<1	no	0	+/3	+	0	0	++ +/2	0	0	0
78	104	102	tank	disuse	20	2	1	poss	0	+++ +/5	++++	0	0	+++ +/3	+	0	0

Table 30: Samples from secondary phase of salt-making deposits

Area C: Saltern 2 (Group 55)

C.3.9 Samples were taken from the disuse fills and clay linings of two filtration units (**117** & **156**; Table 31). Foraminifera and molluscs are abundant in all samples and ostracods are present within both filtration units. Filtration unit **117** also contains waterlogged seeds of duckweed, an untransformed bramble seed and occasional stonewort (Charophyte) oogonia.

Sample No.	Context No.	Feature No.	Function	Volume processed (L)	Flot Volume (ml)	Charcoal est vol (ml)	Charcoal suitable for ID/C14?	Molluscs density/diversity	Hydrobia sp.	Untransformed Seeds	charred seeds	Forams density/diversity	Ostracods	Lemna sp.
85	119	117	disuse	19	3	0	yes	++/3	+	0	+	+++/2	0	0
86	120	117	disuse	18	10	2	no	+++/5	+	+	0	+++/2	+/2	+
90	118	117	clay lining	17	15	<1	yes	++/2	+	0	0	+++/2	0	+++
96	157	156	clay lining	17	30	1	no	++/6	+	0	0	+++ +/3	+/2	0
97	158	156	disuse	15	2	<1	no	++/3	+	0	0	++++ +/4	+	0
140	160	159	disuse	14	1	,<1	no	++/3	+	0	0	+++/2	0	0

Table 31: Samples from Saltern 2

Assessment

C.3.10 The environmental samples have produced significant assemblages of foraminifera, ostracods and molluscs. Preservation of plant remains is poor and where plant remains are present their modes of preservation and contemporaneity are not always clear. Charred remains include occasional cereal grains, weed seeds and a legume. The charred assemblage from the hearth waste deposits is most likely to be contemporary as the items could have been accidentally burnt in the hearths, most likely having been included with the fuel. The untransformed seeds are more problematic in that they could be modern intrusions or they could be contemporary with the deposits and have been preserved through waterlogging. The taxa recovered all have extremely tough seeds that are quite resistant to decay.

C.3.11 The presence of duckweed seeds is interesting as *Lemna* is a freshwater taxa which can only tolerate low salinity. Most of the seeds recovered were present in the lining of the features suggesting that they originated from the clay which must have been sourced inland.

C.3.12 There is scant evidence of what was used to fuel the hearths, which is a common theme on saltern sites of this period. Fuel-ash slag (FAS) was noted as small droplets in several of the hearth waste samples and may represent the use of seaweed as fuel. FAS is a non-metallic type of slag that commonly forms in hearth and is a glassy/vitreous, vesicular material with a cream/grey colour. There is a small amount of background charcoal, most of which is vitrified precluding species identification. The vitrified nature of the charcoal is indicative of repeats/high temperature burning but the fragments are very small and may be intrusive. Occasional charred stems may be indicative of fuel and have been submitted for specialist identification (Appendix C.4).

Statement of potential and recommendations for further work

C.3.13 The initial processing of sub-samples has produced assemblages of foraminifera and ostracods that have been submitted for analysis. Molluscs are well-preserved in many samples and have the potential for further study.

C.3.14 The preservation of plant remains is very limited and no further work is recommended.

C.4 Charcoal

By Denise Druce

Quantification and methodology

C.4.1 Five bulk sample taken from the site were processed to assess their potential for containing palaeoenvironmental remains, including charcoal. Following standard processing and assessment (Appendix C.3) any >2mm size charcoal fragments were extracted for charcoal assessment, primarily to determine its suitability for providing radiocarbon dating material, but also to assess its potential for providing information on fuel use.

C.4.2 Charcoal assessment was carried out using a binocular microscope at up to x40 magnification, whereby fragments were fractured to reveal transverse sections and preliminary species identifications were made. In particular, the presence of any small round wood, sapwood, and short-lived wood species was noted, for the purpose of providing suitable material for radiocarbon dating. The results were recorded on an assessment pro-forma, which will be kept with the site archive. Fragments considered suitable for radiocarbon dating were then fractured to reveal both radial and tangential sections, which were examined under a Meiji incident-light microscope at up to x400 magnification. Identifications were made with reference to Hather (2000), and modern reference material. Characteristics, such as possession of tyloses in hardwoods, any insect damage, or radial splitting were also noted as an aid to assessing wood maturity, and condition prior to charring.

Charcoal assessment

C.4.3 The results of the assessment are presented in Table 32. Four of the five samples produced only rare (<5) >2mm charcoal fragments, comprising primarily small twig fragments of shrubby taxa such as blackthorn-type (*Prunus* sp, which includes sloe/blackthorn, wild cherry or bird cherry), and hawthorn-type (Maloideae, which includes hawthorn, apple, pear or whitebeam). Other taxa, recorded in hearth rake-out pit **128**, include hazel (*Corylus avellana*) and possible heather/heath (*Ericaceae*). The buried soil (89) contained relatively abundant charcoal fragments, which appeared to be dominated by oak (*Quercus* sp) charcoal with a much smaller component of willow/poplar (*Salix* sp/*Populus* sp). Material from all five of the samples was extracted and submitted for radiocarbon dating (Table 10 and Section 6.3.14).

Sample	Context	Feature	Feature type	Charred plant remains	>2mm Charcoal	Material submitted for c14 dating
5	35	34	Salt-making hearth	-	(1), includes short-lived taxa, including *Prunus* sp round wood	Charcoal: *Prunus* sp twig fragment (1 year growth)
66	89	-	Buried soil?	-	(3), dominated by *Quercus* sp, including >10mm	Charcoal: *Salix/Poplar* sp

Sample	Context	Feature	Feature type	Charred plant remains	>2mm Charcoal	Material submitted for c14 dating
					fragments. Rare *Salix/Poplar* sp	
70	85	83	Pit containing probable salt-making waste	Carex seeds (1), buds (1), rhizome/tuber fragments (2)	(1), includes indeterminate stem/twig fragments	Charred rhizome/tuber fragments x2
83	91	128	Pit containing probable salt-making waste	-	(1), dominated by round wood, including cf Ericaeae and *Corylus avellana*	Charcoal: *Corylus avellana* round wood, 5 years growth
90	118	117	Lining of filtration unit	-	(1), includes Maloideae and *Quercus* sp	Charcoal: Maloideae

Notes: (1) =< five items; (2) = 6-25 items, (3) = 26-100 items, (4) =>100 items

Table 32: Results of the charcoal assessment

Assessment

C.4.4 The extremely low levels of charcoal recovered from the features directly associated with salt-making suggests that either other forms of fuel, other than wood/charcoal, was used during the activities, or that preservation of wood charcoal at the site is poor. Even allowing for the low levels, however, it is noticeable that the charcoal assemblages from three of the four features, including hearth **34**, and the fills of hearth rake-out pits **83** and **128**, comprised small round wood or twig fragments, rather than mature wood. This may indicate *ad hoc* collection of what may have been locally available rather than wood sourced from managed woodland. However, the very limited dataset means that any interpretation remains extremely tentative, especially given the possibility of re-working. Other forms of vegetation may have been utilised as fuel for the salt-making activities, however evidence for this is very limited (see Appendix C.3).

C.4.5 The sample taken from the lining of filtration unit **117** differed slightly and contained rare (non-twig/round wood) fragments of hawthorn-type and oak charcoal. The possible buried soil 89 was also noticeably different in that it was dominated by oak fragments, including some over 10mm in size. It is possible that the material comprises either the remains of structural waste, the waste generated during a specific part of the salt-making process, or a different activity altogether.

C.5 Sedimentology, Pollen and Diatoms

By Frances M.L Green

Summary

C.5.1 A sequence of saltmarsh, soils and filtration waste deposits below and within Saltern 2 (monolith <98>) contained sparse pollen and no identifiable diatoms. Pollen evidence showed the saltern was constructed on the upper saltmarsh during a period of potential relative sea-level fall. The filtration waste appears to have been colonised with plants typical of dune slacks as the saltern accumulated and a bioactive soil established. A clayey silt 'soil' intercalated within the saltern may represent a significant break in salt making, either caused by a freshwater/marine flood or simply a period of abandonment. Subsequent soil development supported a grazed grassland with alder carr.

C.5.2 The absence of pollen in the hearth waste of pit **83** means the fuel source for the salt making, probably either peat or charcoal, was not identified.

C.5.3 No identifiable diatoms were found in the clay lining of the filtration unit **146**, although a few foraminifera were present hinting that it may have been sourced from mudflats but this is speculation.

C.5.4 Sedimentology added to these interpretations suggested the ash pit **83** may have been covered between firings and the tips may act as individual heating events.

Introduction

C.5.5 Six pollen and six diatom samples were analysed from the excavation at Lynnsport Areas 4 and 5. Five pollen sub-samples were taken from monolith <98> (2-3cm, 9-10cm 11-11.5cm, 23-24cm and 37-38cm). Monolith <98> sampled the lower deposits of Saltern 2 in Area C (Fig. 10, Section 75) in order to define the nature of the contact between the bottom of the saltern (142) and the underlying naturally deposited sands (141). Other aims were to describe the environment in which the intercalated 'soil' (144) developed.

C.5.6 A single pollen sample was sub-sampled from ash deposit (88) in monolith <73> (Fig. 10, Section 56). Monolith <73> sampled a sequence of hearth waste deposits dumped into pit **83** and was part of Saltern 1 in Area A. The aim was to determine whether peat was used as fuel in the salt making process.

C.5.7 Five diatom samples were taken from the same levels in monolith <98> as the pollen samples (2-3cm, 9-10cm 11-11.5cm, 23-24cm and 37-38cm). No diatom samples were taken from the ash deposits in monolith <73>, but a single sub-sample of sample <87> of the clay lining (147) of filtration unit **146** was processed for diatoms to determine the source of the clay.

Methodology

Pollen preparation

C.5.8 Sub-samples of 1cm^3 were cut from the cleaned faces of the monoliths. Preparations followed the standard method: acetolysis and removal of silicates using HF (Fäegri and Iverson 1975; Moore and Webb 1991).

C.5.9 Two grammes of sediment were desegregated by boiling in 10% potassium hydroxide for 5-10 minutes and passed through a 180µm sieve. Silicates were removed by heating at 80°C in concentrated hyrodrofluoric acid (HF), the high sand content requiring prolonged treatment (more than 24 hours). Acetolysis was performed to remove cellulose. The remaining material was stained mixed with silicone fluid and mounted on slides using large square coverslips. A count of a minimum of 200-300 land pollen types per sample was attempted under a magnification of x400 and x1000. Pollen identifications were assisted by reference to Moore *et al.* (1991) and Andrew (1984), with fungal spores referred to Van Hoeve and Hendrikse (1998). Diagrams were drawn using TILIA (Grimm 1991) with most data expressed as a percentage of total land pollen (tlp i.e. trees, shrubs and terrestrial herbs). Note that aquatics, spores and unidentified are, for example, expressed as a percentage of tlp + aquatics. Algae and fungi are expressed independently as a percentage of tlp (i.e. not including algae or fungi in the final sum). Plant nomenclature follows Fitter *et al.* (1985) with minor amendments from Stace (1997).

Diatom preparation

C.5.10 Diatom samples were prepared by boiling 3-4cm^3 of sediment in 10% Hydrogen peroxide for seven hours or until all the organic material had disappeared. Two drops of supernatant were placed on coverslip with 4-5 drops of water and dried on a hot plate.

The coverslip was then mounted onto a slide using Naphrax. Routine counting under x1000 magnification attempted to count 200 frustules.

