# A Late Saxon to Medieval Saltern at Marsh Lane King's Lynn, Norfolk

## Excavation Report

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Excavation Report

# A Late Saxon to Medieval Saltern at Marsh Lane, King's Lynn, Norfolk

*Archaeological Excavation*

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| | |
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## Summary

*Between the 26th May and 28th of July 2015, Oxford Archaeology East conducted an archaeological evaluation and excavation on land at Marsh Lane, King's Lynn, Norfolk (TF 6331 2163). A medieval saltern mound (NHER 27899) was believed from cartographic evidence to be located in the western part of the site.*

*This report includes the results of the initial phase of evaluation, comprising twelve trenches and test pits, and the subsequent strip & map excavation. The trenches in the western part of the site revealed archaeological remains associated with salt-making during the medieval period. These included elements of four enclosed hearths for brine boiling, comprising hearth floors, flues and superstructures. Two of these hearths were found to truncate clay-lined pits which probably represented silt filtration units from an earlier phase of brine production. Layers of burnt deposits representing hearth waste tips were also present, containing fragments of baked clay and slag. The trenches in the eastern part of the site were devoid of archaeology.*

*A programme of further excavation was required to investigate the saltern mound deposits in the area to be impacted at depth by the proposed development. Further archaeological features were uncovered, including silt filtration units and evidence for less substantial open hearths associated with salt-making. These features and deposits yielded some burnt Thetford-type ware pottery fragments indicating a Late Saxon date for the earlier salt-making activity revealed within the mound. This early date was reiterated by a series of radiocarbon dates that indicate that salt-making was carried out here from the Late Saxon to the medieval period (c.8th to 13th centuries AD). Analysis of the pottery assemblage suggests that activity on the site had probably ceased by the mid-13th century.*

*The saltern at Marsh Lane is one of many mapped by the NMP in the vicinity of King's Lynn and confirms the interpretation given to these sites. Despite the numerous medieval saltern sites identified few have been fully excavated or produced significant artefactual evidence. This excavation has recorded an important example of a medieval salt-making site on The Wash in Norfolk with origins in the Late Saxon period. The remains, and associated features on the site, are evidence for salt-making, evolving from the c.8th century in the Late Saxon period through to the early medieval period with salt-making demonstrated to have ceased by the mid-13th century. The archaeological remains uncovered will contribute significantly to the understanding of the evolution of the salt-making industry of King's Lynn during these periods and the environmental setting in which this industry was situated.*

# 1 Introduction

## 1.1 Location and scope of work

1.1.1 Between the 26th May and 28th of July 2015, Oxford Archaeology East (OA East) conducted an archaeological evaluation and excavations on the site of a known saltern (NHER 27899) on land at Marsh Lane, King's Lynn, Norfolk (TF 6331 2163; Fig. 1). The project was commissioned by Lovell Partnerships Limited in respect of a proposed residential development on the site (planning application 15/00828/FM).

1.1.2 An initial phase of archaeological 'strip & map' excavation across the development area was conducted in conjunction with evaluation trenching to determine the extent of any saltern mound deposits encountered. This phase of work formed the basis for further archaeological investigations into the saltern mound deposits. These works were undertaken in accordance with a Written Scheme of Investigation (Brudenell 2015a) prepared by OA East and approved by James Albone of Norfolk County Council Historic Environment Service (NCC/HES).

1.1.3 A Revised Written Scheme of Investigation (Brudenell 2015b) was prepared by OA East (and approved by NCC/HES) detailing the further programme of excavation required in the western part of the site to mitigate the impact of the proposed development on the medieval saltern mound (NHER 27899) revealed by the initial phase of excavation.

1.1.4 The site archive is currently held by OA East and will be deposited with the appropriate county stores in due course.

## 1.2 Geology and topography

1.2.1 The site is located within the urban reach of King's Lynn, c. 2.2km east of the River Great Ouse, on the eastern edge of the fen-basin. It falls within a wider plot of overgrown scrubland immediately north of Marsh Lane, which is surrounded by residential and commercial developments on all sides. The 1.5ha site is situated to the west of a deep, approximately north to south running drain that divides the wider scrubland plot in two. It is bounded by Marsh Lane to the south, while residential properties lie to the north and west (Fig. 1).

1.2.2 The underlying geology of the site comprises Jurassic Kimmeridge Clay Formation mudstone overlain by a series of intercalated Flandrian clays, silts and peat horizons which fill the wider fen-basin, and reflect a complex history of marine and freshwater inundation over the course of the Holocene (Waller 1994, 10-17). A simple four-fold stratigraphic division of Flandrian deposits is often used (Waller 1994, 13). The latter comprise marine silts of the sequence commonly known as the *Terrington Beds* (or Upper Silts), and result from a transgression which caused marine and brackish water silt and fine-grained sand to be deposited, giving rise to extensive mud flat and salt-marsh environments. These overly peat deposits, the *Nordelph Peat* (or Upper Peat), which in turn overlie the *Barroway Drove Beds* (or Fen Clay). This shares a similar lithology to the Terrington Beds, and comprises soft grey clays and silty clays which were deposited in salt marshes and shallow water brackish lagoons. At the base of the sequence is *Lower Peat* which formed on the pre-Flandrian land surface.

1.2.3 Ground investigation data from approximately 300m to the south-east of the site (three cable percussive boreholes to c. 15m below ground surface; and 12 window sample boreholes, ten to c. 3-4m below ground surface and two to c. 8.5-9m below ground level) revealed parts of the Flandian sequence with the upper surface of the Nordelph Peat recorded at depths of 1.25-4m below ground surface (Grey 2015). This peat was up to 2m thick in the western half of the of site, but was absent from boreholes at the far eastern edge of the site. There was no indication of a Lower Peat in the boreholes.

1.2.4 An archaeological evaluation was also carried out at the same location to the south-east of the site by Oxford Archaeology in 2015 (Webster 2015a). Two peat horizons were recorded immediately below the upper silts, representing the Terrington Beds, the lower of which was radiocarbon dated to the Early Iron Age (786 – 537 cal. BC 95.4% SUERC-61520 GU38211). At the far eastern side of the site the marine silts abutted sands and gravels representing a prehistoric raised beach shoreline which seems to mark the transition to higher ground further to the east.

1.2.5 The site is situated on a flat area of ground at approximately 4m OD (above Ordnance Datum).

## 1.3 Archaeological and historical background

1.3.1 A Desk-Based Assessment by Mott MacDonald for Lovell Partnerships Ltd (Adams 2014) details the archaeological potential of the site and should be referred to for the full background. The following is a summary of the assessment produced for the Written Scheme of Investigation (Brudenell 2015a). A map of the Norfolk Historic Environment Records (NHER) described in the summary is shown on Figure 2. Additional detail providing the regional context for medieval salt-working is also provided in section 1.3.10.

***Prehistoric (c.4000 BC – AD 43)***

1.3.2 Very few prehistoric finds have been recorded within the vicinity of the site, which was subject to episodes of marine sedimentation from the Neolithic, and subsequently freshwater inundation during the Iron Age leading to peat formation. For much of the prehistoric period, however, the site would have been location close to the boundary between marine and freshwater, and was most likely a saltmarsh environment unsuitable for habitation. The area to the east of the site may have been drier and as such this is from where most of the finds derive. A Neolithic axehead was found during ploughing in the vicinity of Marsh Lane (NHER 5491) and Neolithic to Bronze Age flints and pottery have been found 0.5km to the north-east of the site (NHER 35624 and 16836). There is a possible burnt-mound 0.8km to the east of Marsh Lane (NHER 11982), although evidence for this consists of only a collection of burnt flints. The absence of Iron Age finds from the area suggests that it was inundated during this period.

***Roman (c.AD 43 - 410)***

1.3.3 The almost complete absence of Roman finds from the immediate environs of the site suggests that it was still too wet for permanent settlement during this period. The exceptions to this are three coins and a piece of metalwork (NHER 5519; 11990; 11997 and 14628), although even these may represent casual loss. Salterns are characteristic of the fen-edge during this period and these and other signs of Roman industry, such as pottery kilns, are to be found in the wider landscape.

***Saxon & medieval (c.AD 410 - 1500)***

1.3.4 The earliest post-Roman finds from the environs of the site are fragments of a Saxon spearhead from 0.5km to the south-east (NHER 14673). A medieval pottery scatter is recorded to the west (NHER 16833) and it is noted in the Norfolk HER that briquetage was found beneath this at an unspecified location. The scatter partially overlaps with the rounded earthwork of a saltern mound recorded by aerial photography in 1945 in the western part of the site (NHER 27899). A complex of saltern features is also recorded to the south of Marsh Lane (NHER 27864), and is likely to represent the traces of tanks, ponds and other auxiliary fixtures associated with the salt-making industry.

***Post-medieval & modern (c.AD 1500 - present)***

1.3.5 The salt-making industry declined during the post-medieval period, however, several of the saltern mounds were put to other uses during this time, often associated with the siege of King's Lynn during the Civil War. One of these (NHER 13784), 0.4km to the north, was used as a fort during the Civil War or possibly even earlier, during the time of the Spanish Armada. An adjacent mound (27130) to the east of NHER 13784 was used as a bastion as part of the 1643 siege works. In 2014, archaeological monitoring during the removal of 1960s building footings on the saltern at the site (NHER 27899) revealed a rubble spread with 17th to 18th century bricks, suggests the presence of a later structure on the mound. The form and status of the building is as yet unknown, but is further evidence for the reuse of saltern mounds in the vicinity (NCC/HES Event no. ENF135847; OA East Report 1755).

1.3.6 The 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. The earliest maps (not illustrated) of the development area are Faden's Map of 1787 and the 18th century Gaywood Bawsey Drainage map. The former of these shows the site divided between Gaywood Common and Wootton Green. The Gaywood Enclosure map of 1810 (Adams 2014; not illustrated) shows the development area as two fields.

1.3.7 The 1884 and 1904 OS maps show the development area as farmland with the earlier map also showing a sheepfold in its southern part.

1.3.8 An aerial photographic search of the Norfolk Historic Environment Record (NHER) centred on the site shows a large building in 1946 located on the presumed saltern mound in the western part of the site (NHER reference: TF62_TF6321_A_RAF_16Apr1946).

***Previous work***

1.3.9 Prior to this phase of works a programme of archaeological monitoring was undertaken by OA East in December 2014 during the demolition of the structures associated with the site's previous use as a pig farm complex. These works exposed post-medieval demolition layers from possible earlier structures on site but no evidence of salt-making (Webster 2015b). The evaluation conducted by Oxford Archaeology in 2015, to the east of the site at Marsh Lane, was carried out in conjunction with the initial evaluation and strip & map phase of the current phase of work on the saltern site (Webster 2015a). These works did not encounter any archaeological remains associated with salt-making.

***Regional examples of excavated medieval salterns***

*Kings Lynn & Norfolk*

1.3.10 Archaeological survey has identified King's Lynn and the Norfolk Wash coast as a major salt production area dating back to at least the Roman period, with many salt production sites and saltern mounds recorded (Fig. 2).

1.3.11 A medieval (12th-13th century) salt-making complex was excavated at the former Queen Mary's nursing home, Kings Lynn, 2.2km to the south of the Marsh Lane site in 2002-2003 (Cope-Faulkner 2014). A hearth, four clay-lined pits and evidence for eleven filtration units were revealed within a mound comprised of the filtration unit waste. Only the floor of the hearth survived as a burnt red clay layer up to 2.8m long by 1.5m wide. Two patches of more vitrified lining were also identified on its upper surface. This was considered to have been constructed at the pre-existing ground level. Post-holes were revealed around the hearth and probably represented a simple shelter (salt-house/salt-cote). The dumped waste layers overlying the hearth contained salt encrusted oven wall and green vitrified lining fragments, lead sheet fragments of salt pans, pottery and briquetage. The presence of briquetage in this medieval context is a unique example and comprised of broken pedestals which probably were used as supports for the lead salt pans. A quantity of fuel ash slag probably derived from peat burning was also recovered from the site.

1.3.12 An archaeological evaluation of a medieval saltern mound was conducted at Hamburg Way, North Lynn Industrial Estate, 100m to the north-west of the Marsh Lane site in 2008 (Timberlake 2008). Evidence of possibly Roman salt making activity was also evidenced by a waste dump of briquetage typical of the period and a possible settling tank. The medieval saltern mound comprised waste filtration silts overlying a thin layer of fuel ash from probable peat burning at its base. Pottery dating to the 14th-15th centuries was also recovered from the basal layer. A ditch cut along the edge of the mound at a later date yielded finds including further briquetage, salt slag and brick debris. Due to the 'clean' silt nature of the saltern mound (without any fired clay or red earth) the use of brick built hearths at this saltern site was postulated.

1.3.13 An example of a saltern hearth, constructed below ground level, was also excavated at West Lynn (Trimble 2003).

*Lincolnshire examples*

1.3.14 Silt filtration units have been excavated at Wrangle (Bannister 1983) and Wainfleet St Mary (McAvoy 1994), with these examples also containing the remains of the turves placed to filter the salt. Off cuts from lead salt pans were also recovered from Wainfleet St Mary. These sites are documented as being in use along with other examples at Friskney and the Tofts during the 11th century (Hall & Coles 1994).

1.3.15 Excavations at Quadring revealed two hearths constructed below ground level with evidence for stoke holes, flues and surrounding post structure (Healey 1999). These hearths are also described as having been peat fired; pottery also recovered dated the site to the 14th century (Hall & Coles 1994).

*Cambridgeshire examples*

1.3.16 Seven possible small saltern sites have been identified through archaeological survey at Tydd St Giles (Hall & Coles 2014), with one 14th century example excavated at Parson Drove (Evans 1992). The pits and ditches revealed were interpreted as wood lined evaporation tanks fed by sluice-controlled channels cut for the supply of salt water. A change in the local water regime from brackish to freshwater was evidenced that brought about the disuse of the site. No hearths were identified but bricks were recovered and identified as probably acting as supports placed over the hearths, upon which pottery or lead vessels would have been placed for boiling the brine. This is a unique medieval example of salt production on a smaller scale and using the techniques of salt water evaporation tanks and feeder channels usually associated with the Roman method.

1.3.17 Saltern mounds were also recorded at Newton and Leverington (Hall & Coles 1994).

## 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 fieldwork was supervised by the author and Michael Webster with the assistance of Robin Webb, Kathryn Nicholls, David Browne, John Diffey, Nick Cox, Matt Brooks, Mary Andrews, Malgorzata Kwiatkowska and Rebecca Pridmore. The site survey was conducted by Stuart Ladd and David Brown with georectified photography carried out by Lindsey Kemp. The illustrations were produced by Daria Tsybaeva and Séverine Bézie. Thanks is also extended to the various specialists who contributed to this report.

## 2 Aims and Methodology

### 2.1 Evaluation and Strip & Map Excavation

***Aims***

2.1.1 The objective of the evaluation trenching was to determine as far as reasonably possible the presence/absence, location, nature, extent, date, quality, condition and significance of any surviving archaeological deposits within the development area.

2.1.2 The original aims of the subsequent strip & map excavation were set out in the Written Scheme of Investigation (Brudenell 2015a).

2.1.3 The main aims of this excavation were

- To mitigate the impact of the development on the surviving archaeological remains. The development would have severely impacted upon these remains and as a result a full excavation was required, targeting the areas of archaeological interest highlighted by the previous phase of evaluation.
- To preserve the archaeological evidence contained within the excavation area by record and to attempt a reconstruction of the history and use of the site.

2.1.4 The aims and objectives of the excavation were developed with reference to the national, regional and local frameworks, in particular English Heritage (1991 and 1997), whilst the local and regional research contexts are provided by Oake *et al.* (2007), Glazebrook (1997), Brown and Glazebrook (2000) and Medlycott (2011).

***Site Specific Research Objectives***

2.1.5 The site specific research aims of the investigation are to:

- Establish the form, extent, date and use history of the saltern mound. The growth and development of the medieval salt industry played a crucial role in early land reclamation in The Wash, transforming the landscape. The example at Marsh Lane is one of nearly 300 mapped saltern mounds of likely medieval origin around The Wash in Norfolk (Albone *et al.* 2007, 116). However, there have been few opportunities to fully expose and investigate these mounds. This project will aim to characterise the form, date and make-up of the mound, and investigate any features and structures associated with the salt-making process (tanks, boiling heaths, gullies, and other auxiliary fixtures associated with the salt-making industry). At a broader level it will help to shape a better understanding of how the medieval coastline in this part of Norfolk was managed and exploited.
- Establish the extent, form and function of the structural remains previously revealed as a spread of 17th to 18th century rubble on top of the saltern mound during monitoring in 2014 (NHES Event no. ENF135847; Oxford Archaeology East report 1755).
- Establish the presence or absence of features surrounding the saltern, and their relationship to the use of the mound.

***Methodology*** (Fig. 3)

2.1.6 A total of nine trenches (Trenches 1 to 9) were opened to provide a sample evaluation of the development area and a basis for the excavation of the subsequent strip & map excavation (Fig. 3). In addition, four 1m x 1m test pits were also excavated (Test pits 1 to 4), to further characterise the deposits encountered on site.

2.1.7 The strip & map excavation required that an area of approximately 0.162ha be machine stripped to the level of the archaeological horizon. The latter was represented by the medieval saltern mound revealed by the evaluation trenching in the western part of the site.

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

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

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

2.1.11 All archaeological features and deposits were recorded using OA East's *pro-forma* sheets. Trench locations, plans and sections were recorded at appropriate scales and colour and monochrome photographs were taken of all relevant features and deposits.

2.1.12 A total of twenty-one bulk samples were taken from the medieval features associated with salt making. These each totalled 40L and were processed by flotation at OA East's environmental processing facility at Bourn. Three pollen tin samples were also taken across underlying natural and saltern mound deposits as samples for micromorphology, pollen or diatom analysis.

2.1.13 Site conditions were good with occasional showers.

## 2.2 Further Excavations

***Aims***

2.2.1 The revised aims were set out in the Revised Written Scheme of Investigation (Brudenell 2015b) for the subsequent phases of excavation.

***Revised Aims of the Project***

2.2.2 Deposits associated with the known saltern in the western part of the site (NHER 27899) were encountered within Trenches 1, 2, 5, 7, & 9. The remaining trenches (Trenches 3, 4, 6 & 8) did not reveal any significant archaeological remains.

2.2.3 Therefore, following completion of the strip & map excavation the research aims were further refined ensuring that they contributed to the goals of the following Regional Research Frameworks relevant to this area:

- Establish the form and date of the palaeochannel or pond revealed beneath the later mound silts, and establish whether it was modified to control water movement.
- Establish the character and extent of metalworking activity on the mound.

***Methodology***

2.2.4 Based on the results of the strip & map excavation a second phase of excavation was required through the saltern mound deposits in the area to be impacted at depth by the proposed development (Fig. 3).

2.2.5 A third phase of excavation was required in areas unable to be excavated to the development formation level due to the presence of the archaeological features encountered in the previous phases of work (Fig. 3).

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

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

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

2.2.9 All archaeological features and deposits were recorded using OA East's *pro-forma* sheets. Trench locations, plans and sections were recorded at appropriate scales and colour and monochrome photographs were taken of all relevant features and deposits.

2.2.10 A total of fifty bulk samples were taken from the medieval features associated with salt making. These each totalled 40L and were processed by flotation at OA East's environmental processing facility at Bourn. In addition 35 bag samples were taken from the natural deposits and salt mound material (including waste filtration silts & burnt waste layers). These each totalled approximately 1L and were taken as samples for micromorphology, pollen or diatom analysis. Four pollen tin samples were also taken across underlying natural and saltern mound deposits as samples for micromorphology, pollen or diatom analysis.

2.2.11 Site conditions were good with occasional showers.

## 2.3 Regional Research Objectives

2.3.1 Following completion of the fieldwork the site specific research aims were revised and redefined to follow the aims identified in the Regional Research Agendas (Glazebrook 1997, Brown & Glazebrook 2000 & revised Medlycott 2011). In general terms the site will contribute to the over-arching research of the salt production industry associated with the adjacent medieval town of King's Lynn.

2.3.2 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?'

2.3.3 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).'

2.3.4 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.'

2.3.5 Economy (Brown & Glazebrook 2000, 31)

- '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. The following areas of research need to be amplified:... the economic influence of the church.'

# 3 Results

## 3.1 Introduction

3.1.1 The excavation into the suspected saltern (NHER 27899; Figs 1 & 2) revealed evidence for salt-making activity commencing from the Late Saxon period through to the medieval period. Descriptions of the features identified and artefacts recovered are given in this section with a full context inventory presented in Appendix A, Table 4. A site layout plan is given as Figure 3. Feature locations in each excavation phase are shown in Figures 4, 7 & 9 with contour maps shown as Figures 6 & 8. Detailed plans of the silt filtration unit **258** are shown as Figure 5 and brine boiling hearth **205** are shown as Figure 10. Selected sections presented as Figure 11(a-c).

3.1.2 The proposed development area was subject to an initial evaluation and strip & map excavation across the 1.5ha site which revealed the upper horizon of the saltern remains in the northwestern corner of the site at a height of approximately 3.5m OD. The saltern was found to encompass an area of approximately 70m x 40m, extending beyond the site's western and northern boundaries. A total of nine trenches (Trenches 1-9) and four test pits (Test Pits 1-4) were excavated in conjunction with the strip & map excavation to determine the thickness and extent of the saltern mound deposits (Fig. 9; Plate 1). No other archaeological remains were encountered in the rest of the development area.

3.1.3 A further two phases of excavation targeted the saltern mound defined by the previous phases of evaluation in order to mitigate the impact of the development on the surviving archaeological remains (Excavation phases 2 & 3; Figs 4, 6-8).

3.1.4 The second excavation phase (Figs 7-8) encompassed an area of 0.162ha and targeted the saltern mound deposits to investigate *in situ* features associated with salt-making. Silt filtration units and other features were encountered at a height of between 2.7m and 3.0m OD.

3.1.5 The third excavation phase (Figs 4 & 6) extended down to the formation level of the development which was at the level of the basal deposits of the mound (approximately 2.5m OD). This excavation phase targeted any further *in situ* salt-making features buried by the mound deposits as well as the presumed natural marine deposits underlying the mound.

3.1.6 The chronological site phasing presented below is largely based on stratigraphic relationships of features within a sequence of hearth and silt filtration waste silt layers within the saltern mound. 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.

3.1.7 The sequence of saltern mound deposits was recorded to commence from heights of between approximately 1.5m OD and 2m OD and directly overlay natural saltmarsh deposits (Group 240). These extended to a maximum height of approximately 3.2m OD where the mound was truncated by modern disturbance associated with the pre-existing farm buildings on the site.

3.1.8 Three main periods of activity have been identified within the saltern:

- ***Period 1: Late Saxon (c.AD800 – 1066)***
- ***Period 2: Medieval (c.AD1066 – 1250)***
- ***Period 3: Post-medieval/modern (c.AD1500 – present)***

## 3.2 Saltmarsh Deposits (Group 240)

3.2.1 Extending beneath the saltern was a sequence of natural deposits indicative of a mudflat, saltmarsh and tidal creek environment (Plate 2). The top of these deposits was encountered at a height of approximately 2m OD. They comprised masses of clay, silt and sand (240, 242, 243, 244, 246, 247, 249, 252 & 280) with evidence of intertidal creeks (**241**, **245** & **248**) cutting and reworking these deposits (Section 58; Fig. 11c). Deposit 246 contained lenses of organic macrofossil remains, with its upper horizon appearing to be heavily weathered (247). Organic remains including macrofossils were also encountered in deposit 252. Environmental bulk samples were taken from deposits 246 & 252 that yielded plant macrofossil remains indicative of a coastal saltmarsh environment (Appendix C3). This environment was further evidenced from samples taken from these deposits for pollen (Appendix C4) and diatom (Appendix C5) analyses.

3.2.2 Organic remains from deposit 246 were radiocarbon dated to 1883-1691 cal BC (95.4% SUERC-65061 GU39618) to the Early Bronze Age period (Appendix C6). This period around the Wash basin experienced several marine inundation events resulting in the Barroway Drove Beds. A post-clearance Iron Age mudflat/saltmarsh environment was interpreted from the pollen investigation of these deposits, indicative of the Terrington Beds (Appendix C4). The diatom investigation of these deposits also concluded the same environment (Appendix C5). It is probable that due to the high energy intertidal coastal environment, continual erosion, reworking and deposition of Barroway Drove Bed and Terrington Bed silts would have occurred.

## 3.3 Period 1: Late Saxon (*c*.AD800 – 1066)

3.3.1 Two stratigraphic phases of activity were identified within this period, represented by Feature Groups 1 & 2.

***Summary*** (Figs 4, 6-8; Plates 3-6)

3.3.2 Two groups of features associated with salt-making, including silt filtration units, a water tank and the remains of open hearths. These occurred at successive levels within the lower part of the saltern mound and were separated by layers of mostly waste filtration silts and thin layers of burnt hearth waste deposits. A thin layer of what appears to have been a leached and weathered buried soil horizon was also recorded stratigraphically between these two feature groups, possibly representing a period of disuse of salt production at the site.

***Basal Silts***

3.3.3 The saltern mound deposit sequence commenced with a series of silts (239, 293, 302 & 305) which directly overlay the marine clays of Group 240 from a height of approximately 2.4m OD. Pollen remains from the basal context 239 (Section 45; Fig. 11a) indicate that this may represent a pre-existing embankment of silt. The saltern would have been located on the landward side of the intertidal saltmarsh to exploit the salt rich silts. Ease of access to the site for the transportation of fuel and other material and the export of the salt produced would also have been a factor for the location of the saltern. The presence of the tidal creek mapped immediately to the north of the saltern mound (Fig. 2) and still extant today as a drain (Fig. 1) may have provided a means of waterborne transportation to the site.

***Saltern Feature Group 1*** (Fig. 4)

3.3.4 Cutting this lower sequence of basal silts (305, etc) was a group of features associated with salt-making including silt filtration units **253** (Section 55; Fig. 11b; Plate 3), **254**, **258** (Section 60; Fig. 11b; Plate 4), **268** (Section 67; Fig. 11b), **271** & **274** (Section 70; Fig. 11b), and an open hearth (**277**), all located between heights of 2.1m and 2.5m OD.

*Filtration Units*

3.3.5 Elements of six silt filtration units were revealed and are detailed in Table 1 below. Three of these units (**253**, **254** & **258**) were found to be of complete form. These comprised a shallow sub-rectangular and flat-based filtration pit with a channel, up to 0.4m wide, at the western end leading to a deeper circular water tank with a concave base located at the eastern end. The water tank element for a further three filtration units (**268**, **271** & **274**) were also excavated. Each filtration unit was lined with blue-grey clay up to 0.05m thick. Filtration unit **258** (Fig. 5) was found to also contain the remains of turves (264). The filtration unit elements contained silt fills deposited after their disuse. Charcoal fragments were recovered from the backfill (266) of filtration unit **253**. The charcoal was radiocarbon dated to 758-887 cal AD (67.5% SUERC-65063 GU39620) to the Late Saxon period (Appendix C6). In addition, amorphous fragments of baked clay were recovered from the fills of filtration units **253** (20g), **258** (4g) & **274** (7g).

| 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 |
| **253** | 2.72 | 1.4 | 0.44 | 1.4 | 1.4 | 0.18 | 1.0 | 0.44 | 265 | 267 | 266 |
| **254** | 2.32 | 1.0 | 0.36 | 1.2 | 1.0 | 0.08 | 0.8 | 0.36 | 255 | 257 | 256 |
| **258** | 2.2 | 1.2 | 0.4 | 1.2 | 1.1 | | 0.9 | 0.4 | 259 | 261, 264 | 260 |
| **268** | - | - | - | - | - | - | 0.8 | 0.16 | 269 | - | 270 |
| **271** | - | - | - | - | - | - | 0.55 | 0.19 | 272 | - | 273 |
| **274** | - | - | - | - | - | - | 0.84 | 0.38 | 275 | - | 276 |

*Table 1: Group 1 filtration unit inventory*

*Open Hearth*

3.3.6 Hearth **277** (Plate 5), located on the northern edge of the group, measured up to 1.78m in diameter by 0.1m deep and contained a burnt fill (281) containing 68g of amorphous fragments of baked clay.

3.3.7 The features in Group 1 were overlain by a layer of filtration waste silt (250; Section 61; Fig. 11b) to a maximum height of approximately 2.8m OD.

***Buried Soils***

3.3.8 Waste silts 250 were in turn overlain by a thin dark layer (290/291) with mottled orange and black staining indicating much leaching (Section 61; Fig. 11b) at a height of 2.5m OD. This layer probably represents the weathered soil of a pre-existing land surface. The upper horizon underlay the filtration waste silts of Group 202 (see below).

3.3.9 Soil 290/291 may possibly be equated to the buried soil horizon recorded in a different part of the saltern excavation as 218/219 (Section 45; Figure 11a). This buried soil sloped upwards to the east and north between heights of 1.75m-2.5m OD in the central part of the mound and overlying basal silt deposit 239. Charcoal recovered from 218 was radiocarbon dated to 943-1044 cal AD (87.2% SUERC-65057 GU39617), the Late Saxon period.

3.3.10 Both recorded buried soil horizons underlay filtration waste silts within Group 202.

***Waste Silt Group 202***

3.3.11 A sequence of filtration waste silts (157, 202, 217, 279, 289, 300 & 304) was recorded extending to a height of 3.0m OD (Sections 46, 56, 61 & 66; Fig. 11b). Waste silt deposit 202 yielded a single sherd (2g) of Late Saxon Thetford-type ware pottery dating to the *c.* late 10th-11th centuries. A vesicular lumpy concretion (300g) was also recovered from deposit 157, probably representing spatter from brine boiling.

***Saltern Feature Group 2*** (Fig. 7)

3.3.12 This comprised a group of salt-making features including: silt filtration units **164**, **168**, **170**, **179**, **187**, **193**, **203** (Section 43; Fig. 11b; Plate 6), **226** (Section 48; Fig. 11b), **231**, **236** & **294** (Section 45; Fig. 11a); open hearths **175** (Section 35; Fig. 11a), **177** & **190**; and clay lined water tank **223** (Section 48; Fig. 11b) that cut the waste silt deposits (Group 202) at a height of between 2.7m and 3.0m OD.

*Filtration Units*

3.3.13 Evidence for a total of thirteen clay-lined silt filtration units was revealed within this group and are detailed in Table 2 below. Four of these units (**164**, **170**, **187**, **203**) were found to be of complete form. Elements for a further seven filtration units were also excavated and included: the filtration pit elements of units **168**, **179**, **193** & **231**; and the sub-rectangular water tank elements of units **226**, **236**, & **294**. Two further units were found to have been truncated by medieval enclosed hearths, with unit **78**/**81** truncated by hearth **75** (Fig. 9) and unit **131** truncated by hearth **205** (see below; Section 21; Fig. 11a).

3.3.14 The filtration unit elements contained silt fills deposited after their disuse. The backfill (167) of filtration unit **164** (Section 34; Fig. 11a) yielded a single sherd (5g) of early medieval ware pottery dating to the *c.* 11th-13th centuries and 17g of baked clay including 14g of lining. The backfill (189) of filtration unit **187** yielded a charred cereal grain radiocarbon dated to 1021-1166 cal AD (95.4% SUERC-65064 GU39621), the transition between the Late Saxon and medieval periods. Furthermore, the fills of filtration units **170** & **231** contained 1g each of amorphous baked clay fragments.

| 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 |
| **78/81** | - | - | - | - | 1.86 | 0.2 | 1.0 | 0.37 | 80/106 | 82 | 79 |
| **131** | - | - | - | - | - | 0.2 | - | - | 126 | 127, 128, 129 | - |
| **164** | 2.4 | 1.4 | 0.5 | 1.3 | 1.3 | 0.2 | 1.1 | 0.5 | 173 | 166 | 167 |
| **168** | - | - | - | 1.77 | 1.48 | 0.19 | - | - | 172 | 169 | - |
| **170** | 2.7 | 1.4 | 0.32 | 1.5 | 1.4 | 0.2 | 1.2 | 0.32 | 171 | - | 182 |
| **179** | - | - | - | 1.23 | 1.14 | 0.06 | - | - | 179 | - | - |
| **187** | 2.6 | 1.3 | 0.52 | 1.3 | 1.3 | 0.06 | 1.0 | 0.52 | 188 | - | 189 |

| 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 |
| **193** | - | - | - | 1.7 | 1.4 | 0.22 | - | - | - | 194, 195, 196 | - |
| **203** | 2.56 | 1.3 | 0.52 | 1.3 | 1.2 | 0.1 | 0.8 | 0.52 | 222 | 220 | 204 |
| **226** | - | - | - | - | - | - | 0.4 | 0.28 | 227 | - | 228 |
| **231** | - | - | - | 1.7 | 1.3 | 0.2 | - | - | 235 | 232 | - |
| **236** | - | - | - | - | - | - | 0.75 | 0.29 | 237 | - | 239 |
| **294** | - | - | - | - | - | - | 0.3 | 0.16 | 295 | - | 296 |

*Table 2: Group 2 filtration unit inventory*

*Water Tank*

3.3.15 Sub-rectangular Pit **223**, located immediately to the south of filtration units **187** & **203**, measured up to 2.1m in length by 0.85m wide by 0.3m deep. The cut was lined with clay (224) up to 0.05m thick. The backfill (225) yielded purplish coloured clay lining that was discoloured through its contact with concentrated saline solution. The clay also contained organic material which had become incorporated naturally as it settled to the bottom of the pit. This supports the interpretation of this pit being a clay-lined tank for the storage of the concentrated brine produced in the adjacent filtration units **187** and **203**. No other feature of this type was encountered during the excavations.

*Open Hearths*

3.3.16 Hearth **175**, located at the north of the group, was circular in plan and measured up to 0.7m in diameter by 0.1m deep. It contained a burnt fill (176) with charcoal fragments.

3.3.17 Hearth **177**, located to the south adjacent to filtration unit **170**, measured up to 0.6m in diameter by 0.14m deep and contained burnt fill 178.

3.3.18 Hearth **190**, to the south of water tank **223**, measured up to 1.13m in diameter by 0.07m deep and contained two fills. The upper fill (192) contained a possible hand made *ad hoc* clay wedge or support (35g) for a brine boiling vessel.

***Waste Silt Group 201***

3.3.19 The uppermost series of waste silts (201, 212, 214, 278, 288, 297, 298 & 303) in the lower mound sequence overlay the features of Group 2 (Section 46, 56, 61 & 66; Fig. 11b). These silts may also be equated to: waste silts 101 in Trench 2; silt 15 encountered in Trench 5; silt 67 in Trench 9; and silt 155 observed in Test Pit 4 during the strip & map phase of the excavation. Waste silt 67 yielded nine sherds (29g) & waste silt 101 yielded four sherds (8g) of Late Saxon Thetford-type ware pottery dating to the *c.* late 10th-11th centuries. Waste silt 67 also contained 517g of baked clay hearth debris, including elements of lining and superstructure. The pottery from deposit 101 showed signs of burning and possible salt residue on its surface indicating vessels were being used in the salt-making process. Freshwater mussel (129g), common mussel (129g) and cockle shells (5g) were also recovered from deposit 67, displaying evidence for human consumption in the vicinity.

3.3.20 These deposits were overlain by the upper mound sequence consisting predominantly of the burnt hearth waste deposits of Group 200 (see below), or the modern truncation level, at a height of approximately 3.2m OD.

*Hearth waste deposits*

3.3.21 Thin layers of burnt deposits (156, 215, 251 & 299) were also observed within the lower mound sequence, probably representing tips of waste from the open hearths, within the thicker layers of filtration waste silts. Deposit 156 yielded 64g of slag and deposit 251 (Figs 4 & 6) contained 11g of unidentifiable baked clay fragments, along with 5g of slag.

## 3.4 Period 2: Medieval (*c.*AD1066 – 1250)

***Summary*** (Fig. 9)

3.4.1 This comprised a group of enclosed hearths for the brine boiling associated with salt-making. These hearths, which were encountered within the upper saltern mound deposit sequence, predominantly comprised burnt hearth waste containing large amounts of baked clay and slag. The hearths were all truncated, being situated at the top of the saltern mound, with surviving elements including *in-situ* hearth bases, superstructures and flues.

***Hearth waste Group 200***

3.4.2 The upper saltern mound deposit sequence comprised a series of predominantly hearth waste tips of burnt material with frequent baked clay debris from broken up hearths. These deposits were recorded as being a maximum of approximately 0.8m thick. They consisted of reddish brown clays and silts forming a discrete band of burnt material when exposed in plan and section. These deposits also contained frequent slag formed from heated fuel ash within the enclosed hearths combining with the clay lining, and light-weight vesicular concretions probably formed by spatter from brine boiling solutions. The deposits tipped down to the east and south, capping the dome of the saltern mound, from the upper modern truncation level at a height of approximately 3.2m OD. Within this sequence, thin probable filtration waste silt deposits were also recorded.

3.4.3 During the evaluation and strip & map phase, Trench 2 exposed a series of waste deposits: 33, 34, 35, 97, 98, 99, 100, 110, 111, 124, 125, 139, 151 & 153 (Section 27; Fig. 11a). Burnt deposits 91-93 were also revealed in Test Pit 3 (Section16; Fig. 11a) and as 94 in Trench 7. Sherds of early medieval ware & Grimston coarseware pottery dating to the *c.*12th-14th centuries were recovered from deposits 33 (36g), 35 (21g), 94 (121g), 124 (200g) & 153 (3g). These pottery sherds showed signs of overfiring/burning and salt residues indicating these vessels were used in the salt making process. Late Saxon Thetford-type ware pottery dating to the *c.* late 10th-11th recovered from deposits 94 (172g) & 99 (20g) is likely to be residual. A small amount of unidentified fish and small mammal bone was also recovered from these deposits.

3.4.4 The second excavation phase also exposed deposits assigned to Group 200 (Section 45; Fig. 11a; Plates 7 & 8) and comprised burnt tips (200, 206, 207, 209, 211, 213, 216 & 287) with lenses of waste silt (208 & 210). Three sherds (17g) of burnt Late Saxon Thetford-type pottery were recovered. The Thetford-type pottery may indicate disturbance/reworking of the earlier Late Saxon saltern mound deposits. This is further evidenced by a charred unidentified root/tuber from deposit 200 radiocarbon dated to 768-905 cal AD (81.1% SUERC- 65062 GU39619).

3.4.5 Finds recovered from these deposits also included fragments of baked clay hearth lining and superstructure as well as many unidentifiable fragments recovered from deposits 35 (95g), 94 (503g), 98 (459g), 99 (71g), 110 (2g), 111 (22g) & 200 (1133g). A single soft fired brick (664g) was recovered from deposit 94, possibly representing an example of a support for vessels on the enclosed hearths.

3.4.6 Slag, in the form of pale cream to rusty brown vesicular lumps or dense plate-like fragments, was recovered from deposits 33 (62g), 34 (1057g), 35 (368g), 94 (10034g), 98 (20g), 110 (46g), 111 (268g), 124 (2137g) & 200 (547g).

3.4.7 Freshwater mussel (13g), common mussel (13g) and cockle shells (591g) were recovered from deposit 94. Freshwater mussel (5g) and common mussel (5g) were also recovered from deposit 200.

3.4.8 Furthermore, a small quantity of unidentifiable animal bone fragments was recovered. This included: a single unidentified fragment from deposit 33; two fragments of an unidentified medium sized mammal from deposit 94; three fragments of an unidentified fish from deposit 94; and a single unidentified fragment of a small mammal from deposit 124.

***Saltern Feature Group 3*** (Fig. 9)

*Enclosed hearths*

3.4.9 Within the upper saltern mound deposit sequence and immediately below the modern truncation level lay the remains of four enclosed hearths (Fig. 9). Hearth **205** lay towards the southern end of the saltern mound at a level of approximately 2.85m OD with the remains of hearth **11** a short distance to the east. Hearth **75** lay in the central part of the saltern mound and comprised a short linear trench, possibly representing a flue, at a height of 3.5m OD. Similarly, a probable flue (**42**) of a truncated hearth was also revealed on the northeastern side of the saltern at a height of approximately 3.2m OD.

*Hearth **205*** (Section 21, 36; Fig. 11a)

3.4.10 Hearth **205** comprised a sub-circular feature, up to 1.6m in diameter by 0.32m deep, with elements of the superstructure (107) and the hearth base (115) surviving *in situ* (Fig. 10; Plates 9 & 10). The circular pit (**205**) cut waste tip layers 124 & 125 and heavily truncated Period 1 silt filtration unit **131**. The pit was filled by a mass of red clay (115), from repeated heating, forming the hearth base. Two sub-circular areas of vitrified green clay (116 & 162; Plate 11) were observed on the inner wall (of which 3136g was recovered). These were formed due to a chemical reaction between the salt, clay lining and the fuel. The remains of a superstructure were formed by salt encrusted clay (107) that extended up the profile of the central part of the hearth from the clay base and between the two vitrified areas on the internal hearth wall. A further element of this superstructure also extended around one of the vitrified areas.

3.4.11 Waste backfill deposits 112, 114, 117, 118, 119, 120, 121, 122, 123, 132, 149, 150 & 160 were excavated within the hearth structure. Fragments of hearth lining (24g) were recovered from backfill 132. One lump of slag (12g) was recovered from fill 118 and three lumps of slag (28g) were recovered from fill 132. In addition, a small quantity of freshwater mussel (1g), common mussel (1g) and cockle shells (1g) were recovered from fill 132.

3.4.12 Charcoal from deposit 118 was radiocarbon dated to >50000 BP (SUERC- 65065 GU39622), a result indistinguishable from background samples, representing a failed sample.

*Hearth **11***

3.4.13 Hearth **11** (Plate 12) comprised a sub-circular pit up to 1.1m in diameter by 0.1m deep. This pit was filled by fired red clay (12), of which 79g were recovered, forming the hearth base. Two areas of vitrified green clay (229 & 230) were observed, similar to that within hearth **205**.

*Hearth **42***

3.4.14 Hearth flue **42** comprised a linear cut aligned north-east to south-west, 3.9m long, 0.8m wide by 0.2m deep, that contained three fills. Fill 39, at the eastern end, comprised firm red clay possibly representing the remains of a hearth floor. Overlying this were backfills 38 & 41 containing two sherds (22g) of early medieval ware pottery dating to the *c.*11th-13th centuries. A total of 321g of amorphous baked clay hearth debris and sixty lumps of slag (1226g) were also recovered.