Sedimentology

C.5.11 The two monoliths, both 50cm long, were logged using Tröels-Smith (1955) classification scheme. Monolith <98> is described in (Fig. 10, Section 75) is given in Table 33 and monolith <73> in (Fig. 10, Section 56) in Table 34.

Depth (cm) from top of monolith Top of unit	Top of unit m OD	Depth (cm) Base of unit.	Base of unit m OD	Description	Context	Interpretation
0	2.35	7	2.28	Pale orange brown fine structureless sand with a trace of silt. Firm. Gamin3, Ag1, Sharp contact with below.	145	Saltern 2. Waste filtration sands,
7	2.28	8	2.27	Mid-orange sand, soft with no silt, friable. Gamin4. Sharp contact with below.	145	Saltern 2. Waste filtration sands
8	2.27	10	2.25	Mid-grey clay silt with a trace of sand. Moderately firm slightly elastic. Ag2, As2, Gamin+ Sharp boundary with below.	144	Ground surface- 'soil'
10	2.25	13	2.22	Lens of mid-brown firm sandy silt. Gamin3, Ag1. Moderately sharp boundary with below	143	Saltern 2. Waste filtration sands
13	2.22	15	2.20	Lens of super fine sand, not laterally extensive- Gamin4. Gradual boundary with below.	143	Possibly windblown sands- reworking the Saltern 2. Waste filtration sands
15	2.20	35	2.00	Firm, structureless mid-brown, orange, fine sand and silt Gamin3, Ag1 Gradual boundary with below	143	Saltern 2. Waste filtration sands
35	2.00	41	1.95	Firm dark brown structureless clayey silt with some sand, rare fine charcoal. Ag3, Gamin1, As 1, Sharp boundary with below.	142	Ground Surface
41	1.95	50	1.85	Fine soft pale brown very fine sand.	141	Sandflats

Table 33: Sedimentology of Monolith 98 Saltern 2 Area C (Section 75) after Tröels-Smith (1955)

Depth (cm) from top of monolith Top of unit	Top of unit m.OD	Depth (cm) Base of unit.	Base of unit m.OD	Description	Context	Interpretation
0	2.90	2	2.88	Dark grey 'soil' not in situ. Fine sand with humified organic Gamin3, SH1, Sharp contact with below.	79	Redeposited soil?hearth waste? in pit (**83)**
2	2.88	8	2.82	Dark purple pink-ash with fine sand with frequent charcoal and small lumps of yellow silt. Gamin1, Ash3, charcoal++ Sharp boundary with below	88	Hearth waste dumped in in pit (**83)**
8	2.82	10	2.80	Pale brown with grey brown lenses. Very fine soft sand with grey ash and silt Gamin3, Ag/ash1 Sharp boundary with below	87	Windblown? sands and ash from hearth waste in pit (**83)**. Lenses indicate reworking and weathering by wind and rain.
10	2.80	21	2.69	Purple pink ash and lenses of sand and charcoal rich sand. Lenses of clean white sand and black charcoal rich ash. Gamin2 ash, charcoal, Sharp boundary with below.	87	Hearth waste in pit (**83)**. Lenses of washed-in or windblown sands.
21	2.69	33	2.57	Black charcoal rich sand with small lumps of orange fired clay, Lenses of fine white sands. Gamin3, charcoal. Sharp boundary with below.	86	Small fragments of briquetage or hearth lining from the evaporation pans included in the hearth waste in pit (**83**). Weathered-in/windblown sands.
33	2.57	35	2.55	Dirty pale brown and orange sand with Fe staining. Very fine sand. Soft and friable Gamin4. Sharp boundary with below.	85	Windblown sands-weathered-in.
35	2.55	40	2.50	Black sand and probably ash with lenses of white sand. Gamin 2, Charcoal 2, ash. Sharp boundary with below	85	Hearth waste with some windblown/weathered-in lenses of sand. Pit (**83**).
40	2.50	11.1.144	2.46	Mid brown firm silty sand with fine lenses of pale brown sand. Gamin3, Ag1 Sharp boundary with below.	84	Weathered-in filtration waste. The basal fill of the pit.

Depth (cm) from top of monolith Top of unit	Top of unit m.OD	Depth (cm) Base of unit.	Base of unit m.OD	Description	Context	Interpretation
44	2.46	50	2.40	Pale brown very fine, soft and friable massive structureless sand with Fe staining. Gamin 4.		Sediments below base of pit (**83**). Probably filtration waste (69) or earlier natural sand flat deposits.

Table 34: Sedimentology of Monolith 73 Saltern 1 Area A (Section 56) after Tröels-Smith (1955)

Monolith <98> (Saltern 2)

C.5.12 The sedimentology of monolith <98> suggests the pre-saltern deposits of (141) were deposited on a sandflat in a relatively high energy environment exposed to all tides. Above the sands was a firm, clayey silt with anthropogenic remains (142) which was a ground surface over which silty sands of saltern deposits (143) (filtration waste) were dumped.

C.5.13 Overlying filtration waste deposits (143) was grey clayey silt (144). There was a sharp boundary between the saltern deposits (143) and (144), indicating a hiatus of some sort, possibly an erosive one. Layer (144) was a laterally continuous and the same as deposit (168) on the eastern side of the saltern (Section 75). Deposit (144) appeared to drape unconformably over the saltern deposits and has been is interpreted as a soil.

Monolith <73> (pit (83))

C.5.14 The discrete layers with sharp boundaries suggest episodic backfilling of pit **83** with hearth waste presumably from heating for salt evaporation. The fine lenses of clean sand in most deposits show that during the deposition of hearth waste, sands weathered-in from the pit sides and surrounding areas as a result of rain and especially wind. The general lack of massive sand layers, particularly after the lower 10-15cm of the pit, may suggest the pit was covered in between periods of raking out hearth waste. Possibly the discrete layers identified may result from seasonal periods of salt production with the pits covered over during quiescence. Potentially the layers may be annual events, with a period of perhaps five to six years perhaps represented by deposits recorded in monolith <73>?

Pollen Results (Fig. C.5.1)

Monolith <98> (Table 35)

C.5.15 All samples from monolith <98> contained pollen in fair condition but at low to very low counts. Two coverslips were counted and the maximum pollen count ranged between 12 and 77, although spores with environmental significance were found in addition to this in all samples. The low pollen counts are not statistically valid and the following interpretations of landscape are therefore tentative. Finely divided charcoal was found at low levels in all samples with more in sample 9-10cm from 'soil'(144).

C.5.16 With exception of a single sample at grey clayey silt with sand (144) (a former surface) pollen assemblages were characterised by low tree pollen (less than 5% of total land

pollen (tlp)) and dominated by Poaceae (grasses) and Taraxacum-type (dandelion family).

37-28cm (1.98m.OD)

C.5.17 The lowest sample was characterised by plants of the upper saltmarsh. Tree pollen was found at less than 5% tlp indicating an absence of local trees with woodland or isolated trees of pine, birch and alder at some distance. Pollen of the Poaceae (grasses) contributed almost 40%tlp and the saltmarsh is envisaged as predominantly grassy with herbaceous plants some of which would have been salt tolerant. Pollen of the Chenopodiaceae was frequent (*c*.30% tlp) and although undifferentiated this pollen type is typical of saltmarsh pollen diagrams (c.f. zone WGA6 Wiggenhall St Germains (Waller 1994) as the family includes many saltmarsh species e.g. *Atriplex potulacoides* (sea purslane) and *Atriplex prostrata* (spear-leafed orache). Pollen of other typical saltmarsh plants included *Plantago maritima* (sea plantain). Pollen of Taraxcum-type pollen (20%tlp) includes plants such as *Taraxacum* (dandelion), *Leontodon* (hawkbits) and *Hieracium* (hawkweeds) which would have grown on disturbed ground typical of the upper saltmarsh. A mosaic of environments on the upper marsh is envisaged, with marginal freshwater wet areas supporting aquatic plants such as *Typha latifolia* (bulrush) and Cyperaceae (sedges). The presence of *Glomus*-type bodies (mycorrhizal fungi) are indicative of aerobic bioactive soils (Bagyaraj and Varma 1995).

23-24cm (2.12m.OD)

C.5.18 Poaceae was the most important pollen type (*c*.50%tlp) in the filtration waste (143). Another important element of this assemblage were plants of disturbed ground *Taraxcum*-type (*c*.30%tlp). Spores of *Polypodium* (polypody) were recorded at low levels. The genus of *Polypodium* ferns include those which grows in a range of habitats including sand dunes. There was a relatively high count of *Lycopdium selago* (*clavatum*) (staghorn clubmoss) (125% tlp+spores) which again lives of acid sand soils and can be abundant in dune-heath succession of sand dunes. A single pollen grain of *Listera type i*s significant as this group includes helleborines which are found in variety of habitats including dunes and dune-slacks. The presence of *Glomus* in this sample is indicative of a bioactive soil.

11-11.5cm 2.24m.OD

C.5.19 The uppermost sediments of (143) contained a similar pollen assemblage to the lower deposits with the importance of Poaceae (*c*.30%tlp) and the dominance of Taraxacum-type (*c*.60%tlp) suggesting areas of open grassland with disturbed areas which probably reflect quiescence of saltern accumulation. This upper sample differs slightly as it contains a higher proportion of tree and shrub pollen (10%tlp) mostly Pinus (pine) and *Corylus* (hazel). Such changes are indicative of an increasingly developed woody scrubland above the saltmarsh. A relatively high proportion of *Glomus* reflects continued soil development in the upper deposits.

9-10cm 2.26m.OD

C.5.20 *Alnus* (alder) dominated the assemblage (ca 40%) with a small proportion of *Corylus* (hazel) (ca.5%tlp) the suggestion being that this pollen was derived from immediately adjacent to alder carr at the freshwater end of the saltmarsh in a zone away from all tidal influence. Pollen of Poaceae (ca.30%tlp) suggests areas of open grassland with disturbed areas supporting Taraxacum-type (15%tlpl) and *Pteridium* (braken) (>5%tlp). The grass was likely to have been grazed as supported by the presence of fungal spores of the Sordariacaee, a family of fungi of which many live on herbivore dung

(Innes and Blackford 2003). Damper areas of poor fen are suggested by pollen of *Filipendula* (meadowsweet) and Cyperaceaee (sedge). Monolete spores (undifferentiated ferns) were encountered at low levels. No soil mycorrhizal fungi were recorded in this deposit which may or may not have significance.

2-3cm (2.31m.OD)

C.5.21 Only twelve pollen grains were counted in deposit (145). Most of the pollen has probably been lost due to oxidation. The only pollen grains to survive were those of the Poaceae (grasses) but spores (which have thick coats more resistant to decay) were present in relatively high numbers These includes Filicales (undifferentiated ferns) and *Pteridium* (bracken). The soil fungal body of *Glomus* was frequent in this deposit showing that a simple soil had developed into the silty sand of the filtration waste

Monolith <73> (Table 36)

C.5.22 6-7cm

C.5.23 A single sample from hearth rake-out waste in pit <73> contained no pollen. It was full of charcoal and 29 *Glomus* fungal bodies were identified, together with a single recycled trilete spore. Based on these findings it was not possible to identify the fuel source used in the salt making process.