*Hearth **75***

3.4.15 Hearth flue **75** comprised a linear cut aligned approximately north to south, 4.5m long, 1.2m wide by 0.16m deep, that contained a reddish brown clay fill (76). This hearth, which produced no finds, truncated Period 1 filtration unit **78**/**81**.

## 3.5 Period 3: Post-medieval/modern (*c.*AD1500 – present)

***Summary*** (Fig. 9)

3.5.1 Activity dated to this period comprised recent marsh deposits in the eastern part of the site, and modern truncation of the saltern from foundation trenches, pits and services associated with the pre-existing pig farm buildings on the site. Layers of recent made ground were also encountered overlying the site.

***Recent marsh deposits, Groups 198 & 199*** (Section 47; Fig. 11b)

3.5.2 Layers of natural clayey silt and silty clay (29, 30, 31, 32, 73, 85, 86, 88, 89, 102, 105, 198 & 199) were encountered in the eastern part of the site and were observed to overlie the eastern extent of the Period 2 upper, mostly burnt, saltern mound deposits (Group 200). These mixed silts and clays did not display the same laminated and layered characteristics of the filtration waste silt groups. The lower horizon of these deposits was also recorded to directly overlie marine deposit 280 (Group 240) in auger Section 63 (Fig. 11c) at a height of 1.5m OD. This deposit sequence observed across the eastern part of the site can be split into two parts:

- The lower deposit (Group 199), up to 1m thick, composed of blueish grey clayey silt or brown clayey silt with blue grey mottling up to a height of approximately 2m OD. This deposit was recorded as deposit 32 in Trench 8, deposit 73 in Trench 6, deposit 86 in Test Pit 1, deposit 89 in Test Pit 2, deposit 105 in Trench 2 and deposit 199 during the second excavation phase; and
- The upper deposit (Group 198), up to 0.7m thick, comprising mid brown clayey silt or grey silty clay up to a height of approximately 3m OD. This deposit was recorded as deposits 29, 30 & 31 in Trench 8, deposit 85 in Test Pit 1, deposit 88 in Test Pit 2, deposits 102 & 105 in Trench 2 and deposit 198 during the second excavation phase.

3.5.3 Some amorphous baked clay fragments were recovered from deposits 102 (18g), 105 (1g) & 199 (5g). Deposit 88 contained a lump of slag (87g).

***Channel 18/21*** (Section 6; Fig. 11a)

3.5.4 A channel, encountered at a height of 2.5m OD, was recorded immediately to the south of the saltern mound in Trenches 6 (**18**) & 7 (**21**) and contained a sequence of silting deposits (fill 19 in channel **18** & fills 20, 22-26 in channel **21**). The channel was revealed to be approximately 3m wide in Trench 6 (**18**), widening to the west with a maximum recorded width of 6.5m in Trench 7 (**21**), and with a possible spur to this watercourse observed during the strip & map excavation running south. Channel **21** deposits were excavated in Trench 7 to a height of 1.6m OD. The base of the cut of the channel was not encountered in either trench. Channel **21** was observed to cut layer 73 (Group 199). Deposit 22 contained five lumps of slag (110g) and a small pantile fragment (33g) of a type in use from the 17th century but probably of a more recent date. This channel is not indicated on any of the historic maps of the site and the pantile fragment was recovered from the uppermost fill. Given the channel's proximity to the saltern it remains a possibility that this feature may be of greater antiquity with only its final silting phase being in the post-medieval, and its use as being an open water course in the medieval period. If so, such a channel would have been of great importance in facilitating transport of goods to and from the saltern.

***Modern truncation***

3.5.5 Foundation trenches (**59**) for the pre-existing modern structures associated with the site's previous use as a pig farm were encountered across the saltern mound during the evaluation and first phase strip & map excavation (Fig. 9). These trenches were filled with concrete or rubble backfill (60).

3.5.6 Further modern truncation across the site included: pre-existing service trenches, including trenches **7** & **8** (Trench 4); and pits including **9** (Trench 3) & **61** (Trench 9). The fill (64) of pit **61** contained five sherds (25g) of modern pottery types dating to the *c.* late 18th-19th centuries. The fill (10) of pit **9** contained five fragments (765g) of modern ceramic building material (CBM) and two clay pipe fragments (4g).

***Made Ground Group 197***

3.5.7 A build up of recent made ground deposits was also encountered across the site, representing levelling events associated with the site's development and use in the modern period. These were recorded as: layer 13 in Trench 5, layer 28 in Trench 8, layer 71 in Trench 6, layers 83 & 84 in Test Pit 1, layer 87 in Test Pit 2, layer 90 in Test Pit 3 and layers 234 & 286 during the excavation. Layer 87 contained four sherds (8g) and deposit 90 contained one sherd (1g) of modern pottery dating to the *c.*18th-19th centuries.

## 3.6 Finds Summary

***Introduction***

3.6.1 Finds were recovered from all of the excavated areas and consisted of: Late Saxon, early medieval and post-medieval/modern pottery; post-medieval ceramic building material; post-medieval/modern clay pipes; Late Saxon & medieval baked clay fragments from brine broiling hearths; slags of fuel ash waste and salt residues from the brine broiling hearths. Ironworking smithing slag dating to the medieval period was also recovered. A small quantity of faunal and shell remains were recovered from features dating to the medieval period.

***Pottery*** (Appendix B.1)

3.6.2 Seventy-eight sherds of pottery weighing 689g were collected from fifteen contexts during the excavations. The assemblage consists mostly of pottery dating to the 11th–13th centuries from twelve contexts within the saltern mound, with 18th/19th century dated pottery recovered from the remaining three contexts from a recent pit and made ground.

3.6.3 The earlier of the two groups comprised typical local wares of the period. The presence of burning and presumed salt deposits on a number of the sherds suggests that, in this case, they did have an industrial role. Whilst they may have been used for storage (and possibly transportation) of the finished product, the presence of burning suggests they were sometimes exposed to very high temperatures and may have been used in the salt-making process. Forms and fabrics present in the assemblage suggest that the site had probably ceased activity by the mid 13th century.

***Ceramic Building Material*** (Appendix B.2)

3.6.4 Six fragments (798g) of ceramic building material (CBM) were recovered from two contexts. Fill 10 of Period 3 pit **9** contained five fragments of three handmade bricks in three different fabrics dating to the post-medieval period. Fill 22 of natural water channel **21** contained one pantile fragment also dating to the post-medieval period.

***Clay Pipes*** (Appendix B.3)

3.6.5 Two fragments of clay tobacco pipe were recovered from fill 10 of pit **9** with a further three fragments recovered from recent made ground 87. All fragments date to the 18th/19th century.

***Baked Clay*** (Appendix B.4)

3.6.6 The baked clay assemblage comprises 402 fragments weighing 7,726g recovered from 30 contexts. The assemblage comprises largely amorphous pieces, few with any obvious form. The material was found in three fabrics, all most likely formed utilising the local Upper Jurassic clays. A soft fine silty clay with no visible inclusions was used to form a brick-like object from deposit 94 in group 200, plate-like pieces which may be from hearth lining and for a possible hand-squeezed fragment which may be an *ad hoc* wedge or similar support found in open hearth **190**. The second fabric is formed of the same fine clay but with the addition of fine organic material, perhaps chopped grass that may represent the above ground superstructure of the enclosed hearths. A third fabric from Period 1 water tank **223** with irregular organic inclusions has a distinctive purplish colour derived from contact with concentrated saline solution.

***Salt-making slag*** (Appendix B.5)

3.6.7 A total of 374 pieces of slag weighing 14.956kg were collected from thirteen contexts, mostly those forming the saltern mound and associated hearths. The assemblage is composed of a mix of redeposited slag all formed during the high heat process involved in salt-making in brine boiling hearths.

***Chemical analysis (by pXRF) and characterisation of the salt-making slags and other materials*** (Appendix B.6)

3.6.8 A NITON pXRF instrument was used to semi-quantitatively record the surface chemistry of 29 samples from this site. This consisted of 167 individual measurements, all of which were carried out on the same suite of elements, the majority of which were trace heavy metals. The elements recorded included antimony (Sb), tin (Sn), cadmium (Cd), silver (Ag), strontium (Sr), rubidium (Rb), lead (Pb), selenium (Se), arsenic (As), mercury (Hg), zinc (Zn), copper (Cu), nickel (Ni), cobalt (Co), iron (Fe), manganese (Mn) and chromium (Cr).

3.6.9 The salt slags and fired clay bricks from the site show distinct elevations in strontium, an elemental increase which appears to be associated with the boiling of brine and the production of salt. Likewise a smaller but detectable increase in lead and other some heavy metals can only really be explained as a result of contamination associated with the use of lead boiling pans. These were used here as early as the 12th century AD, but probably also in the Late Saxon period; the pans being supported on clay bricks over peat-fuelled hearths. The analyses carried out upon the surfaces of the pottery sherds distinguishes this particular non-local clay source from the locally-made fired clay bricks which in all probability were manufactured from the sleech mound silts.

***Iron smithing debris and ironworking evidence*** (Appendix B.7)

3.6.10 A total of 640g of ferrous iron smithing slag plus 151g of vitrified hearth lining & fuel ash which was probably associated with this activity was recognised amongst the collection of salt working slag from the site. All of this came from the upper, medieval (Period 2) part of the saltern mound. Additionally, there were several samples of iron-contaminated salt slag which were likewise associated with the hearth/ hearth horizon that had been used for this ironworking on the mound top.

3.6.11 The smithing remains constitute what would be expected to be found within the discarded debris of an iron smithing forge and hearth, presumably one associated with an iron anvil and probably a manually-operated bellows. What is most interesting about this iron smithing debris is the unusual size of the smithing hearth base. Thus the correspondence in size between the salt slag cake (see salt slag from context (94): Table 13) and the smithing hearth base might well be because the same clay-moulded hearth was being used for both salt-making and iron smithing, at different times. The use of this salt-making hearth by a blacksmith may be purely opportunistic, and could have been a one-off. However, salt-making requires tools for: the chiselling-out of salt cakes from metal pans; digging the silts used in sleeching; and in cleaning out hearths. These tools would require re-forging and sharpening from time to time.

## 3.7 Environmental Summary

***Faunal Remains*** (Appendix C.1)

3.7.1 An assemblage of seven fragments of moderately preserved animal bone (6g) was recovered from the excavation. The bulk environmental samples recovered abundant fragments of burnt bone from Period 1 filtration units **164** & **231** in Feature Group 2. The only fish bone recovered comprised a couple of fragments from the environmental sample residue of Period 2 hearth waste deposit 200.

***Shell Remains*** (Appendix C.2)

3.7.2 A total of 0.760kg of shell including common mussel, freshwater mussel and cockle shell was recovered from 5 contexts within the saltern.

***Environmental Remains*** (Appendix C.3)

3.7.3 Sixty-seven bulk samples were from deposits associated with Late Saxon and medieval salt-making. Forty-two additional samples were taken for pollen, foraminifera and diatom analysis (see sections 5.3.6 & 5.3.7 below). Despite extensive sampling of the deposits, very few plant remains have been recovered. Similar results were obtained from a contemporary site at Queen Mary's Nurses Home which had better recovery of charcoal but lacked the salt-marsh indicators. Very little charcoal has been recovered from any of the samples and it can only be assumed that it hasn't survived or that wood was not the fuel used. The few fragments of charred heather may possibly represent its use as fuel but it is most likely that dried peat was used to fire the hearths. Burnt peat can be difficult to identify as the organic components are often reduced to ash but any seeds, stems and molluscs present can survive in significant quantities. The lack of these remains from the black layers at Marsh Lane suggest that the burnt peat deposits have decayed to leave only a carbon-rich, black-stained soil. Preservation of the seeds of both salt marsh and terrestrial plants is predominantly by waterlogging which has occurred in the marine silts found beneath the saltern mound, occasional pit fills within Period 1 saltern feature Group 1 and a hearth waste deposit (251) in the lower mound deposit sequence.

***Pollen Remains*** (Appendix C.4)

3.7.4 The study focused on the palynology of sediments obtained from archaeological section 45 (Fig. 11a) through the saltern mound deposits and section 58 (Fig. 11c) through the underlying marine deposits. Surprisingly the pollen count from section 45 yielded an apparently Mid to Late- Bronze Age signal, showing little sign of saltmarsh or marine influence, and seem to come from a freshwater reedswamp environment. The sample from the underlying marine deposits gave the expected saltmarsh dominated pollen signal. The post-clearance signal could be Iron Age or later, and this implies that the mudflat, saltmarsh and tidal creek environment might belong to the Terrington Beds, rather than the earlier Barroway Drove Beds indicated from carbon dating of a charcoal sample recovered from this deposit.

***Diatom Remains*** (Appendix C.5)

3.7.5 The study focused on the diatom assemblage obtained from section 58 (Fig. 11c) of the underlying marine deposits and sampled with monolith tins for microfossil analysis. The diatom assemblages were found to be dominated by fully marine and brackish diatoms indicative of a coastal mudflat/saltmarsh environment. The assemblage obtained from section 45 proved to be devoid of diatoms.

***Radiocarbon dating*** (Appendix C.6)

3.7.6 Six samples of organic remains were selected from the environmental bulk samples of deposits from: the underlying saltmarsh deposits pre-dating the saltern; and features /waste tips within the saltern mound associated with the Late Saxon and medieval salt-making activities (Table 3).

| Sample No. | Sample type | Context | Cut | Group | Period | Feature type | Date | Certificate |
|---|---|---|---|---|---|---|---|---|
| 13 | Charcoal | 118 | 205 | 3 | 2 | Hearth | >50000BP (background result) | SUERC-65065 GU39622 |
| 37 | Charred grain | 189 | 187 | 2 | 1 | Filtration unit | 1021-1166 cal AD | 95.4% SUERC-65064 GU39621 |
| 46 | Charred root/ tuber | 200 | - | 200 | 2 | Hearth waste | 768-905 cal AD | 81.1% SUERC-65062 GU39619 |
| 53 | Charcoal | 218 | - | - | 1 | Buried soil | 943-1044 cal AD | 87.2% SUERC-65057 GU39617 |
| 77 | Charcoal | 266 | 253 | 1 | 1 | Filtration unit | 758-887 cal AD | 67.5% SUERC-65063 GU39620 |

| Sample No. | Sample type | Context | Cut | Group | Period | Feature type | Date | Certificate |
|---|---|---|---|---|---|---|---|---|
| 91 | Charcoal | 246 | 245 | 240 | - | Saltmarsh deposit | 1883-1691 cal BC | 95.4% SUERC-65061 GU39618 |

*Table 3: Radiocarbon dating results*

# 4 Discussion and Conclusions

## 4.1 The saltern (NHER 27899) at Marsh Lane, King's Lynn

*Saltmarsh*

4.1.1 The environmental evidence from the underlying natural deposits (Group 240) beneath the saltern clearly demonstrates the saltmarsh environment in which salt-making activity commenced at this site. The pollen remains indicate these to be Terrington Beds lain down in the Iron Age, while the radiocarbon date indicates these to be Early Bronze Age in date. It is therefore presumed that the tidal creeks also recorded cutting these deposits have continually reworked, redeposited and mixed the silts from both these periods in this high energy coastal environment. The basal deposit of the mound (239) formed a definite rise in the topography of the site and may have been an initial dump of waste silt, or a relatively higher island of banked natural sediment, upon which the salt-workings commenced. Indeed, the pollen evidence from this deposit showed little sign of saltmarsh or marine influence but was lain down in a freshwater reedswamp environment. This further indicates an initial imported dump of freshwater-lain silt from nearby to raise the ground level for the salt-workings and establish the site above the high water mark. The buried soil horizon 218/219 that sloped over the basal deposit, was recorded at a height of between 1.75m-2.5m OD, and radiocarbon dated to 943-1044 cal AD: the Late Saxon period.

*Late Saxon salt-making*

4.1.2 Preservation of the seeds of both salt marsh and terrestrial plants (mainly disturbed ground) has occurred in the marine silts found beneath the saltern mound, occasional pit fills within saltern Feature Group 1 and a hearth waste deposit (251) in the lower mound deposit sequence. The most frequent seeds are of annual seablite, a native plant that grows in a spreading habitat in middle and lower coastal salt-marshes (Stace, 150), in addition to seeds plants such as rushes, sedges and bog-bean which are all plants that thrive in wet-habitats and could also be peat components.

4.1.3 The earliest salt-making features encountered were the remains of six silt filtration units and a single hearth (Feature Group 1). The ratio of evidence for silt filtration activity opposed to brine boiling was also reflected in the lower salt mound deposits with its high proportion of filtration waste silts (Groups 201 & 202) as opposed to the thin tips of hearth waste. The hearth evidence (**277**) comprised a thin but concentrated burnt mass of ground indicative of *ad hoc* open hearths. Interestingly, not all the filtration units were of complete form, indicating either deliberate destruction of these features and possibly the re-use of the clay linings or accidental destruction or weathering of the saltern mound deposits once these features were disused. Unit **258** contained remains of turves within the filtration pit. This group of salt-making features were radiocarbon dated to 758-887 cal AD in the Late Saxon period.

4.1.4 Capping the overlying waste silt (250) of this group was a buried soil horizon (290/291) that could possibly represent a period of disuse for the saltern. It is interesting to note the similar buried soil horizon (218/219) gave a radiocarbon date of 943-1044 cal AD. However, this layer was recorded as directly overlying the basal silts of 239 thought to be of natural freshwater origin and not marine silt filtration waste. It is still possible these soil horizons may be equated as they both underlay the filtration waste silts of Group 202. The single sherd of Thetford-type pottery recovered from the silts of Group 202 also reinforces this (earlier than expected) Late Saxon date range.

4.1.5 These waste filtration silts underlay a second group (Feature Group 2) of thirteen silt filtration units, a water tank for brine storage and three hearths positioned higher up within the saltern mound. The filtration units were identical in form to those of Group 1 and similarly of either complete or incomplete form. The hearth evidence also appeared to represent insubstantial, short-lived open hearths. This group was dated to 1021-1166 cal AD: the transition between the Late Saxon and early medieval periods. A single sherd of early medieval ware pottery with a date range of c.11th-13th centuries was recovered from filtration unit **164**. The emphasis on silt filtration as opposed to brine boiling appears to have continued and is reflected in the thick deposits of overlying waste silts of Group 201 that contained only thin hearth waste horizons. Deposit 67 within this group of silts contained a quantity of mussel shells providing evidence for human consumption. A quantity of Late Saxon Thetford-type ware pottery was recovered from these waste silts of Group 201. Some of the pottery sherds displayed evidence for burning with some also appearing to be coated with salt residue which indicates Thetford-type ware vessels were probably being used in the salt making process and may well have been employed for brine boiling over the open hearths. A possible example of a clay support for a vessel on this type of open hearth was recovered from hearth **190**.

*Medieval salt-making*

4.1.6 The upper deposits capping the saltern mound (Group 200) were found to be of a different composition. Whereas the earlier deposits were mostly composed of filtration waste silts, the later deposits were comprised of thick successive tips of burnt hearth waste containing frequent baked clay, salt slag residues and spent fuel waste from salt boiling hearths. These deposits also contained early medieval ware, Grimston coarseware and medieval coarseware. They probably represent an evolution in the scale and general process of salt production at this site during the medieval period. Deposit 94 within this group also contained a quantity of cockle shells indicative of shellfish consumption by the salt-makers.

4.1.7 This change in scale is emphasised by the appearance of substantial permanent enclosed hearth structures forming the third grouping of features (Feature Group 3) encountered in the uppermost part of the saltern mound. Evidence for four of these enclosed hearths was found with the best preserved example (**205**; Fig 10) having surviving *in situ* elements including the base and internal hearth wall displaying evidence for a double chamber. Elements of the superstructure also survived including a central column of salt encrusted clay separating the two chambers. The accumulations of 'spatter layers' occured when the hot brines boiled over onto the clay lining of the hearth and the pan brick supports. The single soft fired brick recovered from hearth waste Group 200 may be an example of a vessel or pan support on these type of hearths, similar to those found at Walpole St Peter, Norfolk (Clarke 2009).

4.1.8 Amorphous structural fired clay and bricks and brick fragments similar to those found have been found at Wainfleet St Mary, Lincolnshire (McAvoy 1994, 160) and Parsons Drove, Cambridgeshire (Pollard et al. 2001, 444) and hearth lining and other debris including possible pedestals were recovered from the 12th to 13th century saltern site at former Queen Marys Nurses Home, Kings Lynn (Cope-Faulkner 2014).

4.1.9 The mound may have been raised to such a height at this period that permanent structures could now be constructed. However, it must be noted that baked clay, including lining and superstructure fragments, was recovered from the earlier saltern deposits, but in much smaller and sparser quantities. No evidence for salt-cotes sheltering these enclosed hearths was found. The date range of the pottery recovered from these upper layers indicates that the site had probably ceased salt-making activity by the mid 13th century. This is a date consistent with the disuse in the late 13th century of the saltern excavated at the former Queen Mary's Nursing Home, King's Lynn (Cope-Faulkner 2014).

*Post-medieval/modern remains*

4.1.10 Natural deposits were still recorded being laid down after the cessation of salt-making at the site. A succession of deposits (Groups 198 & 199) were found to overlie the eastern part of the saltern mound and the underlying saltmarsh deposits. These took the form of masses of silt and clay presumably laid down in a marsh environment. Indeed, as well as the current site's name itself, historical maps consulted as part of the desk study for the site indicate this area to be marsh throughout the post-medieval and modern periods. The upper construction of the saltern mound appears to have been truncated to level the ground for the modern pig-farm building.

## 4.2 The saltern within the Late Saxon and medieval landscape of King's Lynn

*Economy*

4.2.1 Salt production was an important element of the economy of the region around the Wash from prehistoric times through the Roman and medieval periods. The saltern at Marsh Lane lies in the parish of Gaywood, in the Freebridge hundred, which at the time of the Norman Conquest had 30 recorded salt producing sites, more than anywhere else in the county (Johnson & Collcutt 2008, 17). This was a valuable commodity produced for domestic consumption and for customers who used salt for a variety of commercial needs. An important industrial application was as a preservative including the salting of fish catches on their return to port or its addition as a preservative to cheese. Further examples include its use in the processing and curing of hides and leather. Salt itself could also be used as a medium of exchange for other goods and services (Lane & Morris 2001, 402-404).

*Environment*

4.2.2 The salt-making industry grew to an industrial scale on the coastal margins of The Wash to feed the demand for salt, as evidenced by the many salterns mapped on the Norfolk coast in the NMP Project survey (Fig. 2). Salt production was probably carried out as a seasonal activity, on the coastal mudflats, with campaigns during the summer months (Lane & Morris 2001, 403). It is possible that salt making exploited the salt deposited by the spring tides (Rudkin 1975, 37). A salt-worker would probably return to a farming schedule and work at the end of each campaign (Miller & Hatcher 2014).

4.2.3 Each salt-making site would have had an impact on the local environment. The source of fuel for the brine boiling hearths was an important consideration, with peat being the most cited fuel source. This is evidenced by grants of salterns in Lincolnshire often associated with rights of turbary of peat. Examples include: salterns at Pinchbeck recorded with common land for fuel granted to Bourne Abbey in 1327; and turbary rights associated with salterns at Holbeach (Hallam 1960, 92; Hall & Coles 1994, 143-145). Other fuel sources may have included straw, wood, charcoal or coal depending on local availability. However, very little charcoal was recovered from Marsh Lane that indicates wood was not the fuel used. Burnt peat can be difficult to identify as the organic components are often reduced to ash. The lack of survival of any identifiable seeds, stems or molluscs from the burnt fuel ash deposits suggest these have decayed to leave only the carbon-rich, black-stained soils recorded at Marsh Lane.

4.2.4 It is presumed that organic material such as turf, straw or possibly even peat was also imported to the saltern to be used as a filter through which the salt-impregnated silts were washed through. The filtration tanks excavated at Wainfleet St Mary, Lincolnshire were thought to have contained turves (McAvoy 1994, 140–41) and a filtration unit at Marsh Lane was found to contain the remains of turves.

4.2.5 These fuels and turves would need to be transported to the salterns on the coastal mudflats by oxen. Therefore grants of land for pasturage for oxen were recorded in association with salterns as in the example of a 12th century grant to Waltham Abbey in Wrangle (Hallam 1965, 170; Hall & Coles 1994, 143-145). Teams of oxen were also used for the transportation of the salt rich coastal silt to the saltern and for the carting of the salt produced (Miller & Hatcher 2014).

*Ownership*

4.2.6 The salt-workers would usually rent their salterns, the associated turbary rights and rights of pasturage for their oxen. These rents could be paid in salt to the landowner (Miller & Hatcher 2014). The landowner may have been the lord of the manor in which the saltern lay. Examples include: five salt-houses in South Lynn (later part of King's Lynn) described in the Domesday survey of c.1086 held by Ralph de Tosney as part of his West Acre estate. Examples of ownership by ecclesiastical houses include: the grant of the Bishop of Norwich in 1101-1119 to the cathedral priory of lands including salterns in Gaywood, King's Lynn (Keen 1988, 143; Cope-Faulkner 2014); and salt pans in Terrington St Clement, to the west of King's Lynn owned by the Bishop of Ely (Hall & Coles 1994, 143-145). The salt-workers in some cases may have owned their own salt-houses as documented in Droitwich, Worcestershire in 1215. These workers payed a tax to the burgesses of the town who controlled the rights of salt production with an annual payment from themselves to the Crown. Examples of salt-houses in Cheshire are described as either owner-occupiers or lessees (Miller & Hatcher 2014).

*Process*

4.2.7 The different uses of salt required salt with different characteristics in terms of size and coarseness of grains. These differences could be controlled through production of salt by brine boiling on hearths specially constructed for this purpose thereby regulating the speed and temperature of brine evaporation (Lane & Morris 2001, 402-404). Salt encrusted silt was collected from the adjacent intertidal mudflats and processed with a method known as 'sleeching' in silt filtration units to extract the concentrated brine (Hall & Coles 1994, 143-145). These filtration units comprised a sub-rectangular pit with a flat base lined with clay for the retention of water. Turves would be placed in this pit through which the salt rich silt would be washed to filter out the silt particles. The resulting brine solution would percolate through the turves and drain through a narrow clay lined channel to a deeper clay lined circular pit. The brine could then be collected and transferred to lead pans and boiled over the hearth to produce the salt (Cope-Faulkner 2014). These hearths are recorded as being sheltered within salt-houses or salt-cotes.

*Associated activities*

4.2.8 Lead repairs and off cuts have been found on saltern mounds (Cope-Faulkner 2014; McAvoy 1994, 142) which indicate metalworking may also have been undertaken at some salterns. The evidence from Marsh Lane suggests that lead pans were probably being used at Lynn as early as the 12th century AD, and perhaps earlier in the Late Saxon period, given that lead contamination in the slags and brick supports has also been identified from the Period 1 phase of working. Iron smithing slag with associated vitrified hearth lining and fuel ash slag was identified amongst the salt-working slag of the upper, medieval part of the saltern mound at Marsh Lane. These ironworking remains indicate the clay-moulded enclosed hearths may have been used for both salt-making and iron smithing, at different times, possibly on the tools associated with the salt-making process. The clay for the lining of filtration units and for the construction of the enclosed hearths indicate a further resource that needed to be sourced and imported for the site to function.

*Decline & disuse*

4.2.9 A salt production site was specifically placed to exploit salt water marshes or tidal mudflats, and was dependant also on access to suitable pasturage for oxen and sources of peat for fuel. These sites may have also been placed near to streams used for transportation of materials and goods to and from the site. Salterns would therefore be sensitive to any economic factors or environmental change which may force their abandonment or movement to another location. This would especially be so for any changes in the local water regime including salinity levels, changes in water courses or flooding events. For example the salterns at Quadring and Gosberton in Lincolnshire went out of use due to the silting up of the Bicker Haven outlet to the sea (Hall & Coles 1994, 143-145). The construction of the Old East Seabank flood defences and the raising of ramparts for the defence of King's Lynn probably forced the abandonment of the salterns in this area in the 13th century, as was also demonstrated on the saltern remains excavated at Queen Mary's nursing home (Cope-Faulkner 2014).

## 4.3 Significance

4.3.1 The saltern at Marsh Lane is one of many mapped by the NMP in the vicinity of King's Lynn and confirms the interpretation given to these sites. Despite the numerous medieval saltern sites identified few have been fully excavated or produced significant artefactual evidence. This excavation has recorded an important example of a medieval salt-making site on The Wash in Norfolk with origins in the Late Saxon period. These remains, in the parish of Gaywood, may therefore provide an important link between the known high status Saxon site of Bawsey on the Gaywood River, 3km to the east of the site, and the suspected Saxon origins of the town of King's Lynn (Brown & Hardy 2011, 100). The salt-making industry perhaps acting as a catalyst for its foundation. The remains, and associated features on the site, are evidence for salt-making, evolving from the *c*.8th century in the Late Saxon period through to the early medieval period with salt-making demonstrated to have ceased by the mid-13th century. The archaeological remains uncovered will contribute significantly to the understanding of the evolution of the salt-making industry of King's Lynn during these periods and the environmental setting in which this industry was situated.

## 4.4 Dissemination of the results of excavation

4.4.1 This final report will be submitted to James Albone of Norfolk County Council Historic Environment Service on behalf of Lovell Partnerships Limited who commissioned the work.

4.4.2 A publication proposal has been accepted by Norfolk Archaeology (22/06/2016) with the aim of publishing a short article on the saltern remains in the Society's journal. The article to be published will be submitted by the end of 2016.

4.4.3 The archive for the project will be deposited with Norfolk Museum in January 2017.

## Appendix A. Excavation Context Inventory

| Context | Cut | Grp. | Per-iod | Trench/Test Pit/ **Ex. phase** | Category | Feature Type | Function | Colour | Fine component | Coarse component | Compaction | Shape in Plan | Profile |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7 | | | 3 | Tr4 | modern | ditch | service trench | | | | | | |
| 8 | | | 3 | Tr4 | modern | ditch | service trench | | | | | | |
| 9 | 9 | | 3 | Tr3 | cut | pit | modern truncation | | | | | sub-rectangular | square cut |
| 10 | 9 | | 3 | Tr3 | fill | pit | disuse | mid orange/grey | clay | | firm | | |
| 11 | 11 | 3 | 2 | **I** | cut | closed hearth | brine boiling | | | | | sub-circular | U-shaped |
| 12 | 11 | 3 | 2 | **I** | fill | closed hearth | hearth base | orange/red | burnt clay | | firm | | |
| 13 | | 197 | 3 | Tr5 | layer | made ground | modern | mid beige brown | clayey silt | modern rubble | firm | | |
| 15 | | 201 | 1 | Tr5 | layer | saltern mound | filtration waste | mid brown | clayey silt | | firm | | |
| 18 | 18 | | 3 | Tr6 | cut | channel | watercourse | | | | | linear | |
| 19 | 18 | | 3 | Tr6 | fill | channel | watercourse | mid grey | silty clay | occ. clay lumps | loose | | |
| 20 | 21 | | 3 | Tr7 | fill | channel | watercourse | mid brown red | silty clay | occ. burnt clay | soft | | |
| 21 | 21 | | 3 | Tr7 | cut | channel | watercourse | | | | | linear | |
| 22 | 21 | | 3 | Tr7 | fill | channel | watercourse | mid grey brown | silty clay | | soft | | |
| 23 | 21 | | 3 | Tr7 | fill | channel | watercourse | dark grey brown | silty clay | | soft | | |
| 24 | 18 | | 3 | Tr6 | fill | channel | watercourse | mid grey | silty clay | occ. clay lumps | friable | | |
| 25 | 18 | | 3 | Tr6 | fill | channel | watercourse | mid grey brown | silty clay | occ. clay lumps and sand lenses | friable | | |
| 26 | 18 | | 3 | Tr6 | fill | channel | watercourse | light mid grey | clayey silt | occ. clay lumps | soft | | |
| 28 | | 197 | 3 | Tr8 | layer | made ground | modern | mid dark brown | clayey silt | occ. gravel | soft | | |
| 29 | | 198 | 3 | Tr8 | layer | natural | marsh deposit | light grey | silty clay | | | | |

| Context | Cut | Grp. | Per-iod | Trench/Test Pit/ **Ex. phase** | Category | Feature Type | Function | Colour | Fine component | Coarse component | Compaction | Shape in Plan | Profile |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 30 | | 198 | 3 | Tr8 | layer | natural | marsh deposit | mid orange brown | clayey silt | | soft | | |
| 31 | | 198 | 3 | Tr8 | layer | natural | marsh deposit | mid yellow grey | silty clay | | soft | | |
| 32 | | 199 | 3 | Tr8 | layer | natural | marsh deposit | blueish grey | clayey silt | | firm | | |
| 33 | | 200 | 2 | Tr2 | layer | saltern mound | hearth waste | mid red brown | sandy silt | occ. charcoal | friable | | |
| 34 | | 200 | 2 | Tr2 | layer | saltern mound | filtration waste | mid grey brown | clayey silt | occ. clay lumps and sand lenses | firm | | |
| 35 | | 200 | 2 | Tr2 | layer | saltern mound | hearth waste | mid dark reddish brown | clayey silt | charcoal and fired clay frags. | soft | | |
| 38 | 42 | 3 | 2 | **I** | fill | closed hearth | disuse | dark brown red | clayey sand | | friable | | |
| 39 | 42 | 3 | 2 | **I** | fill | closed hearth | hearth floor | mid red | clay | | firm | | |
| 41 | 42 | 3 | 2 | **I** | fill | closed hearth | disuse | dark red | clay | | firm | | |
| 42 | 42 | 3 | 2 | **I** | cut | closed hearth | hearth flue | | | | | linear | U-shaped |
| 59 | 59 | | 3 | Tr7 | cut | foundation trench | modern structure | | | | | sub-rectangular | |
| 60 | 59 | | 3 | Tr7 | fill | foundation trench | disuse | mid brownish grey | silty clay | rubble | firm | | |
| 61 | 61 | | 3 | Tr9 | Cut | pit | modern truncation | | | | | sub-circular | U-shaped |
| 64 | 61 | | 3 | Tr9 | Fill | pit | disuse | light brownish grey | clayey silt | rare gravel inclusions | firm | | |
| 67 | | 201 | 1 | Tr9 | layer | saltern mound | filtration waste | mid brown with reddish brown lenses | clayey silt | | firm | | |
| 71 | | 197 | 3 | Tr6 | layer | made ground | modern | dark grey brown | silty clay | | friable | | |
| 73 | | 199 | 3 | Tr6 | layer | natural | marsh deposit | mid brown | silty clay | occ. clay lumps and sand lenses | firm | | |

| Context | Cut | Grp. | Per-iod | Trench/Test Pit/ **Ex. phase** | Category | Feature Type | Function | Colour | Fine component | Coarse component | Compaction | Shape in Plan | Profile |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 75 | 75 | 3 | 2 | Tr7 | cut | closed hearth | hearth flue | | | | | linear | U-shaped |
| 76 | 75 | 3 | 2 | Tr7 | fill | closed hearth | disuse | mid red brown | silty clay | | soft | | |
| 78 | 78 | | 1 | Tr7 | cut | filtration unit | silt filtration | | | | | circular | U-shaped |
| 79 | 78 | | 1 | Tr7 | fill | filtration unit | disuse | mid brown grey | silty clay | | firm | | |
| 80 | 81 | | 1 | Tr7 | fill | filtration unit | clay lining | light yellow grey | clay | | firm | | |
| 81 | 81 | | 1 | Tr7 | cut | filtration unit | silt filtration | | | | | circular | U-shaped |
| 82 | 81 | | 1 | Tr7 | fill | filtration unit | disuse | mid brown grey | silty clay | | firm | | |
| 83 | | 197 | 3 | TP1 | layer | made ground | modern | mid yellow | silty clay | | | | |
| 84 | | 197 | 3 | TP1 | layer | made ground | modern | dark grey | sand | fired clay frags., ash, charcoal | loose | | |
| 85 | | 198 | 3 | TP1 | layer | natural | marsh deposit | dark brown | silt | | soft | | |
| 86 | | 199 | 3 | TP1 | layer | natural | marsh deposit | yellowish brown | silt | | soft | | |
| 87 | | 197 | 3 | TP2 | layer | made ground | modern | mid brown | silty clay | | soft | | |
| 88 | | 198 | 3 | TP2 | layer | natural | marsh deposit | dark brown | silt | | soft | | |
| 89 | | 199 | 3 | TP2 | layer | natural | marsh deposit | mid brown | silt | | soft | | |
| 90 | | 197 | 3 | TP3 | layer | made ground | modern | dark grey brown | silty clay | charcoal, clay lumps | soft | | |
| 91 | | 200 | 2 | TP3 | layer | saltern mound | filtration waste | yellowish brown | silt | | soft | | |
| 92 | | 200 | 2 | TP3 | layer | saltern mound | hearth waste | yellowish brown with lenses of red and black | silt | burnt clay fragments | soft | | |
| 93 | | 200 | 2 | TP3 | layer | saltern mound | filtration waste | yellowish brown | silt | | soft | | |
| 94 | | 200 | 2 | Tr7 | layer | saltern mound | hearth waste | dark reddish brown | clayey silt | Frequent charcoal, slag, | soft | | |

| Context | Cut | Grp. | Per-iod | Trench/Test Pit/ **Ex. phase** | Category | Feature Type | Function | Colour | Fine component | Coarse component | Compaction | Shape in Plan | Profile |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | fired clay, shell fragments | | | |
| 97 | | 200 | 2 | Tr2 | layer | saltern mound | hearth waste | mid red brown | silty clay | charcoal flecks | loose | | |
| 98 | | 200 | 2 | Tr2 | layer | saltern mound | hearth waste | mid red | clayey silt | occ clay lumps | loose | | |
| 99 | | 200 | 2 | Tr2 | layer | saltern mound | hearth waste | mid grey brown | clayey silt | occ clay lumps and charcoal | friable | | |
| 100 | | 200 | 2 | Tr2 | layer | saltern mound | hearth waste | mid red brown | silty clay | charcoal flecks | friable | | |
| 101 | | 201 | 2 | Tr2 | layer | saltern mound | filtration waste | mid grey brown | silty clay | clay lumps and sand lenses | friable | | |
| 102 | | 198 | 3 | Tr2 | layer | natural | marsh deposit | mid grey brown | clayey silt | mottling | firm | | |
| 105 | | 198 | 3 | Tr2 | layer | natural | marsh deposit | mid dark blue grey | clayey silt | | firm | | |
| 106 | 78 | | 1 | Tr7 | fill | filtration unit | clay lining | light blue grey | clay | | firm | | |
| 107 | 205 | 3 | 2 | **I** | fill | closed hearth | superstructure | red | clay | | hard | | |
| 110 | | 200 | 2 | Tr2 | layer | saltern mound | hearth waste | dark grey brown | silt | charcoal inclusions | | | |
| 111 | | 200 | 2 | Tr2 | layer | saltern mound | hearth waste | mid red brown | silt | | soft | | |
| 112 | 205 | 3 | 2 | **I** | fill | closed hearth | disuse | mid brown red | clayey silt | charcoal | soft | | |
| 114 | 205 | 3 | 2 | **I** | fill | closed hearth | disuse | dark blue grey | clayey silt | charcoal | friable | | |
| 115 | 205 | 3 | 2 | **I** | fill | closed hearth | hearth base | red | clay | | firm | | |
| 116 | 205 | 3 | 2 | **I** | fill | closed hearth | vitrified hearth base | light green | clay | | hard | | |
| 117 | 205 | 3 | 2 | **I** | fill | closed hearth | disuse | mid red grey | clayey silt | charcoal | soft | | |
| 118 | 205 | 3 | 2 | **I** | fill | closed hearth | disuse | dark blue grey | clayey silt | freq. charcoal | soft | | |
| 119 | 205 | 3 | 2 | **I** | fill | closed hearth | disuse | mid brown grey | silty clay | | soft | | |

| Context | Cut | Grp. | Per-iod | Trench/Test Pit/ **Ex. phase** | Category | Feature Type | Function | Colour | Fine component | Coarse component | Compaction | Shape in Plan | Profile |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 120 | 205 | 3 | 2 | I | fill | closed hearth | disuse | light orange yellow | clayey silt | | firm | | |
| 121 | 205 | 3 | 2 | I | fill | closed hearth | disuse | mid brown grey | silty clay | occ. flecks of charcoal | firm | | |
| 122 | 205 | 3 | 2 | I | fill | closed hearth | disuse | mid brown grey | clayey silt | slag | firm | | |
| 123 | 205 | 3 | 2 | I | fill | closed hearth | disuse | mid brown grey | clayey silt | occ. rubble | firm | | |
| 124 | | 200 | 2 | I | layer | saltern mound | hearth waste | mid brown grey | clayey silt | occ. gravel inclusions | soft | | |
| 125 | | 200 | 2 | I | layer | saltern mound | hearth waste | mid brown grey | clayey silt | rare gravel and charcoal | soft | | |
| 126 | 131 | | 1 | I | fill | filtration unit | clay lining | light blue grey | clay | | firm | | |
| 127 | 131 | | 1 | I | fill | filtration unit | disuse | mid brown grey | silty clay | rare charcoal | firm | | |
| 128 | 131 | | 1 | I | fill | filtration unit | disuse | mid grey brown | clayey silt | fuel ash slag inclusions | firm | | |
| 129 | 131 | | 1 | I | fill | filtration unit | disuse | mid brown grey | silty clay | rare gravel | firm | | |
| 131 | 131 | | 1 | I | cut | filtration unit | silt filtration | | | | | circular | |
| 132 | 205 | 3 | 2 | I | fill | closed hearth | disuse | mid yellow brown | sandy silt | fuel ash slag inclusions | friable | | |
| 135 | | 198 | 3 | Tr2 | layer | natural | marsh deposit | mid yellow brown | clayey silt | sandy lenses and clay lumps | firm | | |
| 136 | | 200 | 2 | Tr2 | layer | saltern mound | filtration waste | mid grey brown | clayey silt | | firm | | |
| 137 | | 200 | 2 | Tr2 | layer | saltern mound | filtration waste | dark grey brown | clayey silt | charcoal flecks | loose | | |
| 138 | | 200 | 2 | Tr2 | layer | saltern mound | filtration waste | mid grey brown | clayey silt | | loose | | |
| 139 | | 200 | 2 | Tr2 | layer | saltern mound | hearth waste | mid dark brown | clayey silt | occ. clay lumps | friable | | |