	Monolith	**98**	**98**	**98**	**98**	**98**
	Section	**75**	**75**	**75**	**75**	**75**
	Context	**145**	**144**	**143**	**143**	**142**
	Sample depth from top of monolith	**2-3cm**	**9-10cm**	**11-11.5cm**	**23-24cm**	**37-38cm**
	Sample height m.OD	**2.32**	**2.26**	**2.24**	**2.12**	**1.98**
Trees						
	Betula	0	0	1	0	2
	Pinus	0	0	2	2	2
	Alnus	0	22	1	0	2
Shrubs						
	Corylus	0	2	2	0	0
Terrestrial herbs						
	Poaceae	12	13	6	21	30
	Cyperaceae	0	1	1	0	1
	Rumex acetosa	0	1	0	0	0
	Chenopodiaceae	0	1	0	2	21
	Filipendula	0	1	0	0	0
	Scrophulariaceae	0	0	0	1	0
	Plantago maritima	0	0	0	0	1
	Taraxacum-type	0	8	20	16	18
	Listera type	0	0	0	1	0
Aquatics						
	Typha latifolia	0	0	0	0	1
Pteridophyte and Bryophyte spores						
	Pteridium	8	6	0	0	0

	Monolith	**98**	**98**	**98**	**98**	**98**
	Section	**75**	**75**	**75**	**75**	**75**
	Context	**145**	**144**	**143**	**143**	**142**
	Sample depth from top of monolith	**2-3cm**	**9-10cm**	**11-11.5cm**	**23-24cm**	**37-38cm**
	Sample height m.OD	**2.32**	**2.26**	**2.24**	**2.12**	**1.98**
	Polypodium	0	0	0	3	1
	Filicales	11	12	9	2	0
	Lycopodium selago	0	0	0	26	0
Foraminifera						
	Foraminifera	0	0	0	1	0
Fungal remains						
	Glomus	13	0	8	1	6
	Sordariaceae	0	4	1	0	0
Total pollen						
	Total pollen	12	49	33	43	77

Table 35: Total pollen and spores counts from Monolith 98 Saltern 2 Area C (Section 75)

	Monolith	**73**
	Section	**56**
	Context	**88**
	Sample depth from top of monolith	**6-7cm**
	Sample height m.OD	**2.32**
Fungal remains		
	Glomus	29
Total pollen		
	Total pollen	0

Table 36: Total pollen and spore counts from Monolith <73> Saltern 1 Area A (Section 56)

Diatom results

C.5.24 Four coverslips were counted for each of the five diatom samples and no countable diatoms were found in any samples.

Monolith <98>

C.5.25 Foraminifera were observed in all samples from monolith <98> except for soil (144) at 9-10cm and the upper deposit of filtration waste (143) at 11-11.5cm.

C.5.26 Broken and uncountable diatoms were found in samples 9-10cm (144) (10 broken diatoms) and 11-11.5cm (143) (2 broken diatoms).

Sample <87> lining (147) of filtration tank 146

C.5.27 No diatoms were identified but green glauconitic marine sand was observed, as were five foraminifera. The foraminifera were not identified but two appeared to be calcareous marine types.

Discussion

C.5.28 Saltern 2 was established on upper saltmarsh (142). The saltmarsh is envisaged to have been at the transition with a freshwater dominated zone above the tidal limit, only being reached by extreme high tides and storms. No diatoms were found in this deposit but the presence of occasional charcoal and foraminifera indicate both the earlier or rare influence of tides and human activity of the site.

C.5.29 The saltmarsh soil (142) developed above fine sands of a sandflat (141) and this change of environment indicates a relative lowering of sea-level. The underlying sands are undated but potentially a radiocarbon date may be obtained from the bottom of the saltmarsh deposits to date the inception of the upper saltmarsh and lowering of relative sea-level.

C.5.30 The saltern itself supported plants. As the filtration waste accumulated (143) there would have been bare sandy silt where grasses, plants of the dandelion family and clubmoss grew in the intervals between further deposition of sands. The presence of *Glomus* also suggests a thin soil may have developed in periods of hiatus in the saltern's development. There were diatom fragments in the saltern sediments but none were identifiable. Tiny charcoal fragments were found in the filtration waste, presumably resulting from the burning of fuel used in the evaporation process. Rare foraminifera and unidentifiable broken diatoms were present.

C.5.31 The grey clayey silt with sand deposit (144) which sealed the first phase of Saltern 2 development appeared to lie unconformably, with a sharp boundary above the upper, brown, sandy silt waste (143). The pollen assemblage from (144) had a strong woodland component, the majority being *Alnus* (alder). The overall impression is of grassland with wetter areas of poor fen at the margins or within a clearing of alder carr. The grassland was grazed, probably by sheep. There is, however, an unresolved problem regarding the origin of the sediment and therefore the taphonomy of the pollen. Despite the fact broken (unidentifiable) diatoms were found in this deposit, there was no indication that layer 144 had any marine or even brackish signal. The diatoms may have been freshwater types or even soil diatoms.

C.5.32 There is no doubt that the cessation of deposition of filtration waste material would ultimately have produced a soil, but the plastic clayey silt is not the same as the substrate from which it is thought to have developed. Therefore, there is a question as to where the clayey silts have come from. Deposit 144 does not have the appearance of a soil profile and has more in common with alluvium. The lack of any marine indicators (144) suggests that it may have been deposited by an extreme flood of the River Gaywood which lies to the east and west of the site and flows to the west into the Great River Ouse. After layer 144 was deposited the sediments may have been colonised and an immature soil developed but there was no evidence of rooting or any macropedological features. The taphonomy of the pollen from this deposit is therefore unknown. Does the pollen represent a flora from the site or from the catchment? Contrastingly, the lack of aquatic pollen hints this is perhaps a soil and the pollen reflects *in situ* vegetation. Soil micromorphology of (144) might determine if this was a soil or alluvial deposit.

C.5.33 The change in sedimentation at the saltern site may have been intentional or accidental. However, this change appears to have been temporary since salt production

continues with deposition of filtration waste (145) above this 'soil' and Saltern 2 continued to accumulate. The salt-making processes may have been abandoned due to flooding by sea-surges or large storms, for example storm surges in 1014, 1029 and 1099 (Simmons 2015). These surges may well have been made worse by sea-level rise during the 9th to 10th centuries.

C.5.34 Alternative reasons for environmental change could have been variations in local hydrological conditions such as a temporary seabank which prevented salt making, or engineering changes to the River Gaywood such as damming for a tide mill such as that still operational at Woodbridge (Suffolk). The lower reaches of the River Gaywood were dammed and several mills stood on this site, the first probably dating to 1101 (Norfolk Mills website, accessed 11-10-2017), however, other undocumented mills may have existed along the River Gaywood.

Sea-level

C.5.35 Saltern 2 was built off saltmarsh deposits at *c*.2m OD. In the modern tidal regime this saltmarsh would be within the daily tidal range and characterised by mudflats or lower marsh. At Hunstanton today the lowest high water; Mean High Water Neap (MHWN) is 1.85m OD and the highest high water Mean High Water Spring (MHWS) 3.65m OD (the lowest tides are MLWN -2.85m OD and MLWS-1.25m OD) (East Anglian Coastal Group 2010). The modern tide levels for Kings Lynn are MHWN 1.97m OD and MHWS 3.77m OD (the lowest tides for Kings Lynn are MLWS-1.23m OD and MHWN-2.03m OD). The estuary at Kings Lynn is highly modified, meaning that comparison to Hunstanton is perhaps more appropriate. If exposed to modern sea-levels, saltmarsh 142 would be covered by virtually all tides, implying Late Saxon sea-levels were lower than today. Such lowering of relative sea-level is in accord with the somewhat debated sea-level curve of the southern North Sea of Behre (2007) (in Simmons 2015), where Early and Middle Saxon sea-levels are still receding after the Roman sea-level rise to a low point in *c*.1000AD. Another complicating factor which might result in a relative lowering of sea-level could be the construction of a seabank such as at Clenchwarton, where a Late Saxon (11th century) sea-bank was built directly on the mudflats (Leah 1992).

Fuel

C.5.36 No pollen was found in the ash deposits of pit **83**, making it inconclusive whether peat or wood was the source of fuel. The sediment contained soil fungi suggesting time elapsed between deposits being dumped. Thin lenses of sand were found in the ash deposits, derived from weathered-in and windblown sands. The lack of massive sand layers in the upper deposits suggest the pit was covered between firings and therefore ash dumps may act as a proxy for the number of firings, possibly even the number of years the pit was used for, as salt-making was seasonal.

Origin of clay lining the filtration tanks.

C.5.37 The results were rather inconclusive. No diatoms were recovered but the presence of marine foraminifera may suggest the clay was collected from the foreshore. However, such low proportions of foraminifera may be from the saline waters collected the tanks rather than the clay.

Further work

C.5.38 The pollen was sparse and no further work is recommended on the samples from Saltern 1 or 2.

C.5.39 No identifiable diatoms were found, therefore no further work is recommended.

C.5.40 Foraminifera were incidentally observed in many samples and may provide an additional paleoenvironmental tool for deposits where the identification of a marine signal is required.

C.5.41 Soil micromorphology of deposit 'soil' 144 is recommended. If this deposit however proves be an alluvial deposit a radiocarbon date would be valuable.

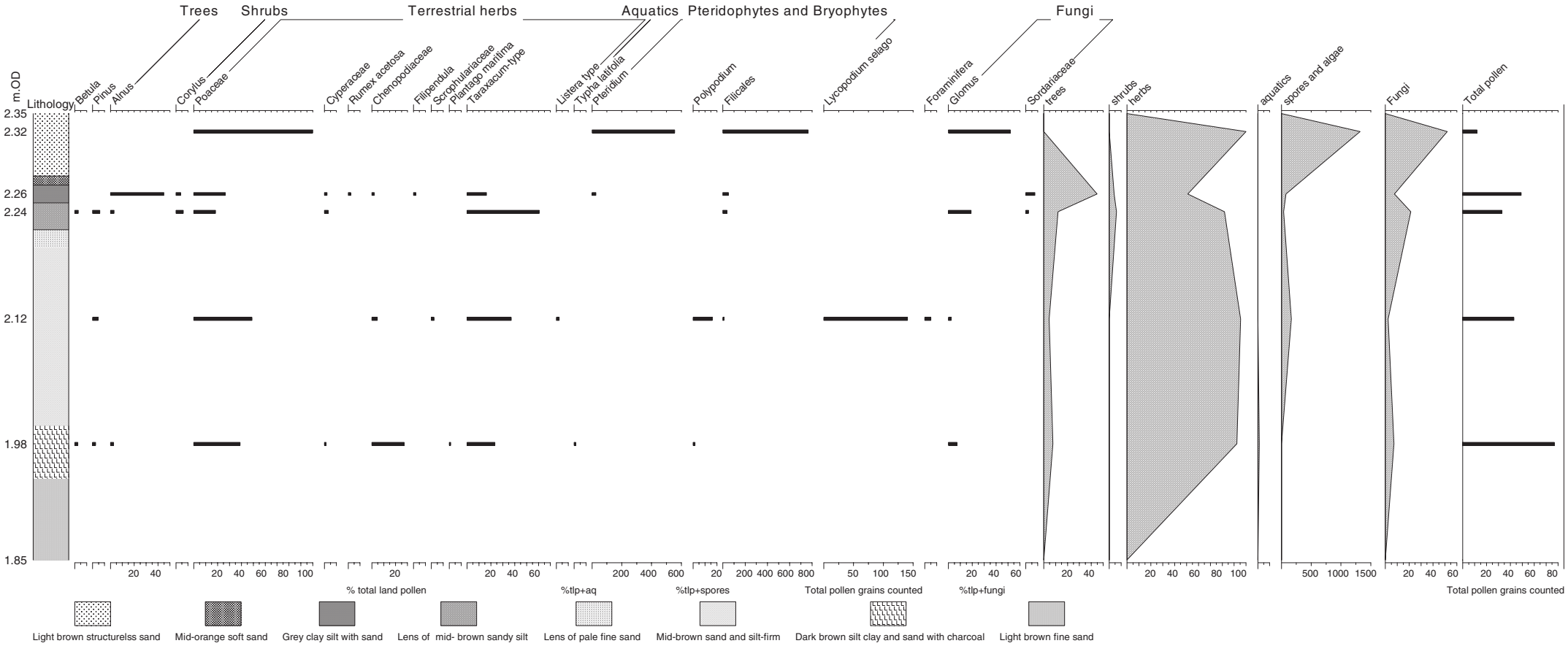
C.5.42 Dating of the bottom and top of the lower saltmarsh deposit 142 would date both the inception of the upper saltmarsh and lowering of relative sea-level, and also date the inception of Saltern 2.