| Context | Cut | Grp. | Per-iod | Trench/Test Pit/ **Ex. phase** | Category | Feature Type | Function | Colour | Fine component | Coarse component | Compaction | Shape in Plan | Profile |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | red | | | | | |
| 140 | | 200 | 2 | Tr2 | layer | saltern mound | filtration waste | mid dark grey brown | clayey silt | occ. charcoal | loose | | |
| 149 | 205 | 3 | 2 | **I** | fill | closed hearth | disuse | light red orange | silty clay | | soft | | |
| 150 | 205 | 3 | 2 | **I** | fill | closed hearth | disuse | light mid brown grey | silty clay | occ. Gravel inclusions | firm | | |
| 151 | | 200 | 2 | Tr2 | layer | saltern mound | hearth waste | mid red brown | silty clay | occ. charcoal | loose | | |
| 152 | | 200 | 2 | Tr2 | layer | saltern mound | filtration waste | mid grey brown | clayey silt | occ. clay lump | friable | | |
| 153 | | 200 | 2 | Tr2 | layer | saltern mound | filtration waste | mid yellow brown grey | clay | | firm | | |
| 154 | | 200 | 2 | Tr2 | layer | saltern mound | filtration waste | mid grey brown | clayey silt | occ. clay lumps | firm | | |
| 155 | | 201 | 1 | TP4 | layer | saltern mound | filtration waste | light brown | clayey silts | | firm | | |
| 156 | | | 1 | TP4 | layer | saltern mound | hearth waste | dark red grey | sandy silt | freq. charcoal | soft | | |
| 157 | | 202 | 1 | TP4 | layer | saltern mound | filtration waste | light yellow brown | clayey silt | | soft | | |
| 160 | 205 | 3 | 2 | **I** | fill | closed hearth | disuse | light orange yellow | clayey silt | | friable | | |
| 162 | 205 | 3 | 2 | **I** | fill | closed hearth | vitrified hearth base | mid green | clay | | hard | | |
| 164 | 164 | 2 | 1 | **II** | cut | filtration unit | silt filtration | | | | | complex | irregular |
| 166 | 164 | 2 | 1 | **II** | fill | filtration unit | disuse | mid brown grey | clayey silt | | soft | | |
| 167 | 164 | 2 | 1 | **II** | fill | filtration unit | disuse | mid brown grey | clayey silt | rare charcoal frags. | soft | | |
| 168 | 168 | 2 | 1 | **II** | cut | filtration unit | silt filtration | | | | | sub- | |

| Context | Cut | Grp. | Per-iod | Trench/Test Pit/ **Ex. phase** | Category | Feature Type | Function | Colour | Fine component | Coarse component | Compaction | Shape in Plan | Profile |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | rectangular | |
| 169 | 168 | 2 | 1 | **II** | fill | filtration unit | disuse | mid reddish brown | clayey silt | occ. charcoal | soft | | |
| 170 | 170 | 2 | 1 | **II** | cut | filtration unit | silt filtration | | | | | sub-circular | U-shaped |
| 171 | 170 | 2 | 1 | **II** | fill | filtration unit | lining | mid blueish grey | clay | occ. charcoal flecks | soft | | |
| 172 | 168 | 2 | 1 | **II** | fill | filtration unit | lining | mid grey blue with orange patches | clay | charcoal | firm | | |
| 173 | 164 | 2 | 1 | **II** | fill | filtration unit | lining | light blue grey | clay | | firm | | |
| 175 | 175 | 2 | 1 | **II** | cut | open hearth | brine boiling | | | | | circular | U-shaped |
| 176 | 175 | 2 | 1 | **II** | fill | open hearth | disuse | dark brownish red | clayey silt | charcoal | loose | | |
| 177 | 177 | 2 | 1 | **II** | cut | open hearth | brine boiling | | | | | circular | U-shaped |
| 178 | 177 | 2 | 1 | **II** | fill | open hearth | disuse | light greyish brown | clayey silt | | soft | | |
| 179 | 179 | 2 | 1 | **II** | cut | filtration unit | silt filtration | | | | | sub-rectangular | square |
| 180 | 179 | 2 | 1 | **II** | fill | filtration unit | lining | dark blueish grey | silty clay | occ. gravel, charcoal | firm | | |
| 182 | 170 | 2 | 1 | **II** | fill | filtration unit | disuse | dark orangy brown | silty clay | | soft | | |
| 187 | 187 | 2 | 1 | **II** | cut | filtration unit | silt filtration | | | | | complex | irregular |
| 188 | 187 | 2 | 1 | **II** | fill | filtration unit | lining | greenish grey with brownish grey flecks | clay | rare gravel inclusions | firm | | |
| 189 | 187 | 2 | 1 | **II** | fill | filtration unit | disuse | dark grey brown | clayey silt | occ. gravel | firm | | |

| Context | Cut | Grp. | Per-iod | Trench/Test Pit/ **Ex. phase** | Category | Feature Type | Function | Colour | Fine component | Coarse component | Compaction | Shape in Plan | Profile |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 190 | 190 | 2 | 1 | **II** | cut | open hearth | brine boiling | | | | | sub-linear | shallow U-shaped |
| 191 | 190 | 2 | 1 | **II** | fill | open hearth | disuse | grey blue | silty clay | | firm | | |
| 192 | 190 | 2 | 1 | **II** | fill | open hearth | disuse | mid brown with yellow red mottling | clayey silt | occ. charcoal flecks | compact | | |
| 193 | 193 | 2 | 1 | **II** | cut | filtration unit | silt filtration | | | | | sub-circular | U-shaped |
| 194 | 193 | 2 | 1 | **II** | fill | filtration unit | disuse | dark greyish brown/light yellowish brown lenses | clayey silt | | soft | | |
| 195 | 193 | 2 | 1 | **II** | fill | filtration unit | disuse | mid orangey brown | clayey silt | | soft | | |
| 196 | 193 | 2 | 1 | **II** | fill | filtration unit | disuse | mid yellowish brown | clayey silt | | soft | | |
| 197 | | 197 | 3 | **II** | layer | made ground | modern | light yellowish grey | sandy silt | frequent flint gravel ,bricks, asphalt, concrete rubble | compact/firm | | |
| 198 | | 198 | 3 | **II** | layer | natural | marsh deposit | mid brown | clayey silt | | firm | | |
| 199 | | 199 | 3 | **II** | layer | natural | marsh deposit | mid brown/yellow brown/greyish blue mottled | clayey silt | | firm | | |
| 200 | | 200 | 2 | **II** | layer | saltern mound | hearth waste | black/red/yellow /grey | sandy silt | occ. gravel inclusions | soft | | |
| 201 | | 201 | 1 | **II** | layer | saltern mound | filtration waste | light brown | silt | | compact/firm | | |

| Context | Cut | Grp. | Per-iod | Trench/Test Pit/ **Ex. phase** | Category | Feature Type | Function | Colour | Fine component | Coarse component | Compaction | Shape in Plan | Profile |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 202 | | 202 | 1 | **II** | layer | saltern mound | filtration waste | mid brown | silt | | firm/compact | | |
| 203 | 203 | 2 | 1 | **II** | cut | filtration unit | silt filtration | | | | | complex | irregular |
| 204 | 203 | 2 | 1 | **II** | fill | filtration unit | disuse | mid greyish brown/blue lenses | clayey silt | | soft | | |
| 205 | 205 | 3 | 2 | **II** | cut | closed hearth | brine boiling | | | | | circular | U-shaped |
| 206 | | 200 | 2 | **II** | layer | saltern mound | hearth waste | reddish brown | silt | fragments of fired clay and charcoal | firm/compact | | |
| 207 | | 200 | 2 | **II** | layer | saltern mound | hearth waste | dark reddish brown | silghtly sandy silt | fired clay, charcoal frags | firm/compact | | |
| 208 | | 200 | 2 | **II** | layer | saltern mound | filtration waste | yellow brown | silt | | firm/compact | | |
| 209 | | 200 | 2 | **II** | layer | saltern mound | hearth waste | dark reddish brown | slightly sandy silt | fired clay and charcoal frags | firm/compact | | |
| 210 | | 200 | 2 | **II** | layer | saltern mound | filtration waste | yellow brown | silt | | firm/compact | | |
| 211 | | 200 | 2 | **II** | layer | saltern mound | hearth waste | dark reddish brown | sandy (ashy) silt | charcoal & fired clay frags | firm/compact | | |
| 212 | | 201 | 1 | **II** | layer | saltern mound | filtration waste | light yellow brown | silt | | firm/compact | | |
| 213 | | 200 | 2 | **II** | layer | saltern mound | hearth waste | reddish brown | silt | fired clay & charcoal frags | firm/compact | | |
| 214 | | 201 | 1 | **II** | layer | saltern mound | filtration waste | light yellowish brown | silt | | firm/compact | | |
| 215 | | | 1 | **II** | layer | saltern mound | hearth waste | reddish brown | silt | fired clay & charcoal frags | firm/compact | | |

| Context | Cut | Grp. | Per-iod | Trench/Test Pit/ **Ex. phase** | Category | Feature Type | Function | Colour | Fine component | Coarse component | Compaction | Shape in Plan | Profile |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 216 | | 200 | 2 | **II** | layer | saltern mound | hearth waste | orange, black, red brown, yellow brown lenses | slightly sandy silt | fired clay & charcoal frags | firm/compact | | |
| 217 | | 202 | 1 | **II** | layer | saltern mound | filtration waste | dark yellowish brown | silt | charcoal frags | firm/compact | | |
| 218 | | | 1 | **II** | layer | surface (external) | buried soil | black | sandy silt | | firm/compact | | |
| 219 | | | 1 | **II** | layer | surface (external) | buried soil | orange | silt | | firm/compact | | |
| 220 | 203 | 2 | 1 | **II** | fill | filtration unit | disuse | dark orangey brown | sandy silt | | soft | | |
| 221 | 203 | 2 | 1 | **II** | fill | filtration unit | disuse | dark brownish grey | sandy silt | | soft | | |
| 222 | 203 | 2 | 1 | **II** | fill | filtration unit | lining | light brownish blue | clay | | soft | | |
| 223 | 223 | 2 | 1 | **II** | cut | water tank | water storage | | | | | sub-rectangular | bowl-shaped |
| 224 | 223 | 2 | 1 | **II** | fill | water tank | lining | light blue grey | clay | no inclusions | firm | | |
| 225 | 223 | 2 | 1 | **II** | fill | water tank | disuse | mid grey brown | clayey silt | rare charcoal + clay lumps/lenses | firm | | |
| 226 | 226 | 2 | 1 | **II** | cut | filtration unit | silt filtration | | | | | sub-circular | U-shaped |
| 227 | 226 | 2 | 1 | **II** | fill | filtration unit | lining | light blue grey | clay | | firm | | |
| 228 | 226 | 2 | 1 | **II** | fill | filtration unit | disuse | mid grey brown | clayey silt | rare charcoal | firm | | |
| 229 | 11 | 3 | 2 | **I** | fill | closed hearth | vitrified hearth base | brownish grey | clay | charcoal flecks | firm | | |

| Context | Cut | Grp. | Per-iod | Trench/Test Pit/ **Ex. phase** | Category | Feature Type | Function | Colour | Fine component | Coarse component | Compaction | Shape in Plan | Profile |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 230 | 11 | 3 | 2 | **I** | fill | closed hearth | vitrified hearth base | greyish green | clay | fired clay | hard | | |
| 231 | 231 | 2 | 1 | **II** | cut | filtration unit | silt filtration | | | | | sub-square | square |
| 232 | 231 | 2 | 1 | **II** | fill | filtration unit | disuse | light greyish brown | clayey silt | occ. fired clay flecks | soft | | |
| 234 | | 197 | 3 | **II** | layer | made ground | post-med./modern | light yellowish brown | silt | | firm/compact | | |
| 235 | 231 | 2 | 1 | **II** | fill | filtration unit | lining | light greyish blue | clay | | soft | | |
| 236 | 236 | 2 | 1 | **II** | cut | filtration unit | silt filtration | | | | | circular | u-shape |
| 237 | 236 | 2 | 1 | **II** | fill | filtration unit | lining | mid greyish blue | clay | | firm | | |
| 238 | 236 | 2 | 1 | **II** | fill | filtration unit | disuse | mid yellowish grey | clayey silt | | firm | | |
| 239 | | | 1 | **II** | layer | saltern mound | filtration waste | mid grey | clayey silt | | compact/firm | | |
| 240 | | 240 | | **III** | layer | natural | saltmarsh deposits | mid grey | slightly sandy silty clay | | firm | | |
| 241 | 241 | 240 | | **III** | cut | natural | intertidal creek | | | | | complex | unknown |
| 242 | 241 | 240 | | **III** | fill | natural | saltmarsh deposits | orange (with grey blue patches) | slightly silty sand | | dense | | |
| 243 | 241 | 240 | | **III** | fill | natural | saltmarsh deposits | mid reddish brown | silty clay | | firm | | |
| 244 | 241 | 240 | | **III** | fill | natural | saltmarsh deposits | orange | slightly silty sand | | dense | | |

| Context | Cut | Grp. | Per-iod | Trench/Test Pit/ **Ex. phase** | Category | Feature Type | Function | Colour | Fine component | Coarse component | Compaction | Shape in Plan | Profile |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 245 | 245 | 240 | | **III** | cut | natural | intertidal creek | | | | | complex | unknown |
| 246 | 245 | 240 | | **III** | fill | natural | saltmarsh deposits | mid grey | slightly sandy silty clay | | firm | | |
| 247 | 245 | 240 | | **III** | fill | natural | saltmarsh deposits | mid reddish brown | slightly clayey sandy silt | | firm | | |
| 248 | 248 | 240 | | **III** | cut | natural | intertidal creek | | | | | complex | |
| 249 | 248 | 240 | | **III** | fill | natural | saltmarsh deposits | mid reddish brown | slightly clayey sandy silt | | firm | | |
| 250 | | | 1 | **III** | layer | saltern mound | filtration waste | light/mid brown grey | clayey silt | rare charcoal | soft/firm | | |
| 251 | | | 1 | **III** | layer | saltern mound | hearth waste | red | silghtly sandy silt | fired clay, charcoal frags | firm | | |
| 252 | | 240 | | **III** | layer | natural | saltmarsh deposits | mid grey blue | silty clay | occ. charcoal & plant macrofossils | firm | | |
| 253 | 253 | 1 | 1 | **III** | cut | filtration unit | silt filtration | | | | | complex | irregular |
| 254 | 254 | 1 | 1 | **III** | cut | filtration unit | silt filtration | | | | | complex | irregular |
| 255 | 254 | 1 | 1 | **III** | fill | filtration unit | lining | light blue grey | clay | | firm | | |
| 256 | 254 | 1 | 1 | **III** | fill | filtration unit | disuse | mid grey brown | clayey silt | | soft | | |
| 257 | 254 | 1 | 1 | **III** | fill | filtration unit | disuse | mid grey brown | clayey silt | | soft | | |
| 258 | 258 | 1 | 1 | **III** | cut | filtration unit | silt filtration | | | | | complex | irregular |
| 259 | 258 | 1 | 1 | **III** | fill | filtration unit | lining | light blue grey | clay | rare charcoal | firm | | |

| Context | Cut | Grp. | Per-iod | Trench/Test Pit/ **Ex. phase** | Category | Feature Type | Function | Colour | Fine component | Coarse component | Compaction | Shape in Plan | Profile |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 260 | 258 | 1 | 1 | **III** | fill | filtration unit | disuse | mid grey brown, occ mottling | clayey silt | rare charcoal | soft | | |
| 261 | 258 | 1 | 1 | **III** | fill | filtration unit | disuse | mid grey brown, occ mottling | clayey silt | rare charcoal | soft | | |
| 264 | 258 | 1 | 1 | **III** | fill | filtration unit | turvs | light grey blue | clay | | fairly soft | | |
| 265 | 253 | 1 | 1 | **III** | fill | filtration unit | lining | mid blue | clay | | firm | | |
| 266 | 253 | 1 | 1 | **III** | fill | filtration unit | disuse | mid reddish brown | silt with small clay incl | | firm | | |
| 267 | 253 | 1 | 1 | **III** | fill | filtration unit | disuse | mid reddish brown | silt | | firm | | |
| 268 | 268 | 1 | 1 | **III** | cut | filtration unit | silt filtration | | | | | sub-circular | bowl-shaped |
| 269 | 268 | 1 | 1 | **III** | fill | filtration unit | lining | light blue grey | clay | | firm | | |
| 270 | 268 | 1 | 1 | **III** | fill | filtration unit | disuse | mid grey brown | clayey silt | rare charcoal | soft | | |
| 271 | 271 | 1 | 1 | **III** | cut | filtration unit | silt filtration | | | | | circular | U-shaped |
| 272 | 271 | 1 | 1 | **III** | fill | filtration unit | lining | light blue grey | clay | | firm | | |
| 273 | 271 | 1 | 1 | **III** | fill | filtration unit | disuse | mid grey clay | clayey silt | | soft | | |
| 274 | 274 | 1 | 1 | **III** | cut | filtration unit | silt filtration | | | | | circular | U-shaped |
| 275 | 274 | 1 | 1 | **III** | fill | filtration unit | lining | mid blue | clay | | firm | | |
| 276 | 274 | 1 | 1 | **III** | fill | filtration unit | disuse | mid reddish brown | silts, rare clay lenses | | firm | | |
| 277 | 277 | 1 | 1 | **III** | cut | open hearth | brine boiling | | | | | complex | irregular |
| 278 | | 201 | 1 | **III** | layer | saltern mound | filtration waste | light brown | silt | | compact/firm | | |
| 279 | | 202 | 1 | **III** | layer | saltern mound | filtration waste | mid brown | silt | | compact/firm | | |

| Context | Cut | Grp. | Per-iod | Trench/Test Pit/ **Ex. phase** | Category | Feature Type | Function | Colour | Fine component | Coarse component | Compaction | Shape in Plan | Profile |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 280 | | 240 | | **III** | layer | natural | marsh deposit | blueish green | clay | plant macrofossil inclusions | firm | | |
| 281 | 277 | 1 | 1 | **III** | fill | open hearth | disuse | mid yellowish brown, dark grey brown, dark red, orange, mixed | clayey silt | fired clay fragments | friable | | |
| 286 | | 197 | 3 | **III** | layer | made ground | modern | mid yellowy grey | clayey silt | rare charcoal | soft | | |
| 287 | | 200 | 2 | **III** | layer | saltern mound | hearth waste | mid browny red | clayey silt | occ. charcoal inclusions | soft | | |
| 288 | | 201 | 1 | **III** | layer | saltern mound | filtration waste | mid grey brown, occ mottling | clayey silt | occ. charcoal inclusions | soft | | |
| 289 | | 202 | 1 | **III** | layer | saltern mound | filtration waste | mid brown grey | clayey silt | occ. charcoal inclusions | soft | | |
| 290 | | | 1 | **III** | layer | surface (external) | land surface | light grey orange | silty clay | rare charcoal inclusions | soft | | |
| 291 | | | 1 | **III** | layer | surface (external) | land surface | light blue grey | clay | rare charcoal inclusions | firm | | |
| 293 | | 293 | | **III** | layer | natural | creek deposit | mid/dark brown grey | clayey silt | occ. charcoal inclusions | soft | | |
| 294 | 294 | 2 | 1 | **III** | Cut | filtration unit | silt filtration | | | | | circular | U-shaped |
| 295 | 294 | 2 | 1 | **III** | fill | filtration unit | lining | blue grey | clay | | firm | | |
| 296 | 294 | 2 | 1 | **III** | fill | filtration unit | disuse | mid brown | silt | | compact/firm | | |
| 297 | | 201 | 1 | **III** | layer | saltern mound | filtration waste | mid greyish brown | silt | | firm | | |
| 298 | | 201 | 1 | **III** | layer | saltern mound | filtration waste | yellow brown | silty sand | | firm | | |

| Context | Cut | Grp. | Per-iod | Trench/Test Pit/ **Ex. phase** | Category | Feature Type | Function | Colour | Fine component | Coarse component | Compaction | Shape in Plan | Profile |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 299 | | | 1 | **III** | layer | saltern mound | hearth waste | deep reddish brown | silt | | firm | | |
| 300 | | 202 | 1 | **III** | layer | saltern mound | filtration waste | mid greyish brown | clayey silt | | soft | | |
| 301 | | | 1 | **III** | layer | surface (external) | land surface | mid brown | sandy clayey silt | | solid | | |
| 302 | | | 1 | **III** | layer | saltern mound | filtration waste | lenses of yellow and bluish grey | clay | | firm | | |
| 303 | | 201 | 1 | **III** | layer | saltern moundfiltration waste | filtration waste | light brown | silt | | compact/firm | | |
| 304 | | 202 | 1 | **III** | layer | saltern mound | filtration waste | mid brown | silt | | firm/compact | | |
| 305 | | | 1 | **III** | layer | saltern mound | filtration waste | mid brown | silt | | compact/firm | | |

*Table 4: Context Inventory*

# Appendix B. Finds Reports

## B.1 Pottery

*By Sue Anderson*

### *Introduction*

B.1.1 Seventy-eight sherds of pottery weighing 689g were collected from fifteen contexts during the excavation. Table 5 shows the quantification by fabric; a summary catalogue by context is included as Table 6.

| Description | Date range | Fabric | No | Wt/g | eve | MNV |
|---|---|---|---|---|---|---|
| Thetford Ware (Grimston) | L.10th–11th c. | THETG | 37 | 248 | 0.63 | 11 |
| Early medieval ware | 11th–13th c. | EMW | 14 | 84 | 0.06 | 10 |
| Medieval coarseware | 12th–14th c. | MCW | 8 | 189 | | 1 |
| Grimston coarseware | 12th–M.13th c. | GRCW | 10 | 135 | 0.11 | 4 |
| *Total Late Saxon to medieval* | | | *70* | *656* | *0.80* | *26* |
| Tin-glazed earthenwares | 16th–18th c. | TGE | 1 | 2 | 0.03 | 1 |
| Refined white earthenwares | L.18th–20th c. | REFW | 2 | 5 | | 2 |
| Creamwares | 18th c. | CRW | 1 | 4 | | 1 |
| Pearlware | L.18th–19th c. | PEW | 1 | 1 | 0.05 | 1 |
| English Stoneware Nottingham-type | 19th c. | ESWN | 1 | 5 | | 1 |
| Late slipped redware | L.18th–19th c. | LSRW | 3 | 16 | | 3 |
| *Total post-medieval to modern* | | | *8* | *33* | *0.08* | *9* |
| | | | 78 | 689 | 0.88 | 35 |

*Table 5: Pottery quantification by fabric*

| Context | Fabric | Type | No | Wt/g | MNV | Form | Rim | Handle | Base | Parallel | Decoration | Glaze int | Glaze ext | Rim diam | Rim percent | Abrasion | Soot | Wear | Draw? | Notes | Spot date |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 33 | EMW | U | 2 | 7 | 1 | | | | | | | | | | | + | | | | oxid ext, occ soft red incl | |
| 33 | EMW | U | 1 | 16 | 1 | | | | | | | | | | | | | | | oxid int, white deposit ext | |
| 33 | GRCW | B | 1 | 13 | 1 | | | | S | | | | | | | + | | | | pinkish deposit all over | |
| 35 | GRCW | U | 1 | 15 | 1 | | | | | | | | | | | | int | | | or THETG? Slight shoulder | |
| 35 | GRCW | U | 1 | 6 | 1 | | | | | | | | | | | | | | | burnt or heavily overfired | |
| 41 | EMW | B | 1 | 12 | 1 | | | | S | | | | | | | | | | | oxid both surfaces | |
| 41 | EMW | R | 1 | 10 | 1 | JR | SEV | | | | | | | 180 | 6 | + | | ext | | slightly squared rim edge, but damaged | |
| 64 | ESWN | D | 1 | 5 | 1 | | | | | | | | B | | | | | | | | |
| 64 | LSRW | D | 1 | 14 | 1 | | | | | | SLW int | Y/B | DB | | | | | | | | |
| 64 | REFW | U | 2 | 5 | 2 | | | | | | | | | | | | | | | | |
| 64 | PEW | R | 1 | 1 | 1 | BL | PL | | | | TP blue border int | C | C | 120 | 5 | | | | | flaring sided? | |
| 67 | THETG | U | 6 | 11 | 1 | | | | | | | | | | | + | | | | fully reduced | |
| 67 | THETG | U | 1 | 7 | 1 | | | | | | | | | | | | | | | fully reduced | |

| Context | Fabric | Type | No | Wt/g | MNV | Form | Rim | Handle | Base | Parallel | Decoration | Glaze int | Glaze ext | Rim diam | Rim percent | Abrasion | Soot | Wear | Draw? | Notes | Spot date |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 67 | THETG | U | 1 | 5 | 1 | | | | | | | | | | | | | ext | | oxid ext | |
| 67 | THETG | B? | 1 | 6 | 1 | | | | F? | | | | | | | | | | | fully reduced | |
| 87 | TGE | R | 1 | 2 | 1 | PL? | EV | | | | | W | W | 240 | 3 | | | | | | 18? |
| 87 | CRW | B? | 1 | 4 | 1 | | | | FR? | | | C | C | | | | | | | blue tinge to glaze | |
| 87 | LSRW | D | 1 | 1 | 1 | | | | | | SLW int | Y | | | | | | | | | |
| 90 | LSRW | D | 1 | 1 | 1 | | | | | | SLW int | C | B | | | | | | | | |
| 94 | THETG | RU | 12 | 154 | 1 | AB | 4 | | | | | | | 140 | 47 | | | | | rounded end to rim | |
| 94 | THETG | U | 4 | 18 | 1 | | | | | | | | | | | | | | | poss same as jar, but don't join, fully reduced | |
| 94 | GRCW | RU | 7 | 101 | 1 | BL | INT | | | Little type BI | | | | 300 | 11 | | | | | | |
| 94 | EMW | U | 4 | 11 | 1 | | | | | | | | | | | + | | | | pinkish deposit int & on breaks | |
| 94 | EMW | U | 2 | 9 | 2 | | | | | | | | | | | | | | | | |
| 99 | THETG | RU | 4 | 20 | 1 | AB | 4 | | | | | | | 130 | 16 | + | | ext | | ext surface pink, flaky, burnt | |
| 101 | THETG | U | 4 | 8 | 1 | | | | | | | | | | | | + | | | overfired, whitish int | |
| 124 | EMW | U | 1 | 11 | 1 | | | | | | | | | | | | + | | | | |

| Context | Fabric | Type | No | Wt/g | MNV | Form | Rim | Handle | Base | Parallel | Decoration | Glaze int | Glaze ext | Rim diam | Rim percent | Abrasion | Soot | Wear | Draw? | Notes | Spot date |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 124 | MCW | RU | 8 | 189 | 1 | JR | COLL | | | | | | | | | | | | ? | abundant ms, appearing mostly black on surface, pale buff surfaces, grey core, rare cq & Fe | 13-14 |
| 153 | EMW | U | 1 | 3 | 1 | | | | | | | | | | | | | | | | |
| 167 | EMW | U | 1 | 5 | 1 | | | | | | | | | | | + | | | | oxid surfaces, bright orange-red | |
| 200 | THETG | B | 2 | 13 | 1 | | | | S | | | | | | | | | | | overfired | |
| 200 | THETG | U | 1 | 4 | 1 | | | | | | | | | | | | | | | overfired | |
| 202 | THETG | U | 1 | 2 | 1 | | | | | | | | | | | | | | | pale buff int | |

*Table 6: Summary pottery catalogue by context*

### *Methodology*

B.1.2 Quantification was carried out using sherd count, weight and estimated vessel equivalent (eve). A full quantification by fabric, context and feature is available in the archive. 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.

### *Pottery by period*

*Late Saxon to medieval*

B.1.3 The seventy sherds of this broad period represented only 26 vessels. A medieval coarseware jar from waste deposit (124) was probably the latest vessel in the group. Other vessels were in three main fabrics, which are probably broadly contemporary with each other. The date ranges given for Grimston Thetford-type ware and Grimston coarseware in Table 10 are those suggested by Little (1994, 90) and they do not overlap, but it is noted in the same volume (Lentowicz 1994, 83) that there was a transitional period in which forms of both groups were produced in both fabrics. Nevertheless, some contexts in this assemblage contained only Thetford-type wares and these suggest that activity began on the site in the 11th century (see below).

B.1.4 Only ten or eleven vessels of Thetford-type ware were represented by 37 sherds. Most sherds were body fragments, but there were two bases (one flat and the other sagging), and two jar rims (both everted with parallel sides and rounded ends). One of these comprised 12 (or possibly 16) sherds in waste deposit (94).

B.1.5 Ten sherds of Grimston coarseware represented only four vessels. There was one sagging base, two body sherds, and seven sherds from a shallow bowl (Little 1994, type BI). The latter was found in waste deposit (94), along with one of the Thetford-type jars and a few sherds of EMW.

B.1.6 The early medieval wares in this group were all in fine sandy (greensand) fabrics with occasional ferrous inclusions, similar to early medieval wares made at Blackborough End (Rogerson and Ashley 1985). They varied in colour from fully reduced black, through brownish red to bright orange-red, although most had reduced cores. One sagging base was present, and there was one simple everted jar rim, but all other fragments were body sherds.

B.1.7 Eight sherds of a jar with a collared rim were recorded as medieval coarseware. The vessel is unprovenanced, although it has similarities in fabric to pottery made in the Cambridgeshire/Suffolk fens. The fabric comprised abundant medium-coarse sand, which appeared black on the yellowish surfaces, and occasional coarse inclusions such as ferrous material and coarse quartz. The core was mid grey. The form appeared to be a developed type and the vessel has been dated to the 13th/14th century. However the lack of any glazed Grimston ware at the site, given its normal ubiquity on sites in King's Lynn, may indicate that the site had ceased activity before this.

B.1.8 A number of sherds in all fabrics showed signs of overfiring or burning. These were recovered from waste deposits (35), (99), (101) and (200). Sherds with whitish or pinkish deposits were noted in waste deposits (33) and (94). This probably indicates that the vessels were being used in the salt-making process.

*Post-medieval to modern*

B.1.9 Three contexts contained pottery of 18th–19th-century date. Potentially the earliest sherd in the group was a small everted rim fragment from a tin-glazed earthenware plate or dish, probably of 18th century date, recovered from made ground (87). With this were a fragment of a creamware footring base and a tiny sherd of slipped redware, the latter suggesting a late 18th or 19th-century date for the context. Another small body sherd of this ware, part of a hollow ware vessel, was recovered from made ground (90).

B.1.10 Sherds of probably 19th-century date were recovered from layer (64) and comprised two undecorated refined whiteware body sherds, a small fragment of rim from a pearlware transfer-printed bowl, a body sherd of late slipped redware with streaky brown glaze over the white slip internally, and a body sherd of Nottingham-type stoneware.

***Pottery by Context***

B.1.11 Table 7 shows the distribution of fabrics by context.

| Context | Cut | Group | Period | Type | Fabrics | Spot date |
|---|---|---|---|---|---|---|
| 33 | | 200 | 2 | waste deposit | EMW GRCW | 12th–M.13th c. |
| 35 | | 200 | 2 | waste deposit | GRCW | 12th–M.13th c. |
| 41 | 42 | 3 | 2 | hearth flue? | EMW | 11th–13th c. |
| 67 | | 201 | 1 | waste deposit | THETG | L.10th–11th c. |
| 94 | | 200 | 2 | waste deposit | THETG EMW GRCW | 12th–M.13th c. |
| 99 | | 200 | 2 | waste deposit | THETG | L.10th–11th c. |
| 101 | | 201 | 1 | waste deposit | THETG | L.10th–11th c. |
| 124 | | 200 | 2 | waste deposit | EMW MCW | 13th c.? |
| 153 | | 200 | 2 | waste deposit | EMW | 11th–13th c. |
| 167 | 164 | 2 | 1 | silt filtration unit | EMW | 11th–13th c. |
| 200 | | 200 | 2 | waste deposit | THETG | L.10th–11th c. |
| 202 | | 202 | 1 | waste deposit | THETG | L.10th–11th c. |
| 64 | 61 | | 3 | modern pit fill | ESWN PEW LSRW REFW | L.18th–19th c. |
| 87 | | 197 | 3 | made ground | TGE CRW LSRW | L.18th c. |
| 90 | | 197 | 3 | made ground | LSRW | L.18th–19th c. |

*Table 7: Pottery by context.*

B.1.12 Most of the Late Saxon to medieval sherds were recovered from waste deposits in the saltern, with later material from truncation layers and made ground.

***Discussion***

B.1.13 The assemblage contains two separate but intrinsically broadly contemporary groups, one dating to the 11th–13th centuries and the other to the 18th/19th centuries.

B.1.14 The earlier of the two groups comprised typical local wares of the period, with identifiable vessel forms being the usual jar and bowl types. Although these vessels can be found on many sites of the period, they are more typically associated with domestic contexts and they are not specific to any particular function. The presence of burning and presumed salt deposits on a number of the sherds suggests that, in this case, they did have an industrial role. Whilst they may have been used for storage (and possibly transportation) of the finished product, the presence of burning suggests they were sometimes exposed to very high temperatures and may have been used in the salt-making process. Forms and fabrics present in the assemblage suggest that the site had probably ceased activity by the mid 13th century.

B.1.15 There is no ceramic evidence for any activity between the end of the saltern and the 18th century. The finds from the made ground and layers may have been deposited following truncation of earlier layers, however (G Clarke, pers comm). There was no redeposition of earlier material. The post-medieval pottery is all of English origin and typical of the 18th and 19th centuries.

## B.2 Ceramic Building Material

*By Sue Anderson*

B.2.1 Six fragments (798g) of Ceramic Building Material (CBM) were recovered from two contexts (Table 8).

B.2.2 Fill 10 of Period 3 pit **9** contained fragments of three handmade bricks in three different fabrics. The largest piece, in a fine sand and grog-tempered purplish fabric measured 100mm wide and 60mm thick, had cream-coloured medium sandy lime mortar on the upper surface, and was probably of 19th-century date. A fragment of brick in a dark red estuarine clay was likely to be of later medieval or early post-medieval date. A small piece in poorly mixed yellow/red/dark grey clays, probably of estuarine origin, may be a medieval brick, but similar bricks were produced into the post-medieval period in this area. Two fragments in fine sandy micaceous fabrics were of uncertain form. One was flat and the other was slightly curved with a straight-cut edge. The fabrics and manufacture of both were similar to machine-made pantiles, but these pieces were smoothed on both surfaces, whilst pantiles have sanded bases. They may be fragments of drainpipes or field drain tiles.

B.2.3 A small fragment of pantile in a fine sandy fabric, with a sanded base, was found in natural channel (22). Pantiles were in use from the 17th century onwards in East Anglia, but this example was well made and probably of fairly recent date.

| *Context* | *Cut* | *Fabric* | *Form* | *No* | *Wt* | *Width* | *Height* | *Mortar* | *Notes* | *Date* |
|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 9 | est | B | 1 | 133 | | | thin | red-purple | late-med? |
| 10 | 9 | fsg | B | 1 | 502 | 100 | 60 | cream ms on upper | pinkish purple | post-med. |
| 10 | 9 | est | B? | 1 | 68 | | | | yellow/red/dark grey poorly | post-med? |

| Context | Cut | Fabric | Form | No | Wt | Width | Height | Mortar | Notes | Date |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | mixed | |
| 10 | 9 | fsm | T | 1 | 28 | | | | looks like PAN but smoothed on both sides, flat | post-med. |
| 10 | 9 | fsm | DP? | 1 | 34 | | | | looks like PAN but smoothed on both sides, curved with one cut edge | post-med. |
| 22 | 21 | fs | PAN | 1 | 33 | | | | sparse fine Fe | post-med. |

*Table 8: CBM by context*

## B.3 Clay pipes

*By Sue Anderson*

B.3.1 Five fragments of clay tobacco pipes were recovered from two contexts (Table 9). Layer (10) contained two stem fragments with bore diameters of 2.2mm and 2.6mm, suggesting an 18th–19th-century date range. Made ground (87) contained two fragments of bowls, one with a milled rim, both of which appeared to be from bowls of 18th-century date, and a fragment of stem with a bore diameter of 2.0mm, which may indicate and 18th/19th-century date.

| Context | Cut | Group | Frag | No | Wt (g) | Bore diam (mm) | Notes | Date |
|---|---|---|---|---|---|---|---|---|
| 10 | 9 | | stem | 1 | 2 | 2.2 | | 18th-19th century ? |
| 10 | 9 | | stem | 1 | 2 | 2.6 | | 18th century ? |
| 87 | | 197 | bowl | 1 | 4 | | half bowl, milled rim | early 18th century |
| 87 | | 197 | bowl | 1 | 2 | | small frag. | 18th century ? |
| 87 | | 197 | stem | 1 | 1 | 2.0 | | 18th-19th century ? |

*Table 9: Clay pipes by context*

## B.4 Baked Clay

*By Sarah Percival*

***Introduction***

B.4.1 The baked clay assemblage from the excavation comprises 402 fragments weighing 7,726g from 30 contexts.

***Nature of the Assemblage***

B.4.2 The assemblage comprises largely amorphous pieces, few with any obvious form. The material was found in three fabrics, all most likely formed utilising the local Upper Jurassic clays (Table 10). A soft fine silty clay with no visible inclusions was used to form a poorly fired irregular brick-like object 83mm thick with red orange surfaces and occasionally dark grey core. The same fabric was also used for plate-like pieces 28mm thick which may be from hearth lining smoothed onto the walls of the hearth below ground and for a possible hand-squeezed fragment which may be an ad hoc wedge or similar support found in open hearth **190**. This fabric is similar to clays used to make cone-shaped pedestals and hearth lining found at the 12th to 13th century saltern excavated at the former Queen Mary's Nurses Home Kings Lynn (Cope-Faulkner 2014, fig. 9.).

B.4.3 The second fabric is formed of the same fine clay but with the addition of fine organic material, perhaps chopped grass. The fragments made of this organic tempered fabric often have one smoothed surface and may represent the above ground superstructure of the oven.

| Fabric | Description | Type | Quantity | Weight (g) |
|---|---|---|---|---|
| O1 | Fine clay with common short regular elongated voids | Lining | 7 | 461 |
| | | Miscellaneous | 82 | 791 |
| | | Superstructure | 5 | 288 |
| Q1 | Fine clay with few visible inclusions | Brick | 1 | 664 |
| | | Lining | 89 | 5072 |
| | | Miscellaneous | 209 | 210 |
| | | Superstructure | 3 | 28 |
| QO | Fine clay with occasional mixed irregular elongated voids | Lining | 6 | 212 |
| Total | | | **402** | **7726** |

*Table 10: Quantity and weight of baked clay by fabric*

B.4.4 A third fabric, a fine silty clay with irregular elongated organic inclusions has distinctive lilac orange colouring comparable in both colour and composition with poorly fired clay recovered from the base of settling tanks at the Roman saltern sites at Middleton (Percival 2001, 184). It is therefore possible that this material is derived from the lining of a brine pit, an interpretation compatible with the context of recovery within the fill of water tank **223**.

***Distribution***

B.4.5 The assemblage is almost all redeposited with the possible exception of the clay lining found in pit **223**. The largest collection of baked clay comes from dumped layers and perhaps represent material used to consolidate unstable ground or perhaps from clearing and levelling of the site (Table 11).

B.4.6 The soft fired brick comes from the burnt mound perhaps composed of hearth debris whilst the possible support was found in the fill of pit **190**.

| Period | Feature | Context | Feature type | Type | Quantity | Weight (g) |
|---|---|---|---|---|---|---|
| 2 | Group 200 | 35 | Upper saltern mound | Lining | 2 | 95 |
| 1 | Group 201 | 67 | Lower saltern mound | Lining | 2 | 85 |
| | | | | Miscellaneous | 21 | 221 |
| | | | | Superstructure | 7 | 211 |
| 2 | Group 200 | 94 | Upper saltern mound | Brick | 1 | 664 |
| | | | | Lining | 10 | 298 |
| | | | | Miscellaneous | 15 | 100 |
| | | | | Superstructure | 1 | 105 |
| 2 | Group 200 | 98 | Upper saltern mound | Lining | 30 | 459 |
| 2 | Group 200 | 99 | Upper saltern mound | Miscellaneous | 9 | 71 |
| 3 | Group 198 | 102 | Recent deposits | Miscellaneous | 45 | 18 |
| | | 105 | Recent deposits | Miscellaneous | 3 | 1 |
| 2 | Group 200 | 110 | Upper saltern mound | Miscellaneous | 1 | 2 |
| 2 | Group 200 | 111 | Upper saltern mound | Miscellaneous | 5 | 22 |
| 3 | Group 199 | 199 | Recent deposits | Miscellaneous | 10 | 5 |
| 2 | Group 200 | 200 | Upper saltern mound | Lining | 16 | 1133 |
| | | | | Miscellaneous | 1 | 11 |
| 1 | | 251 | Hearth waste | Miscellaneous | 19 | 11 |
| 2 | 42 | 38 | Enclosed hearth | Miscellaneous | 3 | 223 |
| | | 41 | Enclosed hearth | Miscellaneous | 6 | 98 |
| 1 | 164 | 166 | Filtration unit | Miscellaneous | 6 | 2 |
| | | 167 | Filtration unit | Lining | 1 | 14 |
| | | | | Miscellaneous | 5 | 1 |
| 1 | 223 | 225 | Water tank | Lining | 3 | 193 |
| 2 | 205 | 162 | Enclosed hearth | Lining | 27 | 3136 |
| 2 | 11 | 12 | Enclosed hearth | Miscellaneous | 5 | 79 |
| 2 | 205 | 115 | Enclosed hearth | Lining | 8 | 308 |
| | | 132 | | Lining | 3 | 24 |
| 1 | 190 | 192 | Open hearth | Support? | 1 | 35 |
| 1 | 231 | 232 | Filtration unit | Miscellaneous | 20 | 1 |
| 1 | 258 | 264 | Filtration unit | Miscellaneous | 16 | 4 |
| 1 | 253 | 265 | Filtration unit | Miscellaneous | 10 | 12 |
| | | 266 | Filtration unit | Miscellaneous | 17 | 8 |
| 1 | 274 | 275 | Filtration unit | Miscellaneous | 7 | 2 |
| | | 276 | Filtration unit | Miscellaneous | 35 | 5 |
| 1 | 277 | 281 | Open hearth | Miscellaneous | 27 | 68 |
| 1 | 170 | 171 | Filtration unit | Miscellaneous | 4 | 1 |
| **Total** | | | | | **402** | **7726** |

*Table 11: Quantity and weight of baked clay by feature*

### *Discussion*

B.4.7 Salt was an important trading commodity for medieval King's Lynn (Owen 1984, 41) and was produced on a number of sites along the Nar in West Lynn and elsewhere on the outskirts the town (Silvester 1988, fig. 14). Salt production sites at Lynn were mentioned at LENA in Domesday Book (Brown 1984, 215b) and also in a charter by Bishop Herbert de Losinga of 1100 (Hankinson 2005, 80). Several of the Domesday saltern sites appear to have survived into the later medieval period (Clarke and Carter 1977, 412) and have been dated by pottery evidence to the 12th and 13th centuries (Silvester 1988, 27).