C.5.43 Combine with pollen results (Boreham 2016) and diatom results (Hiller 2016) from the excavation of a saltern by OA East at Marsh Lane (750m to the north east).

Acknowledgements

C.5.44 The author would like to thank Frank Davies and Alison Davies of the Department of Geography, University of Durham for the pollen preparations.

Fig. C.5.1 Pollen percentage data from monolith 98, Section 75



C.6 Radiocarbon dating certificates

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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

05 October 2017

Laboratory Code	SUERC-75156 (GU45028)
Submitter	Zoe Ui Choileain Oxford Archaeology East 15 Trafalgar Way Bar Hill Cambridgeshire CB23 8SQ
Site Reference	ENF141949
Context Reference	85
Sample Reference	70
Material	CPR : Rhizome/tuber fragment
$\delta^{13}C$ relative to VPDB	-26.4 ‰
Radiocarbon Age BP	1191 ± 31

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.

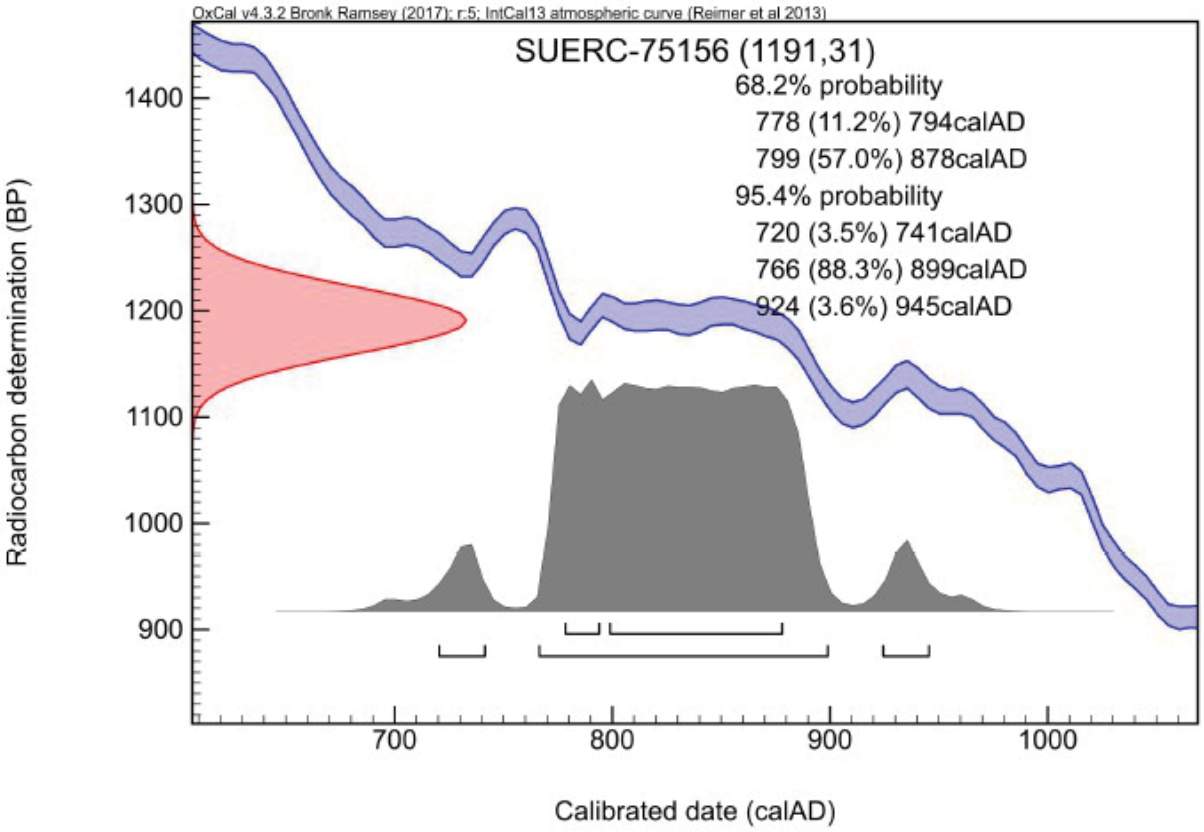
Samples with a SUERC coding are measured at the Scottish Universities Environmental Research Centre AMS Facility and should be quoted as such in any reports within the scientific literature. The laboratory GU coding should also be given in parentheses after the SUERC code.

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 Taylor

Checked and signed off by : E. Dunbar



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

05 October 2017

Laboratory Code	SUERC-75157 (GU45029)
Submitter	Zoe Ui Choileain Oxford Archaeology East 15 Trafalgar Way Bar Hill Cambridgeshire CB23 8SQ
Site Reference	ENF141949
Context Reference	118
Sample Reference	90
Material	charcoal : Maloideae
$\delta^{13}C$ relative to VPDB	-26.6 ‰
Radiocarbon Age BP	1239 ± 31

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.

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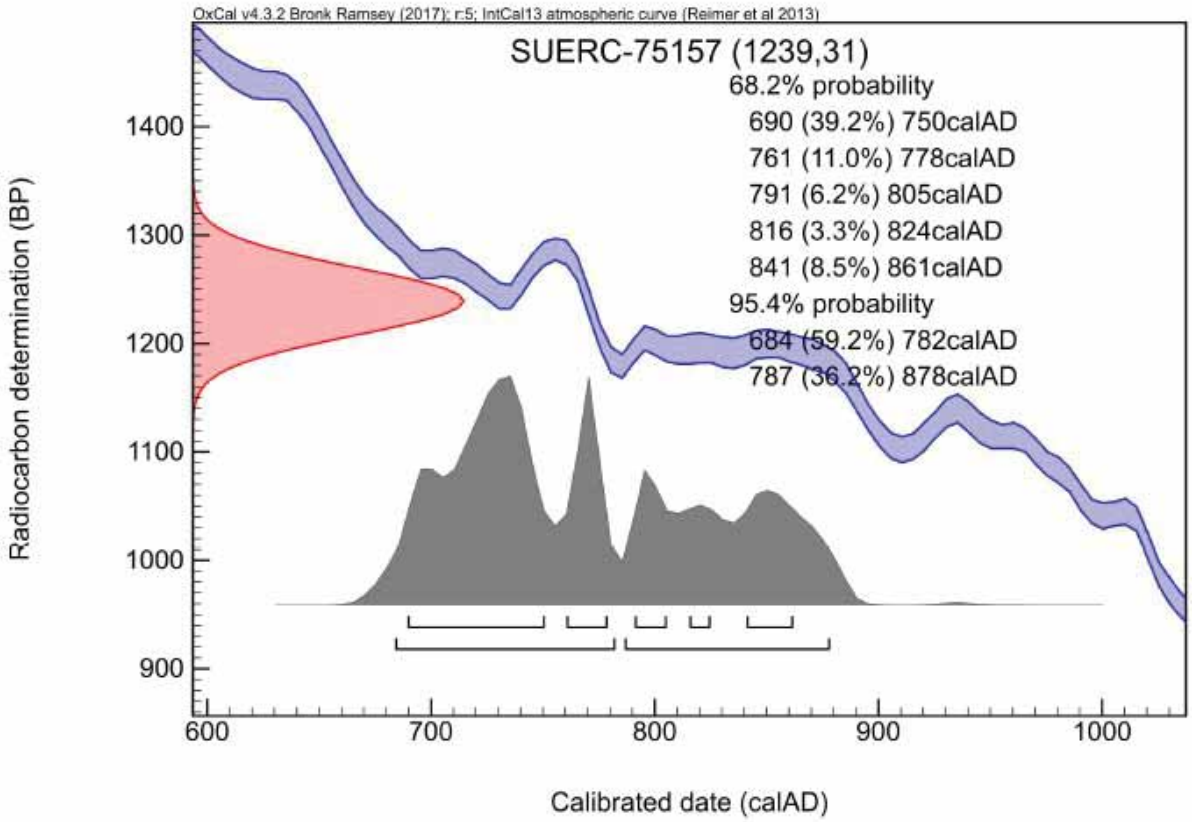
For any queries relating to this certificate, the laboratory can be contacted at suerc-c14lab@glasgow.ac.uk.

Conventional age and calibration age ranges calculated by :

Checked and signed off by : E Dunbar



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.

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† Reimer et al. (2013) *Radiocarbon 55(4) pp.1869-87*

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RADIOCARBON DATING CERTIFICATE
05 October 2017

Laboratory Code	SUERC-75161 (GU45030)
Submitter	Zoe Ui Choileain Oxford Archaeology East 15 Trafalgar Way Bar Hill Cambridgeshire CB23 8SQ
Site Reference	ENF141949
Context Reference	89
Sample Reference	66
Material	charcoal : Salix sp/Populus sp
$\delta^{13}C$ relative to VPDB	-25.6 ‰
Radiocarbon Age BP	1136 ± 31

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.

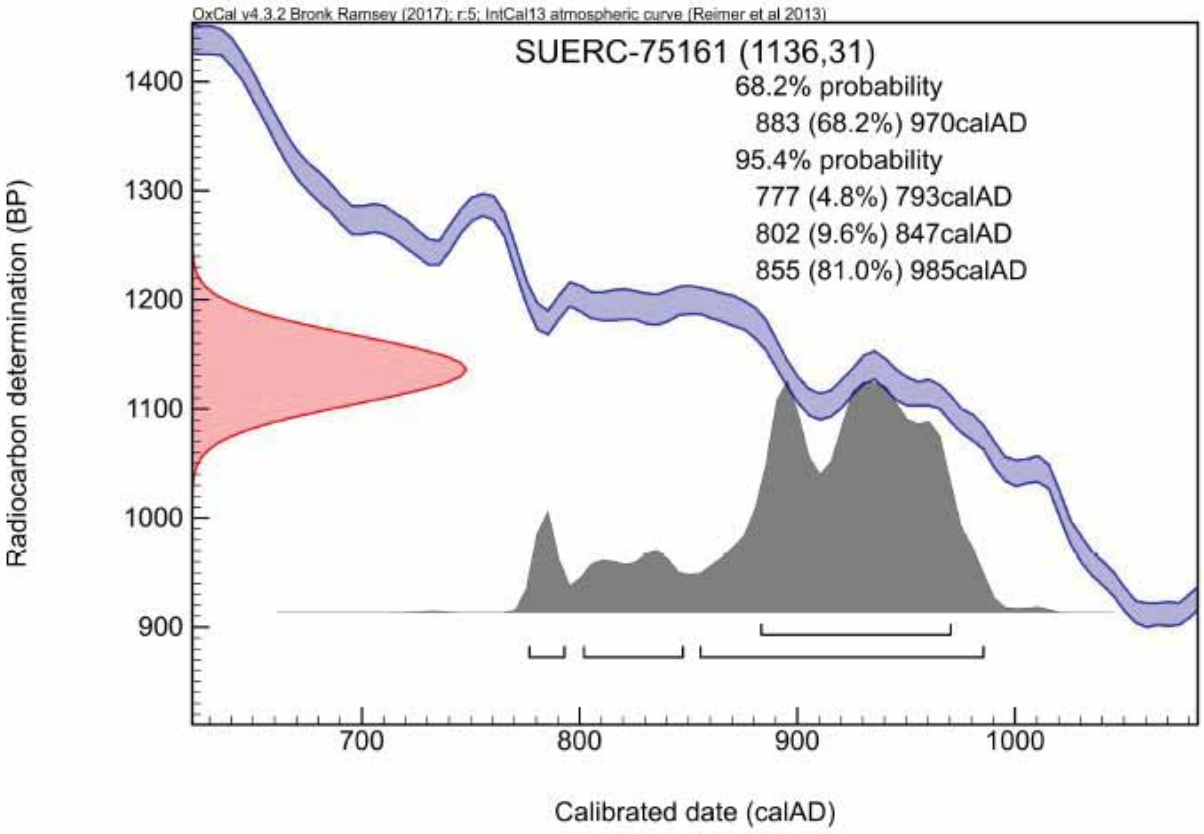
Samples with a SUERC coding are measured at the Scottish Universities Environmental Research Centre AMS Facility and should be quoted as such in any reports within the scientific literature. The laboratory GU coding should also be given in parentheses after the SUERC code.

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 Taylor

Checked and signed off by : E. Dunbar



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
05 October 2017

Laboratory Code	SUERC-75162 (GU45031)
Submitter	Zoe Ui Choileain Oxford Archaeology East 15 Trafalgar Way Bar Hill Cambridgeshire CB23 8SQ
Site Reference	ENF141949
Context Reference	91
Sample Reference	83
Material	charcoal : Corylus avellana
$\delta^{13}C$ relative to VPDB	-25.6 ‰
Radiocarbon Age BP	1166 ± 31

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.

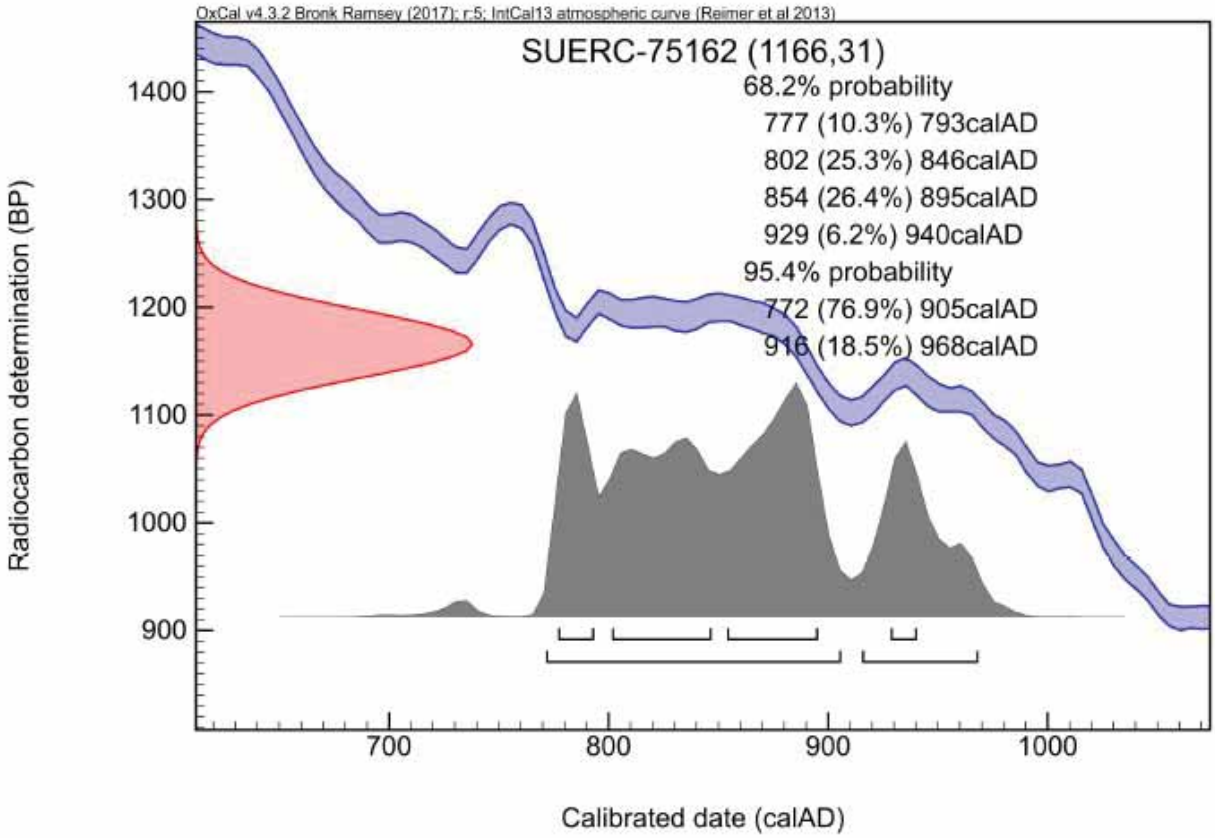
Samples with a SUERC coding are measured at the Scottish Universities Environmental Research Centre AMS Facility and should be quoted as such in any reports within the scientific literature. The laboratory GU coding should also be given in parentheses after the SUERC code.

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 Tripney

Checked and signed off by : E Dunbar



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 D. Product Description

Product number: 1

Product title: Full archive report
Purpose of the Product: To analyse the site and address the research aims and objectives stated in this report and to disseminate to the local community
Composition: Grey literature archive report deposited at Norfolk HER and ADS/OA online library
Derived from: Analysis of site records, specialist reports and data and background research
Format and Presentation: Grey literature client report
Allocated to: GC, MB
Quality criteria and method: Checked and edited by RC MB
Person responsible for quality assurance: MB
Person responsible for approval: MB
Planned completion date: 2018

Product number: 2

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: Article in serial journal
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) 2019

Appendix E. Risk Log

Risk Number: 1
Description: Specialists unable to deliver analysis report due to over running work programmes/ ill health/other problems
Probability: Medium
Impact: Variable
Countermeasures: OA has access to a large pool of specialist knowledge (internal and external) which can be used if necessary.
Estimated time/cost: Variable
Owner: SP FG RF SA HF
Date entry last updated: May 2017

Risk Number: 2
Description:non-delivery of full report due to field work pressures/ management pressure on Co-authors
Probability: Medium
Impact: Medium - High
Countermeasures: Liaise with OA Management team
Estimated time/cost: Variable
Owner: GC MB
Date entry last updated: May 2017

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Appendix G. OASIS Report Form

All fields are required unless they are not applicable.

Project Details

OASIS Number	oxfordar3-285004		
Project Name	Lynnsport 4 & 5: Middle to Late Saxon Salterns on Land Adjacent to Greenpark Avenue, King's Lynn, Norfolk. PXA and Updated Project Design		
Project Dates (fieldwork) Start	27-02-2017	Finish	04-05-2017
Previous Work (by OA East)	Yes	Future Work	Yes

Project Reference Codes

Site Code	XNFGAL17	Planning App. No.	16/01327/FM
HER No.	ENF141949	Related HER/OASIS No.	ENF139746

Type of Project/Techniques Used

Prompt: Direction from Local Planning Authority - PPS 5

Please select all techniques used:

☐ 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 Types/Significant Finds & Their Periods

List feature types using the NMR Monument Type Thesaurus and significant finds using the MDA Object type Thesaurus together with their respective periods. If no features/finds were found, please state "none".

Monument	Period	Object	Period
saltern	Medieval 1066 to 1540	fired clay	Medieval 1066 to 1540
hayrick	Post Medieval 1540 to 1901	slag	Medieval 1066 to 1540
orchard	Modern 1901 to Present	ceramic tobacco pipe	Post Medieval 1540 to 1901

Project Location

County	Norfolk	Site Address (including postcode if possible)	
District	Kings Lynn & West Norfolk	Land adjacent to Greenpark Avenue, King's Lynn, Norfolk, PE20 2NE	
Parish	King's Lynn		
HER	Norfolk		
Study Area	2.79ha	National Grid Reference	TF 62897 20966

Project Originators

Organisation	OA EAST
Project Brief Originator	James Albone (NCC/HES)
Project Design Originator	Dr Matthew Brudenell (OA East)
Project Manager	Dr Matthew Brudenell (OA East)
Supervisor	Graeme Clarke (OA East)

Project Archives

Physical Archive	Digital Archive	Paper Archive
Norfolk Museum and Arch. Service	OA East	Norfolk Museum and Arch. Service
ENF141949	ENF141949	ENF141949

Archive Contents/Media

	Physical Contents	Digital Contents	Paper Contents
Animal Bones	☒	☒	☒
Ceramics	☒	☒	☒
Environmental	☒	☒	☒
Glass	☐	☐	☐
Human Bones	☐	☐	☐
Industrial	☒	☒	☒
Leather	☐	☐	☐
Metal	☒	☒	☒
Stratigraphic		☐	☒
Survey		☒	☒
Textiles	☐	☐	☐
Wood	☐	☐	☐
Worked Bone	☐	☐	☐
Worked Stone/Lithic	☐	☐	☐
None	☐	☐	☐
Other	☐	☐	☐

Digital Media	Paper Media
☒ Database	☐ Aerial Photos
☒ GIS	☒ Context Sheet
☐ Geophysics	☐ Correspondence
☒ Images	☐ Diary
☒ Illustrations	☐ Drawing
☐ Moving Image	☐ Manuscript
☐ Spreadsheets	☐ Map
☒ Survey	☒ Matrices
☒ Text	☐ Microfilm
☐ Virtual Reality	☒ Misc.
	☒ Research/Notes
	☒ Photos
	☒ Plans
	☒ Report
	☒ Sections
	☒ Survey

Notes:

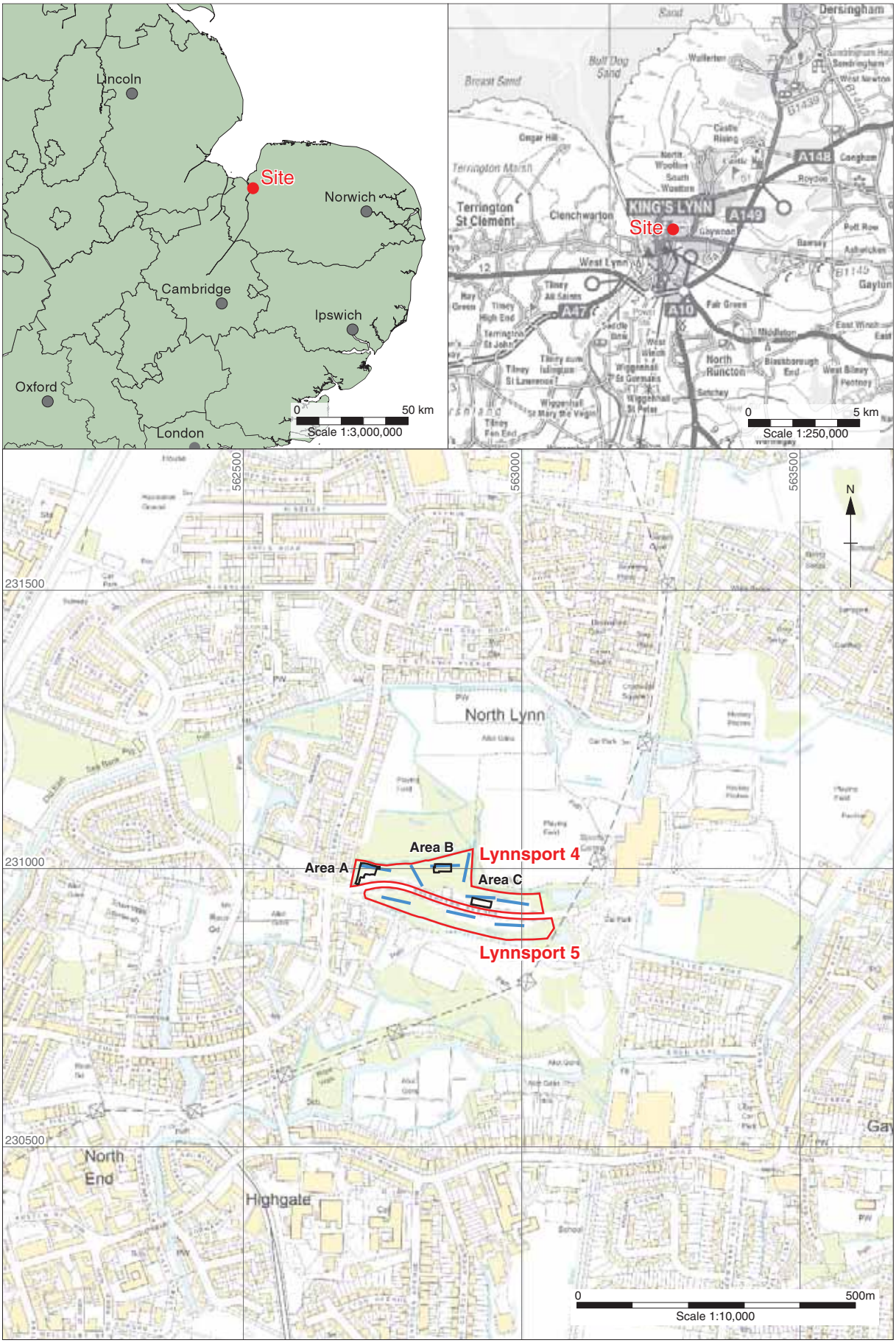


Figure 1: Site location showing excavation areas (black) overlying evaluation trenches (blue) in development areas outlined (red)