B.4.8 Despite numerous medieval saltern sites having been identified few have been fully excavated or produced significant artefactual evidence. Amorphous structural fired clay and bricks and brick fragments similar to those found have been found at Wainfleet St Mary, Lincolnshire (McAvoy 1994, 160) and Parsons Drove, Cambridgeshire (Pollard *et al.* 2001, 444) and hearth lining and other debris including possible pedestals were recovered from the 12th to 13th century saltern site at former Queen Marys Nurses Home, Kings Lynn (Cope-Faulkner 2014). 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 similar to the pedestals used to support pans at Iron Age and Roman salterns (McAvoy 1994, 142).

B.4.9 Chopped organic material was commonly added to briquetage in prehistoric and Roman times to aid forming light-weight durable objects such as pans and superstructure and were often made in advance. It is possible that a similar procedure is evidenced here with the silty local clay being used *ad hoc* for hearth lining and pan supports whilst the organic tempered fabrics represent items made in advance.

B.4.10 The purplish water tank lining is formed of silty local clay into which organic material has become incorporated naturally as it settled to the bottom of the pit. The lilac colour of the lining indicates exposure to concentrated saline solution.

## B.5 Salt-making slag

*By Sarah Percival*

### *Introduction*

B.5.1 A total of 374 pieces of salt-making slag weighing 14.956kg was collected from thirteen contexts mostly those forming the saltern mound and associated hearths (Table 12). Chemical analysis of the slag was undertaken, the results of which are presented in Appendix B.6.

### *Nature of the Assemblage*

B.5.2 The assemblage is composed of a mix of slag all formed during a high heat process. Some of the slag takes the form of pale cream to rusty brown light weight vesicular lumps composed of many fused pieces and incorporating occasional debris such as pebbles and sand. The second form is dense and plate-like appearing to have formed in the bottom of the hearth. This dark grey to pale cream slag is found in large angular sections with visible bubbles within the body of the slag and occasional bands of green vitrified material running through. One fragment has green glassy vitrified surfaces similar to that seen on material found in at a hearth excavated at the site of the 12th to 13th century saltern at former Queen Mary's Nurses home on the south side of the Millfleet, Kings Lynn (Cope-Faulkner 2014).

*Distribution*

B.5.3 All of the slag appears to be redeposited, almost all in heaps of debris formed as the saltern hearths and tanks were cleared after use but some perhaps put down to help consolidate wet ground during working.

| Period | Feature type | Feature | Context | Description | Quantity | Weight (g) |
|---|---|---|---|---|---|---|
| 2 | Upper saltern mound | Group 200 | 94 | Dense plate vesicular lumpy concretion | 58 | 6265 |
| | | | | Vesicular lumpy concretion | 233 | 3769 |
| 2 | Enclosed hearth | 42 | 41 | Vesicular lumpy concretion | 60 | 1226 |
| | | 205 | 116 | Vesicular lumpy concretion | 14 | 23 |
| | | | 132 | Vesicular lumpy concretion | 3 | 28 |
| | | | 118 | Vesicular lumpy concretion | 1 | 12 |
| 2 | Upper saltern mound | Group 200 | 33 | Vesicular lumpy concretion | 4 | 62 |
| 2 | Upper saltern mound | Group 200 | 156 | Vesicular lumpy concretion | 3 | 64 |
| | | | 200 | Vesicular lumpy concretion | 17 | 489 |
| | | | | Vesicular lumpy concretion one with glassy vitrified surface | 7 | 58 |
| 2 | Upper saltern mound | Group 200 | 34 | dense plate vesicular lumpy concretion | 5 | 1057 |
| | | | 35 | Vesicular lumpy concretion | 14 | 368 |
| 3 | Recent deposits | Group 198 | 88 | Vesicular lumpy concretion | 1 | 87 |
| 2 | Upper saltern mound | Group 200 | 110 | Vesicular lumpy concretion | 5 | 46 |
| | | | 111 | Vesicular lumpy concretion | 26 | 268 |
| | | | 124 | Dense plate vesicular lumpy concretion | 14 | 2137 |
| 1 | Lower saltern mound | Group 202 | 157 | Vesicular lumpy concretion | 1 | 300 |
| 2 | Upper saltern mound | Group 200 | 98 | Vesicular lumpy concretion | 9 | 20 |
| 3 | Channel | 21 | 22 | Vesicular lumpy concretion one with glassy vitrified surface | 5 | 110 |
| 1 | Hearth waste | | 251 | Vesicular lumpy concretion | 3 | 5 |
| Total | | | | | 509 | 16809 |

*Table 12: Quantity and weight of slag by feature*

*Discussion*

B.5.4 Similar slags have been recovered from medieval saltern mounds excavated at Bicker Haven, Lincolnshire and Hamburg Way, North Lynn (Healy 1975, 36 and 1999, 90; Timberlake 2008, 8). Healy notes that tests carried out on the slag recovered from Bicker Haven by the then Ancient Monuments Laboratory showed that the slag was an 'ash glaze formed by fusion of fuel ash and clay' and representing material raked out of the hearth base (1975, 36). It is likely that a similar process formed the dense hearth bottom deposits with vitrified areas found here, the often angular lumps showing where the material had been broken up for removal and clearing. The green glassy surfaces occasionally found on briquetage are formed by 'a chemical reaction between sodium ions and moisture in the fuel' which produce sodium hydroxide, a glass modifier which converts the surface of the hearth into a glaze (Miles 1975, 27).

B.5.5 The light weight vesicular concretion is more similar to that described at Hamburg Way suggested to represent an accretion of spatter from the boiling brine solutions (Timberlake 2008, 30). These were also noted to exhibit a rusty brown colouring perhaps due to post-depositional staining.

## B.6 Chemical analysis (by pXRF) characterisation of the salt-making slags and other materials

*By Simon Timberlake*

***Methodology***

B.6.1 A NITON pXRF instrument was used to semi-quantitatively record the surface chemistry of 29 samples from this site. The assemblage of salt-making slag is fully described in Appendix B.5. This consisted of 167 individual measurements, all of which were carried out on the same suite of elements, the majority of which were trace heavy metals. The standard analysis time of 30 secs per element was used, at energies between 1 and 41 keV, the results of the spectral analysis appearing on the instrument screen in either parts per million (ppm) or as a bulk %, depending upon the software package chosen. Elemental spectra were recorded for at least 17 different elements per measurement, and the results normalised to the standard deviation (error) for each. All of the samples were surface analysed in their un-crushed state (the penetration of the x-ray beam was limited to a depth of about 2-3mm max), after having first run the instrument against sample blanks as well as a Certified Reference Material (CRM), the latter being composed of a rock rich in clay minerals (CRF Till-4). Throughout the period of the analyses the operation (calibration) of the instrument was continually checked by re-running the CRM and the blanks, and on each occasion these gave an acceptable reading within 10-25 ppm margin.

B.6.2 The elements recorded included antimony (Sb), tin (Sn), cadmium (Cd), silver (Ag), strontium (Sr), rubidium (Rb), lead (Pb), selenium (Se), arsenic (As), mercury (Hg), zinc (Zn), copper (Cu), nickel (Ni), cobalt (Co), iron (Fe), manganese (Mn) and chromium (Cr). The colour-coding of the values for each element per measurement (as shown in the accompanying tables) provides some indication of the significance of the levels recorded (i.e. x2, x3, x4-6, x6-10, x10-20). It is this degree of significance which is important in interpreting the relevant composition of the sample; either in terms of its bulk composition, or more commonly its trace element contamination.

***Characterisation of the samples***

B.6.3 A visual characterisation was first carried out on all the samples to be analysed. This revealed 13 samples of salt slag (22 pieces), at least one of which was contaminated with hearth ash ((116) <2>), two with inclusions from iron smithing hearth debris (111), and two with iron oxyhydroxide staining resulting from either the corrosion of iron, or else as a result of their contact with an iron panning horizon ((156) + (157)). In addition, a single iron smithing hearth (SHB) was identified from (34) the upper mound filtration waste (silts), along with smithing slag lumps (SSL) from (33) + (41) <2>, and some platy smithing slag (110) + (94) 2. It was noted that the SHB was of a similar size to the salt slag cakes, suggesting that both activities may have been carried out within the same hearth.

B.6.4 A small fragment of a perforated fired clay object which might have been a brick or pan support with a c.10mm round hole on its upper surface which was coated with a thick layer of green glaze (vitrification) was an unusual find from context (22) in F.21 (Tr.7). All the other fired clay objects appeared to have been weathered and partly disintegrated fragments of clay blocks of varying thicknesses, most likely bricks derived from the support structure(s) of the brine boiling hearth(s).

B.6.5 Fragments of between 8-10 different bricks were identified, most of these crudely moulded and made from fine micaceous estuarine silt, in some cases vegetable-tempered. These came from both the lower and upper levels of the saltern mound, thus from Period 1 (Late Saxon) as well as Period 2 (12th-13th century AD) of the saltmaking activity. It seems possible that the Late Saxon bricks were smaller (25-45mm thick) than those used during the Medieval period, although no complete examples of these were either seen or recovered. Likewise a small number of pieces of what could have been clay sealing joins were examined from (41), and conceivably these might represent repairs or else seals to the hearth structures.

B.6.6 Nine sherds of medieval pottery from (94) and (33) which were sooted on the exterior, and which may have been from cooking pots, were analysed both on the exterior and interior surfaces for metals. It was hoped by this means to distinguish metal contamination which was post-depositional from that which was contemporary, and related to use.

B.6.7 Three consecutive 30cm monoliths (<22>: base (153) >(98)+(154) >(139) top) which had been taken from Section 27 (Trench 2) of the upper saltern mound and which had originally been intended for pollen sampling were serially analysed non-destructively at 3-4 cm intervals for metals. This analysis was undertaken to obtain some idea of any vertical changes in chemistry in the sequence of filtration waste silt (sleeching tailings) that was associated with the Medieval salt working. At different horizons within these monoliths small particles of charcoal could be seen, alongside laminae containing burnt clay and possibly also fine residues of salt slag.

B.6.8 An internal control in the form of an analysed silt sample with quite low metal values taken from the base of (153) was used as a background comparison for the chemistry of the slags, fired clay and pottery samples. Details of the sample characterisation is provided in Table 13.

| Context no. + nos. | Nos. pieces | Size (mm) | Wt. (g) | Description | Category | Period | Context assocn. | Phot | Points analysed |
|---|---|---|---|---|---|---|---|---|---|
| 94 (1) | 3 | 250x150x40 (depth) + 65x25 | 1814 + 66 | round-bottom hearth slag cake w vitrified laminae | **salt slag** | 2 | hearth waste | 1 | 7 |
| 41 | 3 | 110x50 + 100x20 +70x35 | 298 + 96 +43 | (1)conglomeratic (2) Fe-rich (3) green vitrified laminae | **salt slag** | 2 | hearth disuse | | 6 |
| 124 | 2 | 150 (broken) x25 + 70x30 | 266 + 77 | (1) round-bottom slag cake (2) small vitrif laminae | **salt slag** | 2 | mound hearth waste | | 5 |
| 88 | 2 | 85x20 (2 halves) | 84 | part of slag cake? | **salt slag** | 3 | TP2 | | 4 |
| 22 | 2 | 55x25 +35x25 | 40 + 9 | (1) with green vitrif laminae (2) green glaze (vitrif) burnt clay | (1) **salt slag** (2) perforate **vitrified clay** support? | 3 | Tr.7 F.21 | | 4 (x2) |
| 27 | 3 | 55x15 + 32x25 + 30x20 | 24 + 21 + 8 | x3 lumps with vitrif inclusions | **salt slag** | | not listed | | 4 |
| 118 | 1 | 35x10 | 12 | edge round-bottom slag cake | **salt slag** | 2 | closed hearth dis | 1 | 5 |
| 116 <2> | 3 | 35x7 + 25x15 + 30x10 | 4 + 5 + 2 | x3 soft sintery lumps veined with green vitreous material | ash **contaminated salt slag** | 2 | closed hearth vitrified base | | 4 |
| 111 | 2 | 85x30 + 50x7 | 74 + 9 | some calcined flint + Fe oxide sinter | **salt slag** contamin **Fe** | 2 | mound hearth waste | | 6 |
| 35 | 3 | 100x30 (2 halves) + 70x60 | 111 + 103 | (1) sintery slag with Fe staining (2) completely vitrified bubbly slag | (1)**salt slag** (2)**fuel ash/ vitrif clay** | 2 | mound hearth waste | | 6 |
| 94 (2) | 4 | 135x15-25 + 70x20 + 45x20 + 95x15-20 | 222 + 48 + 20 + 190 | (1) iron oxides, vitrif sinter with tuyere hole (2) vitrif clay + Fe oxides (3) salt slag (4) iron oxides + fayal | (1)**smith slag** (2)**vitrif clay** (3)**salt slag** (4) **smith slag** | 2 | mound hearth waste | | 7 |
| 41 <2> | 1 | 17x7 | 3 | vesicular drop of vitrif iron oxide rich material | **iron smithing slag** lump | 2 | closed hearth disuse | | 4 |
| 110 | 1 | 60x20 | 42 | sintery iron oxides | **smithing slag** | 2 | mound hearth waste | | 4 |
| 157 | 1 | 60x30 | 29 | sintery iron oxide concreted material | **salt slag** with iron | 1 L.Saxon | lower saltern mound | | 5 |
| 156 | 2 | 65x30 + 40x20 | 40 + 11 | sintery iron oxide concreted material | **salt slag** with iron (iron pan or corrosion) | 1 L.Saxon | lower saltern mound | | 4 |
| 34 | 1 | 130x90x25 (broken) | 315 | round-bottom slag cake with iron oxides and fayalite | **iron smithing hearth base** (NB same size as salt slag cakes?) | 2 | mound filtration waste | | 4 |
| 33 | 6 | 40x8 + 50x20 + 35x10 + 30x6 + 35x8 + 17x11 | 15 + 26 + 6 + 4 + 5 + 2 | dense irregular lumps high in iron oxides | **iron smithing slag lumps** | 2 | mound hearth waste | | 5 |
| 67 (1) | 2 | 60x60x25 (2 pieces) | 86 | hard scorched/ partly vitrified clay | **semi-vitrified brick** | 1 L.Saxon | mound filtration waste | | 5 |
| 167 | 2 | 70x45x50 + 55x35x25 | 91 + 31 | fragments of same weathered fired clay object with red-purple coloration | **clay brick** (part of) | 1 L.Saxon | filtration unit disuse | | 5 |

| Context no. + nos. | Nos. pieces | Size (mm) | Wt. (g) | Description | Category | Period | Context assocn. | Phot | Points analysed |
|---|---|---|---|---|---|---|---|---|---|
| 41 (3) | 4 | 40x30x10 + 30x10 + 25x8 +25x4 + 20x3 | 9 + 4 + 2 + 1 + 1 | thin pieces of well-fired grey clay | **clay joins** | 2 | closed hearth disuse | | 4 |
| 67 (2) | 3 | 50x50x20 + 30x30x25 + 35x15x15 | 58 + 34 + 9 | orange-pinkish clay with reddish oxidised/ corroded exterior | **clay brick** abraded frags | 1 L.Saxon Thetford | mound filtration waste | | 5 |
| 41 (4) | 2 | 120x80x25-30 + 60x60x40 | 215 + 77 | (1) pinkish orange silty clay with one edge + grey ash stain (2) a light pink hard clay veg tempered fabric | **clay brick** fragments | 2 | closed hearth disuse | | 6 |
| 225 | 1 | 95x50x55 | 159 | pinkish coloured clay with purple stained exterior | **clay brick** weathered frag | 1 L.Saxon | water tank disuse | | 5 |
| 94 (3) | 4 | 90x60x35 + 60x30x30 + 70x40x20 + 35x30x12 | 133 + 42 + 38 + 12 | grey pink to bright pink micaceous silty clay (parts of blocks) | **clay brick** fragments | 2 | mound hearth waste | | 5 |
| 38 <1> | 1 | 80x60x35 | 107 | grey pink silty clay with bleached exterior | **clay brick** | 2 | closed hearth disuse | | 6 |
| 162 <52> | 4 | 160x70x90 + 70x65x45 +35x20 + 30x20 (all part of same) | 940 + 170 + 15 + 12 | bright pink-red silty clay fabric with bleached grey-white exterior | **clay bricks** (frags) | 2 | closed hearth vitrified base | | 4 |
| 94 (4) | 5 | 35 + 25 + 25 + 20 + 20x3-5 | 7 + 4 + 4+ 1 + 1 | dkgrey-black coarseware pottery | **cooking pot** | 2 | mound hearth waste | | 5 |
| 33 | 4 | 50 + 25 + 20x3-4 + 40x10 | 14 + 4 + 1 + 12 | grey-brown ext reddish int. thin coarseware pot + sherd of thicker grey pot | **cooking pot** | 2 | mound hearth waste | | 9 |
| 153 <22> | 1 | 300 | | mound material (silt) | monolith <22> | 2 | filtration waste | | 6 |
| 98 + 154 <22> | 1 | 300 | | mound material (silt) | monolith <22> | 2 | filtration waste | | 9 |
| 139 <22> | 1 | 300 | | mound material (silt) | monolith <22> | 2 | filtration waste | | 7 |

*Table 13: Characterisation of the samples analysed by pXRF*

### ***Results***

*Salt slags*

B.6.9 Twelve of these samples were analysed, with 55 measurements taken on up to 20 individual fragments (Table 14). From these significant results (of at least x2 the error value) were obtained on eight elements ( tin(Sn), strontium(Sr), rubidium(Rb), lead(Pb), arsenic(As), zinc(Zn), iron(Fe) and manganese(Mn)).

B.6.10 Some of the highest significant values were those obtained for strontium, with readings of up to 30x the error value at 436 – 958 ppm Sr for slags (94), (118), (116) and (35) from the upper saltern mound, high values of 10-20x the error at 176-488 ppm Sr for slags (41), (124), (88), (27), (22) and (111), the lowest values (though still elevated) being between 78-245ppm (6-8x the error) for slags (156) and (157) from the lower part of the saltern mound, thus from saltworking activity dating to the Late Saxon period. High strontium values are associated with sea salt and the evaporation of brine.

B.6.11 Iron was high in all the slags, ranging from 24694 – 100054 ppm (i.e. typically 0.25-10% Fe), but this was not unexpected given the ubiquitous nature of iron in the environment, and also the concentration gradient associated with the formation of a salt slag. Another probable origin for the highest iron may be the contamination with ironworking debris from the upper saltern mound hearth/ furnace area. However, the green coloration in some of the lower iron-rich banded slag may be due to a ferrous (Fe2+) presence mostly likely associated with the primary brine boiling activity. All the slag samples reported high iron, yet the extreme range in values between the various precipitated layers was also interesting, and could in some way be a function of the brine boiling process. No significant difference in the readings for iron between the salt slags from the lower part of the mound (Late Saxon) and those from the upper part (Medieval) was noted. The one exception to this was slag sample (156). Parts of this were exceptionally rich in iron (c. 10% Fe) suggesting a possible source in a corroded iron object (see Table 13).

B.6.12 Manganese, as one would expect, broadly follows the distribution of iron, but is in a much lower concentration (between 559 – 1606 ppm Mn and 2-6x the error), some of it perhaps being post-depositional. Interestingly, when compared to the error values, the Mn concentrations for the lower saltern (Late Saxon) slags are slightly lower than those from the upper layers.

B.6.13 Zinc shows no easy to interpret pattern. It is significantly high only in slag sample (41) with between 125-576 ppm Zn (up to 6x error), but for most of the remaining samples the value is low (for the most part <50 ppm) and not significant.

B.6.14 Rubidium is an element which to some extent follows the concentration of strontium. It is present in sea water associated with potassium, but also in clay minerals, thus there are two possible sources. Here we are looking at rubidium at a significantly lower concentration compared to strontium, and it is interesting that here those slags highest in strontium (94) and (116) actually show an inverse relationship with the concentration of rubidium. The significant levels of rubidium range from just 17 – 78 ppm.