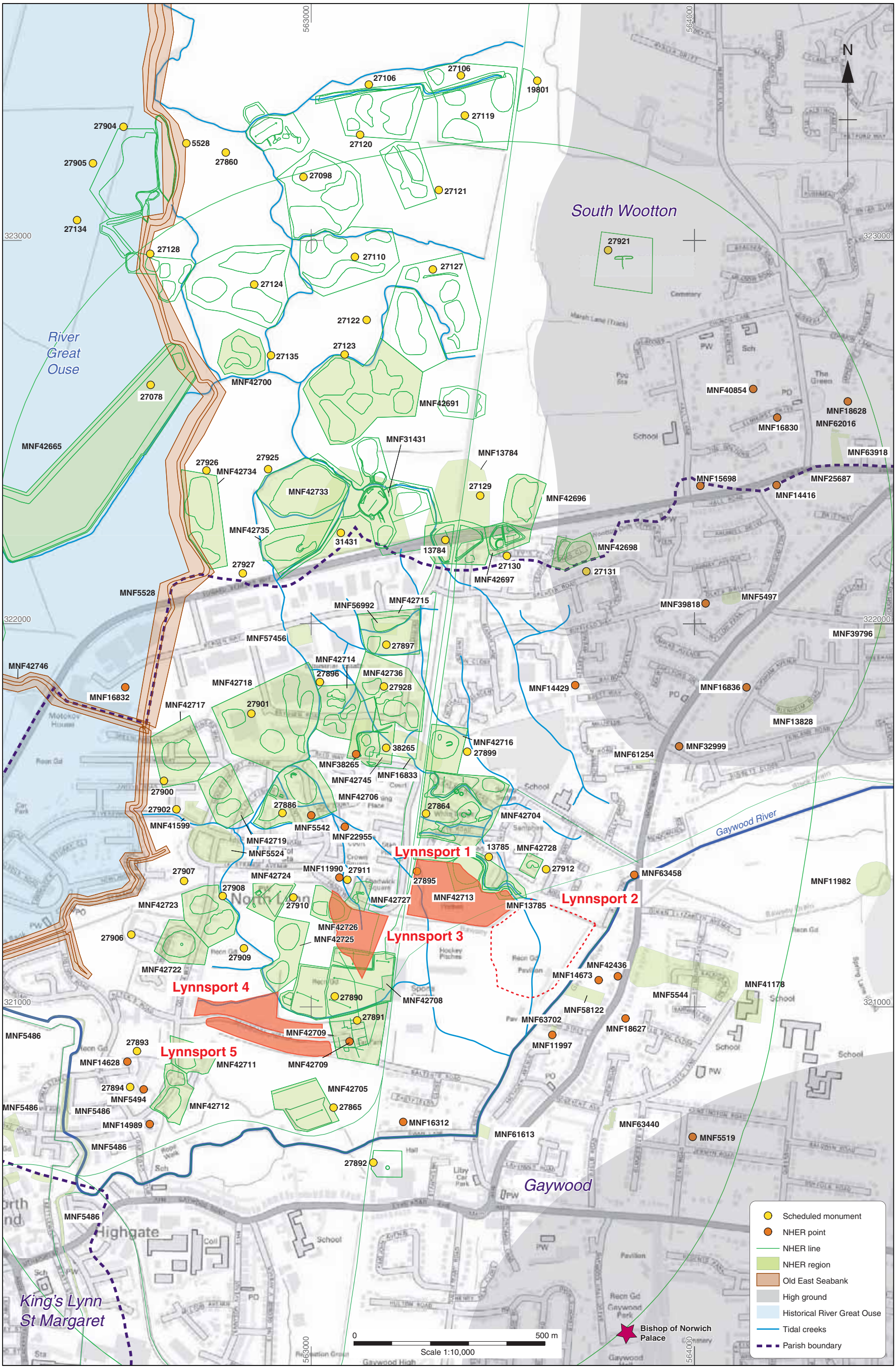


Figure 1: Map showing location of NHER records with NMP data, sea banks & pre-existing tidal creeks mapped from historic photograph (NHER reference: TF62_TF6321_A_RAF_16Apr1946.tif). Lynnsport development areas showin in red outline.

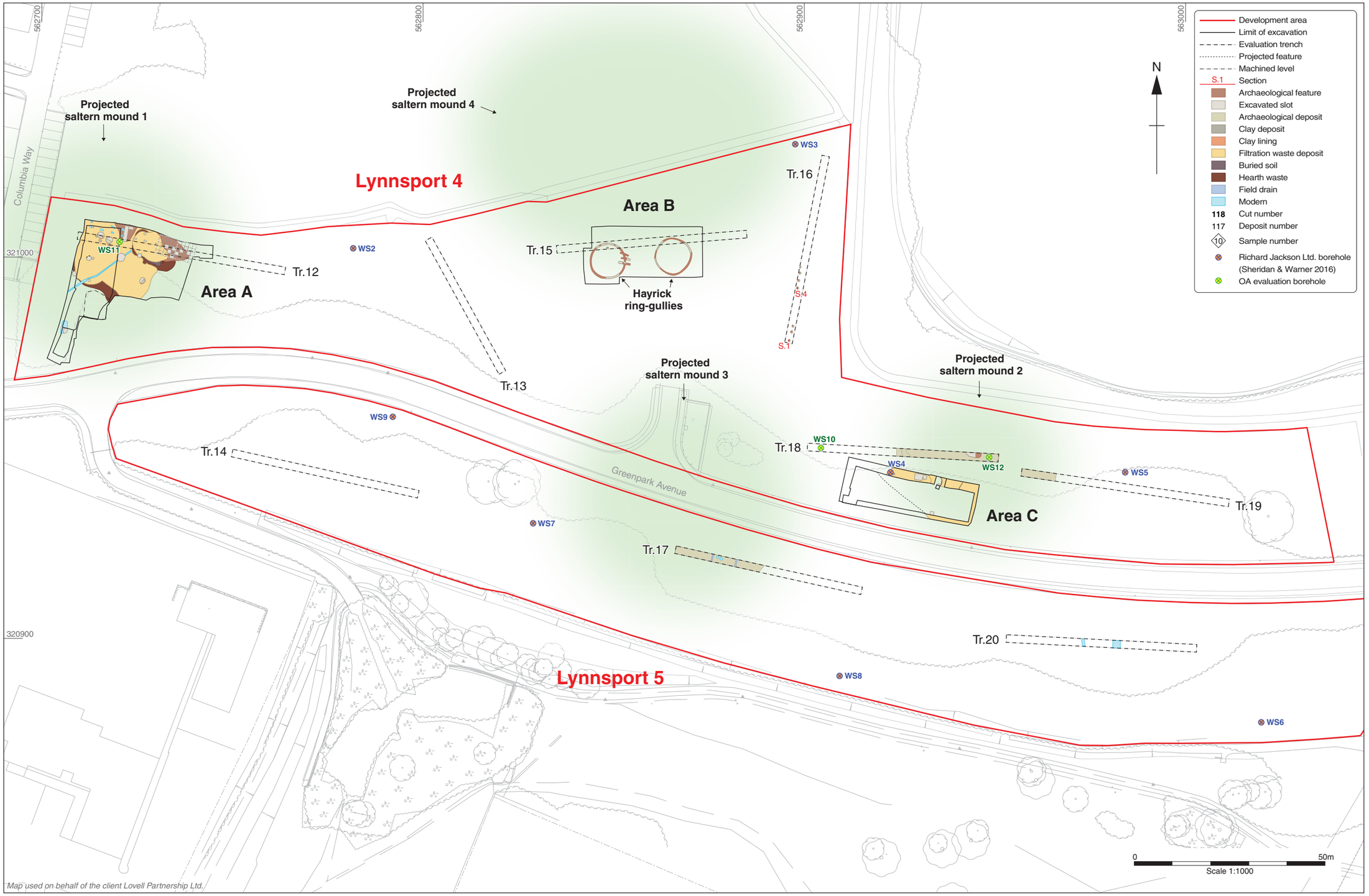


Figure 3: Site layout plan

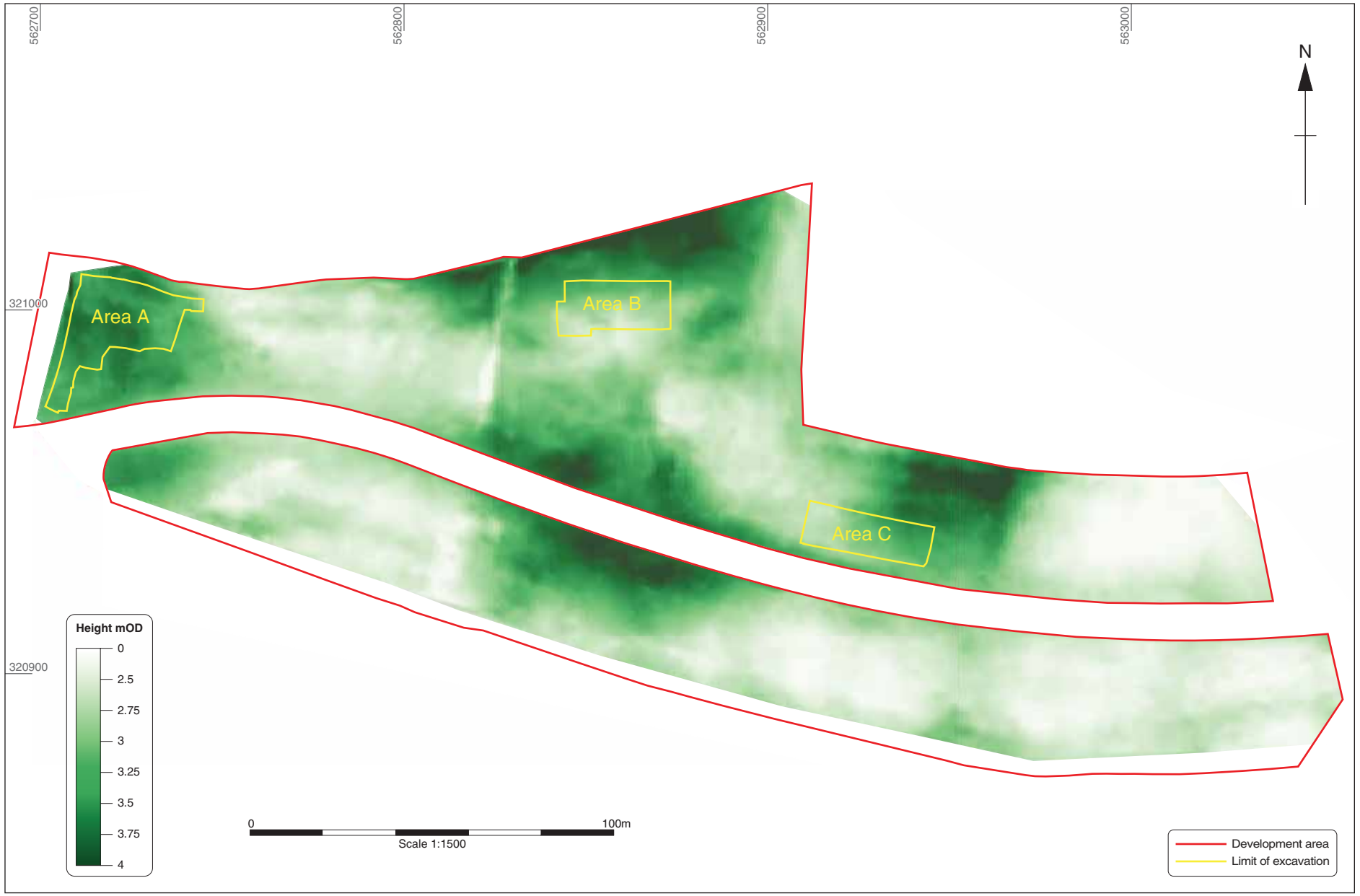


Figure 4: Topographical model of the site

Figure 5: Area A layout plan

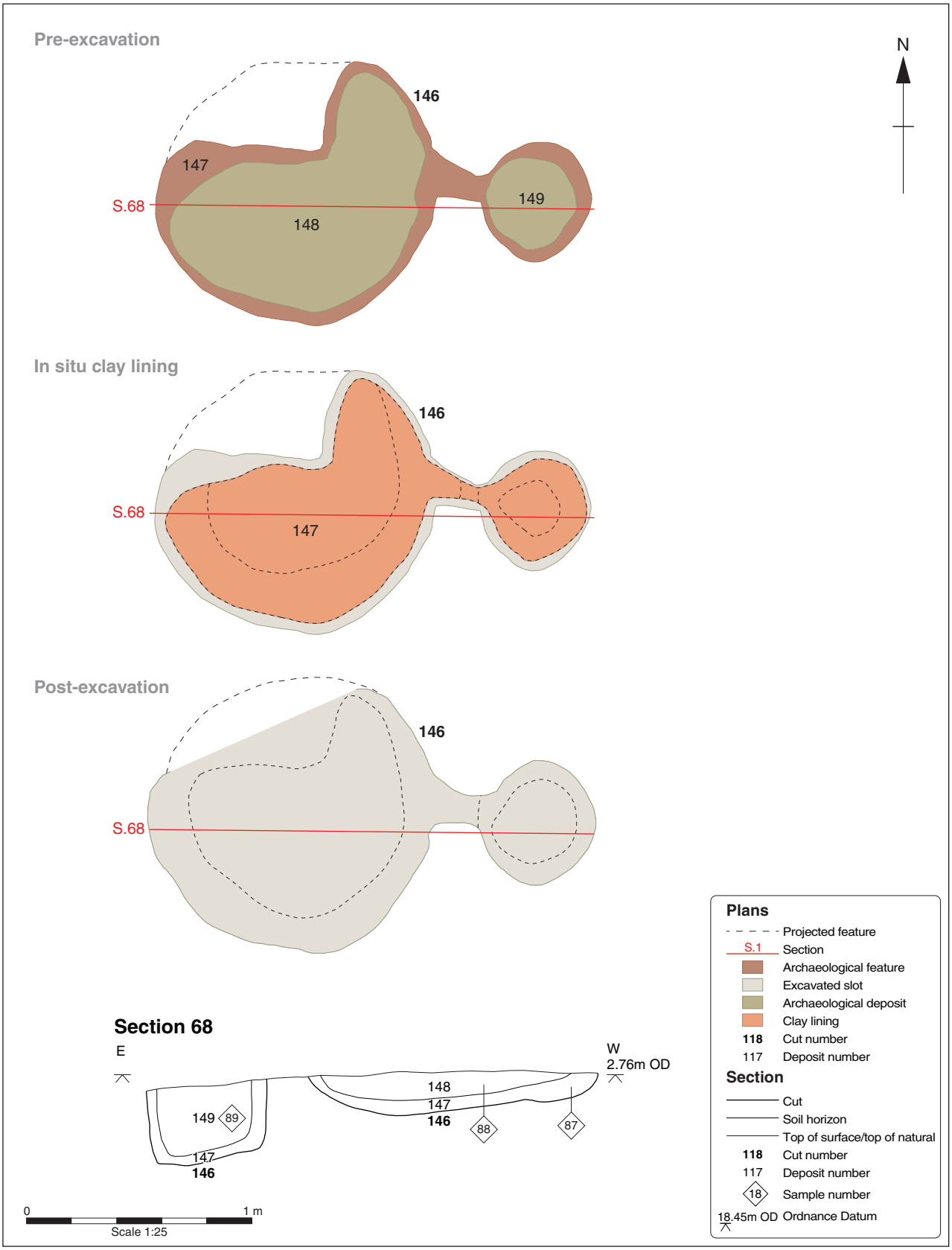


Figure 6: Plan of Period 2 silt filtration unit **146**

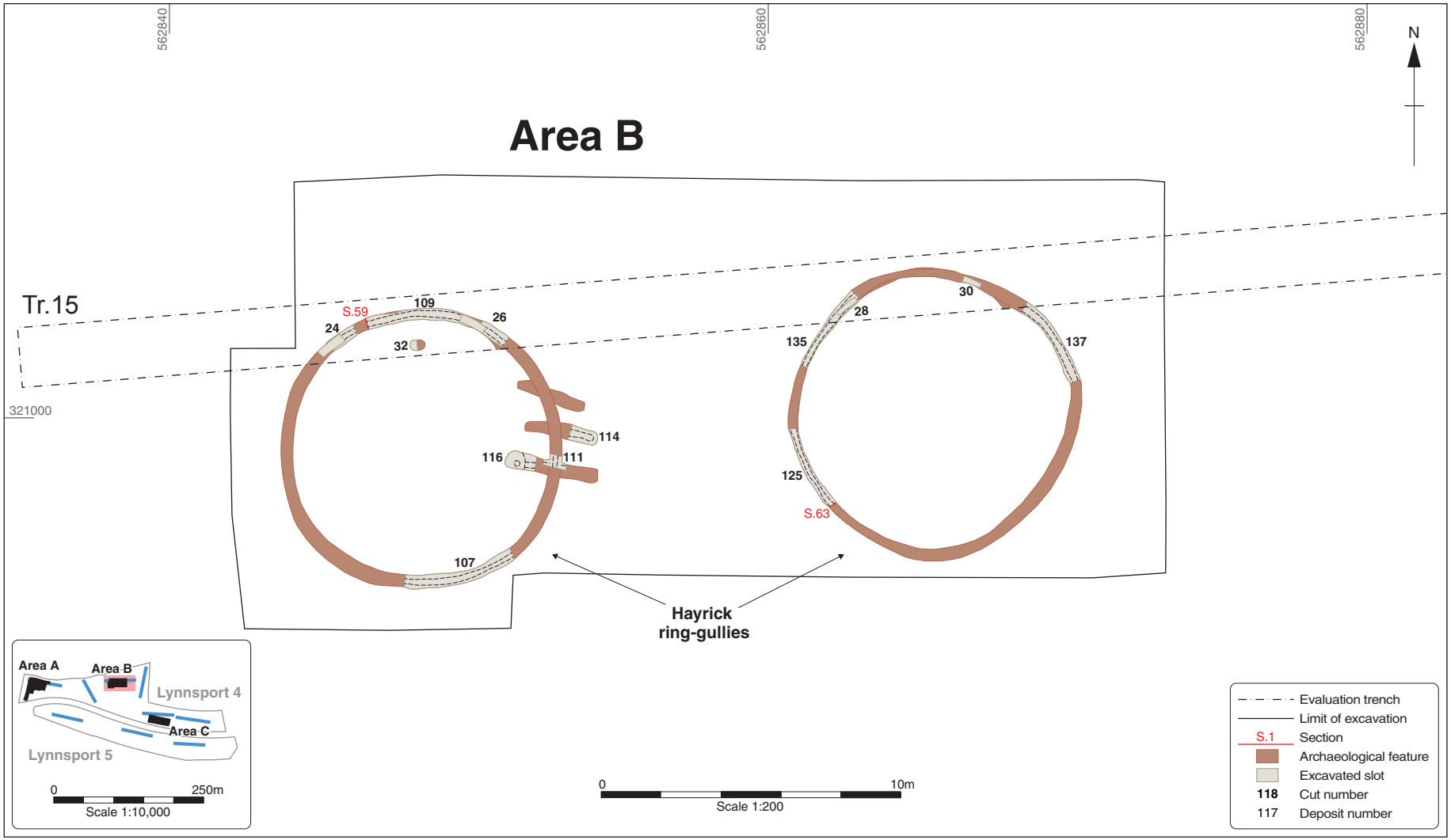


Figure 7: Area B layout plan

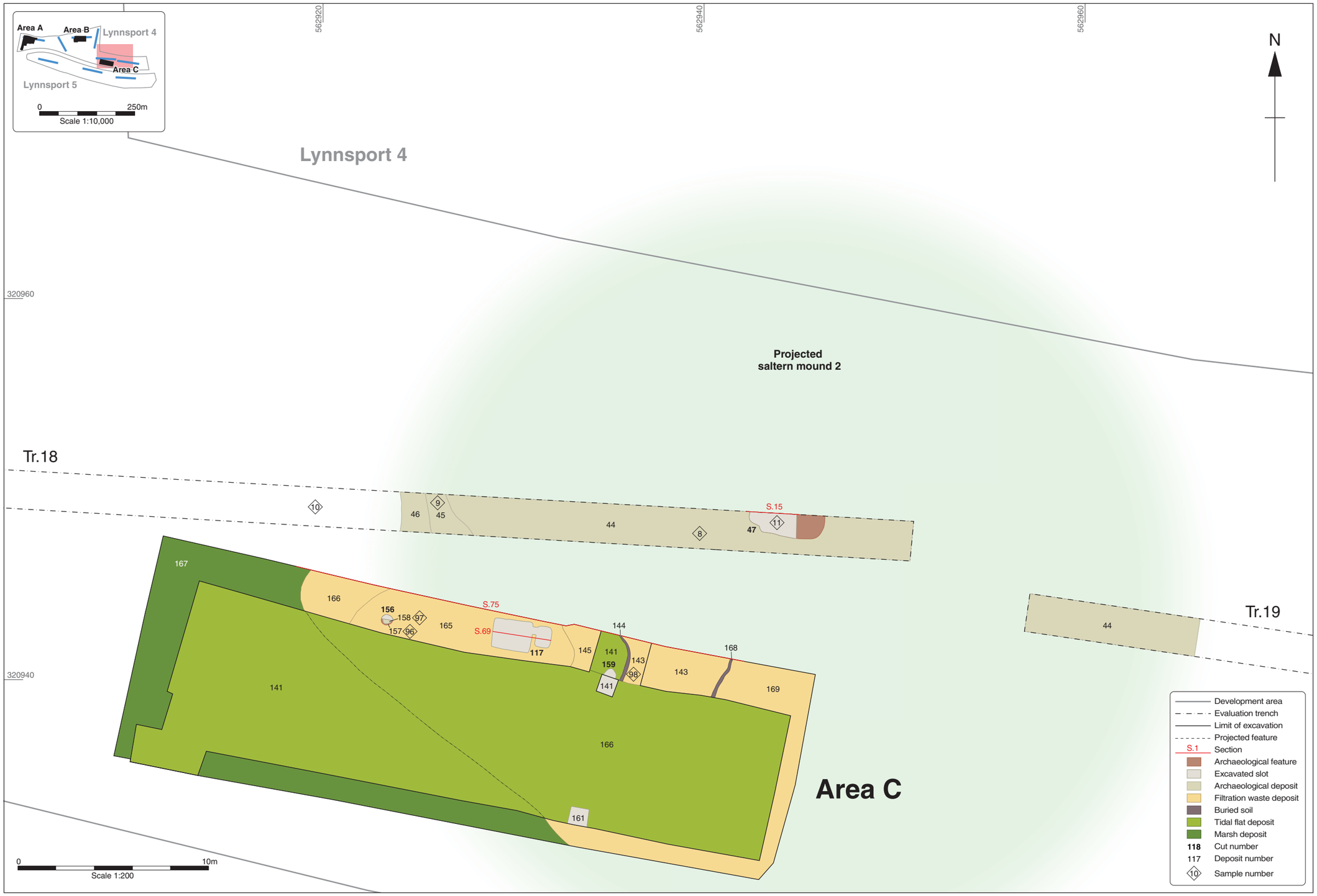


Figure 8: Area C layout plan

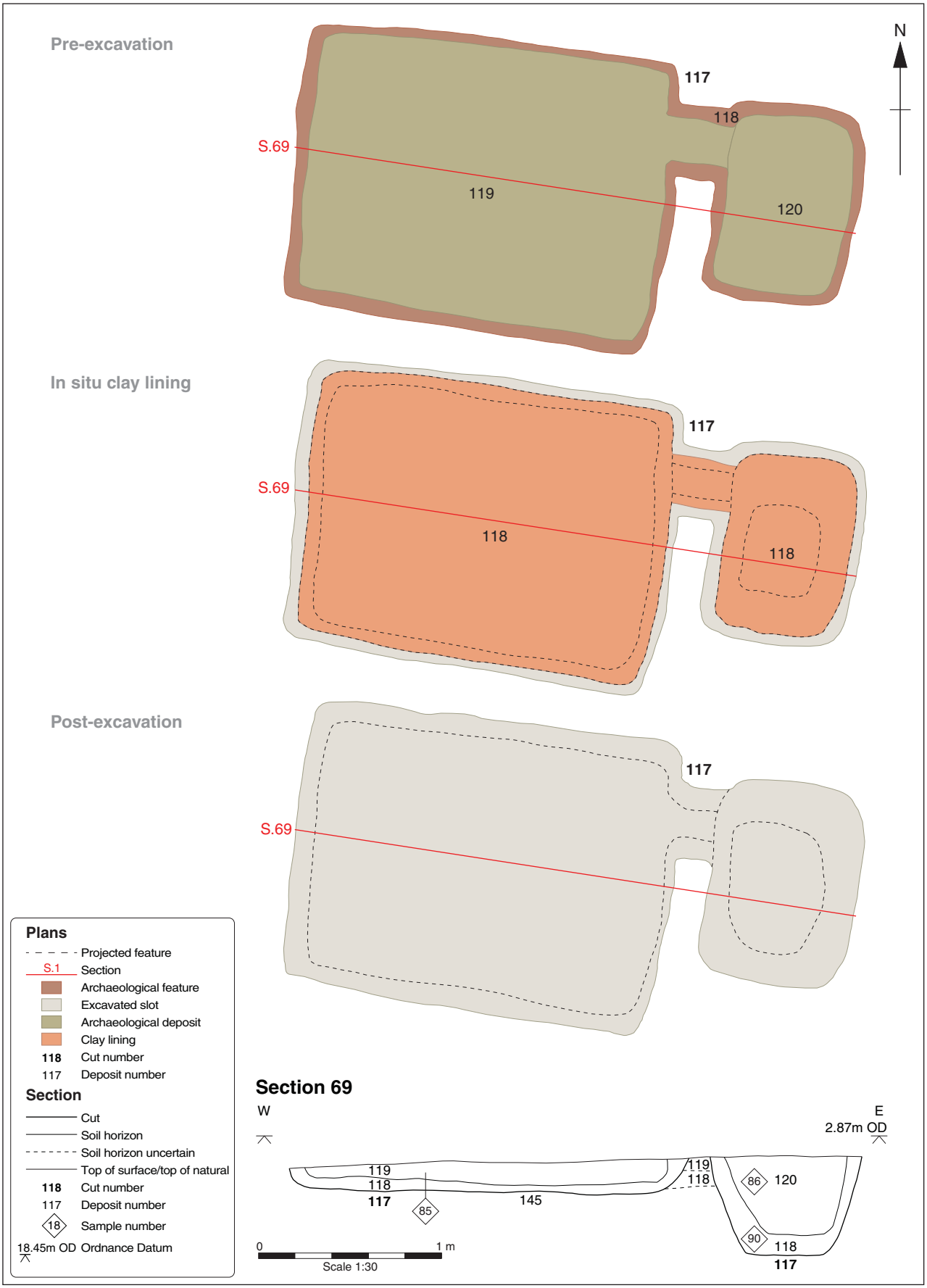
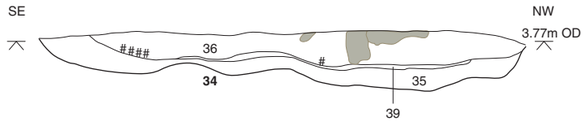


Figure 9: Plan of Period 2 silt filtration unit **117**

AREA A

Section 14



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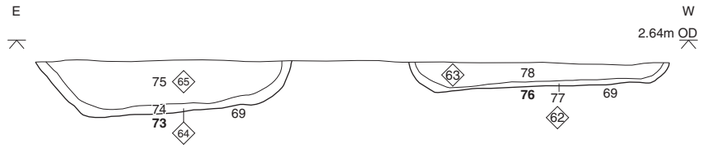

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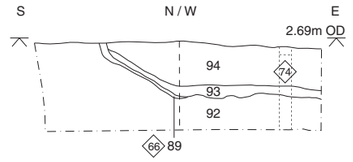

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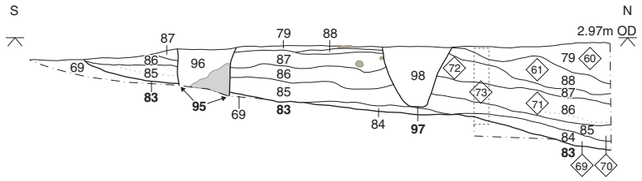

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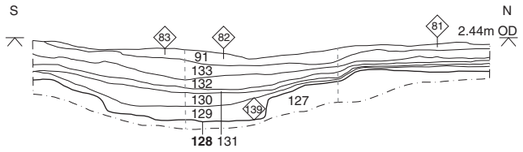

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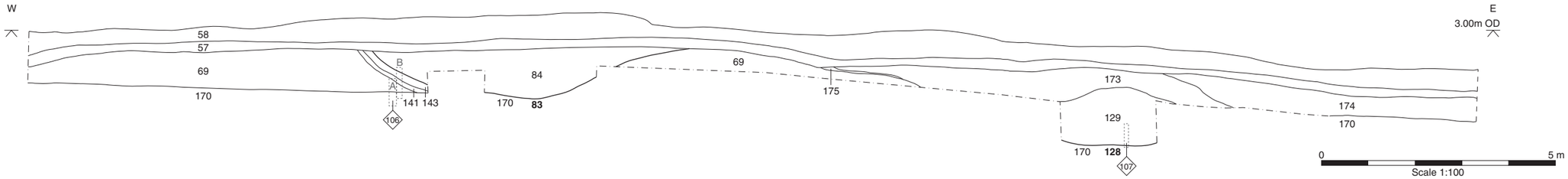

AREA B

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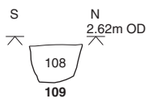

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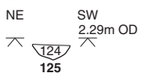

AREA C

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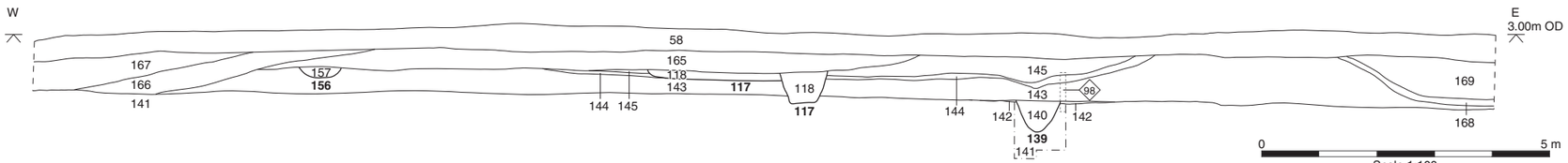

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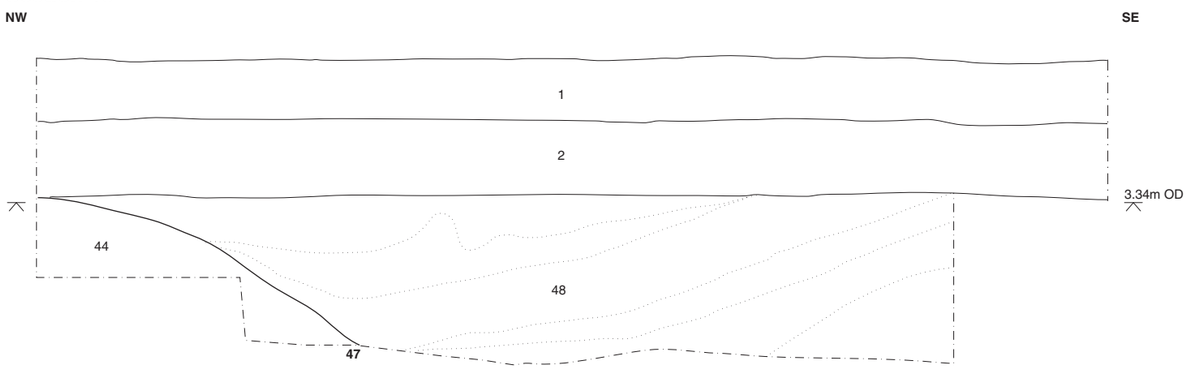

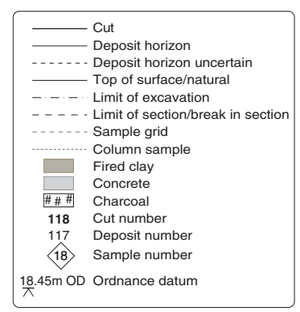

Figure 10: Selected sections

Plate 1: Area A, looking west

Plate 2: Area B, looking west

Plate 3: Area C, looking west

Plate 4: Saltern 1 filtration unit **146**, looking south

Plate 5: Saltern 1 hearth **34**, looking south-west

Plate 6: Saltern 1 hearth rake-out pit **83**, looking west

Plate 7: Saltern 1 hearth rake-out pit **128**, looking west

Plate 8: Saltern 1 tank **76**, looking south

Plate 9: Saltern 1 tanks **73**, **76** & **80**, looking south

Plate 10: Saltern 2 filtration unit **117**, looking south

Plate 11: Saltern 2 pit **47**, looking north

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