B.6.15 Low but significant levels of tin (of between 129 – 288 ppm at 2-3x error) are mainly present within slag samples (124), (35), (118) and the interior of (94), and it is possible but by no means certain that this is related in some way to the presence of lead, and/ or strontium or manganese. Thus this may have an anthropogenic origin, but not certainly so.

B.6.16 Arsenic seems only to be elevated in slag samples (111), (156) and (157), all three of which are visibly contaminated with iron. It seems most likely therefore that this external iron contaminant is probably also the source of the arsenic. However, the values for arsenic are still quite low (74 – 211 ppm at 2-4x the error) and not dissimilar from the levels of tin. However, neither the tin nor the lead correlate with the arsenic. Stratigraphically though it might be possible though to correlate part of this small elevation in arsenic with two of the slags from the lower part of the mound (Period 1).

B.6.17 Lead is in some ways one of the most interesting metals. It is significantly high in all of the salt slags except (88) and (157), although it might be argued that it is lower in both of the Late Saxon slags (156) and (157) compared to those from the upper mound. Significant lead values range from 54-772 ppm (at between 2-10x the error); the highest values being associated with slags (41 (772 ppm Pb)), (27 (513 ppm Pb)), (124 (373 ppm Pb)) and (116 (427 ppm Pb)) – all of these being slags from the upper mound. There seems to be little doubt that error significant values as high as 513 and 772 ppm Pb (i.e. 0.07%) must represent some sort of anthropogenic contamination associated with the salt making or other industrial/ craft activity on site. However, this doesn't explain the range of values experienced, nor the sometimes background terrestrial values which are typical of the clay till control (i.e. 30-60 ppm Pb) which is present at some points on some of the slags. This will require some interpretation as to the reasons behind this.

B.6.18 The overall similarity in the spectra recorded for each of the different salt slag samples is graphically demonstrated in Appendix B.6 Figures 1 & 2. This is a process known as 'wiggle-matching', a method used to show how similar (or different) such samples are. Appendix B.6 Figure 2 shows the actual degree of difference. Basically all of these slags are very similar in chemical composition.

| SAMPLE | Sn | Sn Error | Sr | Sr Error | Rl | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| crm till 4 | 35.59 | 52.16 | 108.91 | 9.67 | 14[illegible] | | | | | | | | | | | |
| (94) slag 1 | 100.51 | 78.54 | 408.82 | 24.55 | 32.[illegible] | | | | | | | | | | | |
| (94 )slag 2 | 128.77 | 73.91 | 488.1 | 25.12 | 32.[illegible] | | | | | | | | | | | |
| (94 )slag 3 | 114.86 | 70.96 | 395.74 | 22.1 | 26.[illegible] | | | | | | | | | | | |
| (94 )slag 4 | 175.79 | 71.6 | 447.7 | 23.17 | 36 | | | | | | | | | | | |
| (94) slag side 1 | 263.55 | 79.32 | [illegible] | 35.06 | 25.[illegible] | | | | | | | | | | | |
| (94) slag side 2 | 172.03 | 68.07 | [illegible] | 32.39 | 21.[illegible] | | | | | | | | | | | |
| (94) slag smll p | 185.87 | 72.47 | 441.63 | 23.28 | [illegible] | | | | | | | | | | | |
| crm till 4 | 1.71 | 52.13 | 95.12 | 9.24 | 142 | | | | | | | | | | | |
| (41) no 1 | 36.99 | 71.15 | 176.49 | 15.62 | 52 | | | | | | | | | | | |

*Table 14: Metals/ trace elements within salt slags recovered from contexts 22, 27, 35, 41, 88, 94, 111, 116, 118, 124, 156 & 157 and recorded in ppm*

B.6.19 The pXRF analysed results for the three best samples of iron smithing slags (110), (33) and (34) are presented in Table 15. One of these samples (34) was a partial smithing hearth base (SHB), whilst (33) consisted of six fairly dense slag smithing lumps, and (110) a more sintery concretion of smithing debris.

B.6.20 We still find strontium at very high levels in the iron slag (i.e. between 186 – 514 ppm (8-14x the error value Sr)), yet not reaching the highest levels associated with the salt slags. This is interesting in that it suggests probable contamination and cross-over between the two activities, and possibly also some post-depositional enhancement of the porous iron slags with salt. The particular elevation of Sr within slag (33) is not easy to explain, as it might have been thought that the more sintery salt-encrusted iron slag (110) would produce higher values.

B.6.21 Rubidium is low yet still significantly enhanced in all three samples (at 34 -59 ppm (2-4x error)). This perhaps relates to the brine contamination, yet it may be higher in the smithing hearth base (34) due to the former presence of a baked/ vitrified clay lining.

B.6.22 Iron, not at all surprisingly is very high (i.e. between 245,365 – 700,358 ppm (24-70% Fe) at >60x error), and is highest of all in (34) the dense iron-rich smithing hearth base (c.70% Fe), a sample in which it is probably being under-recorded due to the detection range of the instrument.

B.6.23 Manganese is likewise higher within (34) the smithing hearth base (i.e. 1376 – 6511ppm Mn (3-4x error)), this association suggesting that it is primary enhancement associated with the composition of the iron, and not a post-depositional effect.

B.6.24 Although nickel is not significantly elevated (in respect of the error value) within any of the samples except for a single measurement taken on (34), the relatively high values shown (of between 181-861 ppm Ni) would appear to suggest the presence of some nickel in this iron. Amongst all the other samples from (salt slags, fired clay etc) nickel is either undetectable, or else way below the error significant level.

B.6.25 Arsenic shows clear (yet small) levels of enhancement in the slags, particularly within slag (110) and in the smithing hearth base (34) (84 -169 ppm As in (110) and 176 -216 ppm As in (34)). This suggests a small amount of arsenic within the composition of the iron.

B.6.26 Lead is once again interesting, but in this case on account of its relatively low level here compared to the sorts of concentrations reached in the salt slags. Lead does have a low level significance still (of between 34 – 79 ppm (2x error), yet this shows no correlation at all with the sample which is richest in iron, arsenic, nickel and manganese; the smithing hearth base (34). This clearly shows that lead is associated with the salt-working, and not the iron working.

| SAMPLE | Sr | Sr Error | Rb | Rb Error | Pb | Pb Error | As | Ni | Ni Error | Fe | Fe Error | Mn | Mn Error |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| crm till 4 | 106.09 | 9.76 | 148.44 | 11.73 | 48.53 | 16.67 | 93.98 | 55.83 | 70.49 | 32603.22 | 731.56 | 718.53 | 191.53 |
| (110) no1 | 266.8 | 27.8 | 42.42 | 13.3 | 75.18 | 35.89 | 169.42 | 438.36 | 271.13 | 389259.5 | 4712.58 | 1713.68 | 782.23 |
| (110) no 2 | 230.37 | 25.33 | 28.87 | 11.25 | 58.38 | 32.54 | 165.1 | 371.5 | 255.82 | 414360.7 | 4732.31 | 2618.41 | 829.2 |
| (110) no 3 | 240.16 | 24.04 | 30.66 | 10.66 | 52.48 | 29.06 | 138.23 | 352.95 | 205.99 | 324517.8 | 3914.11 | 1918.69 | 679.34 |
| (110) no 4 | 245.04 | 22.69 | 34.59 | 10.39 | 73.75 | 30.04 | 84.27 | 264.46 | 195.24 | 271934.3 | 3360.98 | 2688.17 | 649.62 |
| (33) no 1 | 498.04 | 35.59 | 36.14 | 12.22 | 82.08 | 35.4 | 52.2 | 458.97 | 253.16 | 265232 | 3747.68 | 2415.56 | 710.92 |
| (33) no 2 | 473.95 | 34.83 | 42.17 | 12.9 | 54.96 | 31 | 67.95 | 181.54 | 235.97 | 266797.8 | 3763.7 | 2132.59 | 694.36 |
| (33) no 3 | 458.07 | 33.16 | 46.19 | 12.87 | 79.27 | 34.29 | 66.51 | 294.89 | 226.11 | 252156.8 | 3541.66 | 1377.08 | 612.78 |
| (33) no 4 | 514.21 | 36.53 | 41.24 | 12.97 | 64.32 | 32.44 | 46.47 | 326.35 | 243.45 | 272785 | 3838.57 | 1948.08 | 693.74 |
| (33) no 5 | 333.67 | 34.11 | 39.02 | 14.45 | 92.54 | 42.07 | 51.39 | 255.11 | 297.73 | 447676.2 | 5586.25 | 1953.99 | 917.2 |
| (34) no 1 | 190.6 | 27.14 | 37.33 | 14.35 | 70.58 | 37.55 | 176.75 | 861.6 | 392.13 | 700358.1 | 7126.02 | 6511.5 | 1331.05 |
| (34) no 2 | 186.35 | 21.31 | 48.13 | 12.4 | 40.07 | 26.26 | 216.45 | 350.81 | 249.36 | 352714.2 | 4057.64 | 5763.85 | 882.95 |
| (34) no 3 | 179.17 | 18.76 | 48.41 | 11.1 | 34.01 | 21.2 | 191.39 | 192 | 177.05 | 245365.4 | 3046.17 | 1709.32 | 544.59 |
| (34) no 4 | 256.64 | 19.77 | 59.38 | 10.86 | 79.64 | 26.51 | 81.4 | 245.69 | 151.47 | 175499.1 | 2318.43 | 1376.29 | 427.64 |
| crm till 4 | 88.37 | 9.05 | 128.33 | 10.94 | 44.37 | 16.31 | 95.1 | 20.52 | 64.53 | 31239.6 | 714.82 | 530.37 | 173.96 |
| silt monolith CNTRL | 95.71 | 9.13 | 51.71 | 7.2 | 22.58 | 12.65 | 13.79 | 31.69 | 61.12 | 17097.94 | 522.19 | 290.1 | 136.15 |
| | | | | | | | | | | | | | |
| KEY: | x2 error | | x3 error | | x4-6 err | | x6-10 | | x10-20 | | x20-60 | | >x60 |

*Table 15: Metal content of iron smithing slags from contexts 33, 34 and 110 recorded in ppm*

*Fired and vitrified clay*

B.6.27 Some eight different samples of fired clay brick and supports and fired vitrified clay lining from the upper part of the saltern mound ((41), (94), (38), (162) and (33)) as well as the lower part of the saltern mound associated with Late Saxon working ((67), (167) and (225)) were analysed in 36 separate measurements (Table 16).

B.6.28 Strontium was consistently high on all the samples recorded, regardless of context, yet all of these lay within a range of between 140 – 211 ppm (at 8-16x error), which overlaps with, but which is at a level up to 4x lower than that recorded in the salt slags. This probably confirms the association of (all of this) fired clay brick etc with the salt working, and thus the source of the strontium in the boiling (enrichment) of the brines. Much of this may be in the form of the surface coating/ impregnation of the brick and clay with sea salt

B.6.29 As expected the levels of rubidium are high (between 25 – 181 ppm (3-11x error)), and probably greater than in the salt slags, on account of the enhancement with brine and the also presence of potassium from feldspars, mica and clay minerals. The highest levels (of up to 181 ppm Rb) were associated with one of the semi-vitrified clay brick fragments associated with the Late Saxon working (67)2, although some of the measurements of the Medieval brick (38) were also high (up to108 ppm Rb). There seemed to be no obvious enhancement associated with vitrification.

B.6.30 Iron was high throughout the clay samples, but in elevations that might be expected of burnt and slightly iron-rich clays (i.e. of between just 2-8% Fe (>20x error)), the highest values being associated with samples (67). There was no obvious association of the clay samples with iron working (as revealed through the chemistry of the samples looked at), which perhaps matches the context association of most of these with disused salt hearth and filtration waste etc.

B.6.31 Neither manganese nor zinc showed any sort of obvious pattern, although both elements were enhanced in different samples, manganese in particular in (162), (22), (38) and (67)2. Manganese was significant and ranged from 326 – 1229 ppm (2-4x error) in most samples. Relatively low levels of antimony are also associated with samples (41), (167) and (67), but likewise this shows no clear correlation with anything else.

B.6.32 Lead is enhanced in most but not all of the samples (the exception being sample (167) – a brick associated with a Late Saxon filtration tank). In fact the levels of lead upon the surfaces of the fired clay bricks etc. is really quite variable, ranging from 33 – 274 ppm Pb (2-8x error), therefore lower by a factor of x3 than the levels of lead contamination present in the salt slag. Also there appears to be no real evidence for higher levels of lead in the bricks associated with Medieval working; similar but still small levels of contamination being present on the fired clay from both the lower and upper parts of the saltern mound.

| SAMPLE | Sb | Sb Error | Sr | Sr Error |
|---|---|---|---|---|
| (162) no1 | 50.86 | 65.51 | 190.92 | 13.24 |
| (162) no 2 | 32.81 | 65.78 | 200.41 | 13.62 |
| (162) no 3 | -6.94 | 64.72 | 212.4 | 13.9 |
| (162) no 4 | 1.5 | 64.9 | 211.56 | 13.88 |
| crm till 4 | 29.62 | 60.56 | 95.12 | 9.24 |
| (22 ) glazed surface | 78.74 | 65.2 | 169.53 | 12.41 |
| (22) underneath | 138.38 | 83.78 | 140.9 | 14.14 |
| (38) no 1 | -44.26 | 62.08 | 124.01 | 10.69 |
| (38) no 2 | -0.36 | 61.89 | 112.04 | 10.11 |
| (38) no 3 | 20.7 | 62.63 | 110.97 | 10.14 |
| (38) no 1 | 35.95 | 66.08 | 104.5 | 13.54 |

*Table 16: Metals/ Trace elements within fired and vitrified clay from contexts 22, 35, 38, 41, 67, 162, 167 and 225 recorded in ppm*

*Pottery sherds* (Table 17)

B.6.33 Both rubidium and strontium appear in equal amounts (between 66 and 93 ppm Rb + Sr); the overall similarity in these two levels combined with the lower values of strontium being quite typical of a source which is clay minerals rather than brine (N.B. one might compare these levels of Sr with the considerably elevated amounts associated with salt slag and fired clay (Tables 14 & 16) but also with the background for clay, as represented by the CRM sample Till 4, to which all the measurements have been compared.

B.6.34 The iron levels within the pottery sherds are all pretty similar, being between 3-4% Fe, which is pretty much what one might expect as a terrestrial (crustal) background. However the manganese enhancement on the sooted exterior of the pot sherds from (33) (i.e. 445 – 1317 ppm Mn (4x error)) may in part be post-depositional, yet the elevated values upon the interior surface of the same (i.e. 492 – 794 ppm (2-3x error)) suggest otherwise, that it must in part relate to composition.

B.6.35 The presence of small but just significant amounts of arsenic, zinc, copper and nickel within both these pots attests to a quite different chemistry of this ceramic that appears both unrelated and relatively unaffected by the depositional environment.

B.6.36 Once again, though, the moderate elevations in lead levels upon all the sherds is quite striking (i.e. between 62-227 ppm Pb recorded in measurements of both internal and external surfaces all the sherds (3-7x error)). The highest values though are definitely those associated with the sooted exterior surfaces of the pot recovered from (33) (i.e. 195 – 227 ppm Pb). Once again these levels may be post-depositionally enhanced, as such soots will selectively accumulate csome heavy metals from the surrounding sediments, yet the pots like the iron-smithing may also have been used on contaminated hearths. Another explanation might be the application of lead glazes upon some parts of these Medieval pots.

| SAMPLE | Sr | Sr Error | Rb | Rb Error | Pb |
|---|---|---|---|---|---|
| crm till 4 | 102.68 | 9.4 | 148.29 | 11.46 | 68.53 |
| (33) pot exterior no 1 | 77.34 | 8.34 | 84.1 | 8.83 | 226.92 |
| (33) pot exterior no 2 | 79.68 | 8.48 | 82.3 | 8.8 | 224.28 |
| (33) pot exterior no 3 | 73.76 | 8.14 | 85.35 | 8.84 | 219.37 |
| (33)pot exterior no 4 | 78.24 | 8.21 | 81.06 | 8.53 | 227.46 |
| (33) pot exterior no 5 | 74.2 | 8.15 | 81.67 | 8.66 | 195.82 |
| (33) pot interior no 1 | 65.8 | 8.07 | 86.94 | 9.23 | 136.15 |
| (33) pot interior no2 | 73.71 | 8.47 | 93.91 | 9.59 | 133.34 |
| (33) pot interior no 3 | 67.95 | 8.12 | 93.58 | 9.47 | 136.61 |
| (33) pot interior no 4 | 75.27 | 8.36 | 87.42 | 9.1 | 132.34 |
| (94) pot no 1 | 76.72 | 8.1 | 77.47 | 8.31 | 57.9 |

*Table 17: Trace elements present on the surfaces of pottery sherds from contexts 33 & 94, recorded in ppm*

*Silt tailings* (Table 18)

B.6.37 The results of serial measurements of the chemistry of these upper mound waste silts or tailings over a c.90 cm section from (153) to (139) is interesting in that it appears to show some contamination of the brine-washed (or 'sleeched') silts with probable burnt hearth waste and salt debris. Measurements were taken at 3-5cm intervals where possible.

B.6.38 Strontium shows a much reduced and only barely discernable pattern for brine contamination which may be slightly more significant at the top of the sequence than the bottom, but in general varies very little (68 – 110 ppm Sr (8-11x error). However context (139) at the top shows a small but definite increase (i.e. 99 – 105 ppm Sr (11x error) compared with the base (153).

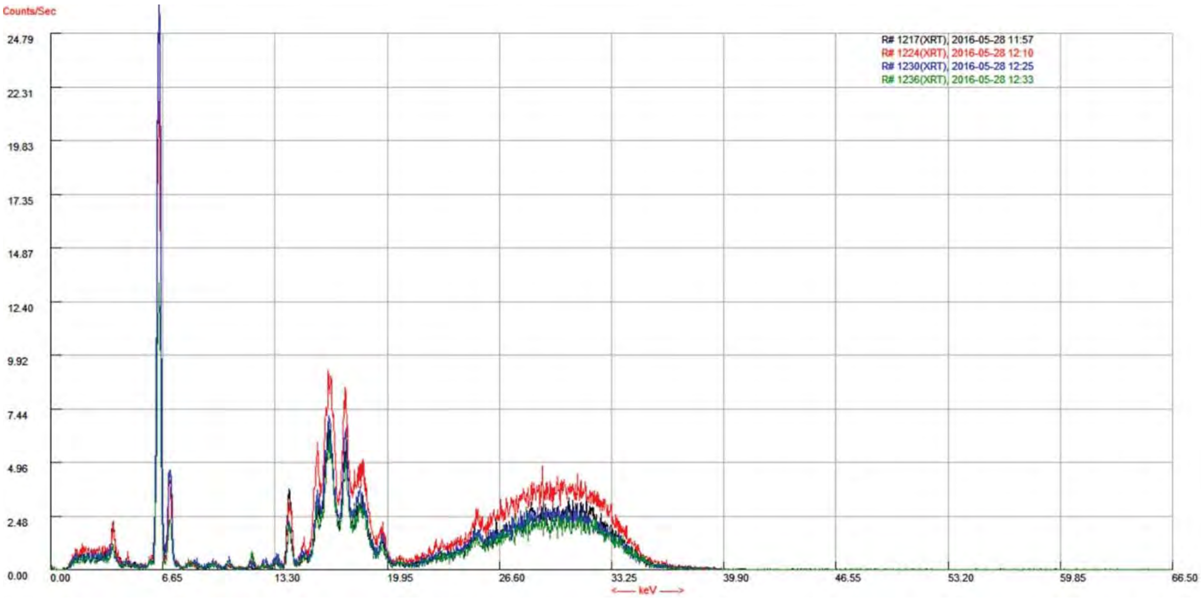
B.6.39 Rubidium levels are significant in their values (up to 8x error), but again not that different from the clay background, yet this don't reach anything like the enhancement seen upon the salt-affected/ heavily fired surfaces of some of the clay brick supports, such as those from (67) and (225) associated with Late Saxon salt manufacture. However, the underlying similarities in composition of the mound silts (most probably estuarine silts) and the fired clay suggests that the latter were most likely made on the spot, most probably from the mound silts themselves.

B.6.40 The iron content of the silts ranges between 1- 4%, and there also seems to be no appreciable change in this content between the bottom and the top of the section. This is different from the ceramic sherds, but not that different from the iron content of the fired clay bricks, except that the latter become enhanced in iron in those areas affected most by intense burning. The distribution of the manganese content in the silts may correlate to the changes in iron, but in particular to the changing levels of lead.

B.6.41 Lead is still present in moderately high amounts within the upper part of the sequence (contexts (154) + (139)) where the levels of this range from 67 – 531 ppm Pb (or 3-11x error). For the most part this is still a factor of x2 less than the concentration of lead within the more contaminated salt slags, yet it may reflect the much higher proportion of contaminated hearth waste and charcoal present within the silts in contexts (154) and (139). The highest level of contamination (at 531 ppm Pb) was recorded from the mid-point of layer (154) (i.e. 44cm from the top of monolith section <22>). This point also corresponds with a slight an elevation in arsenic (c.100 ppm As).

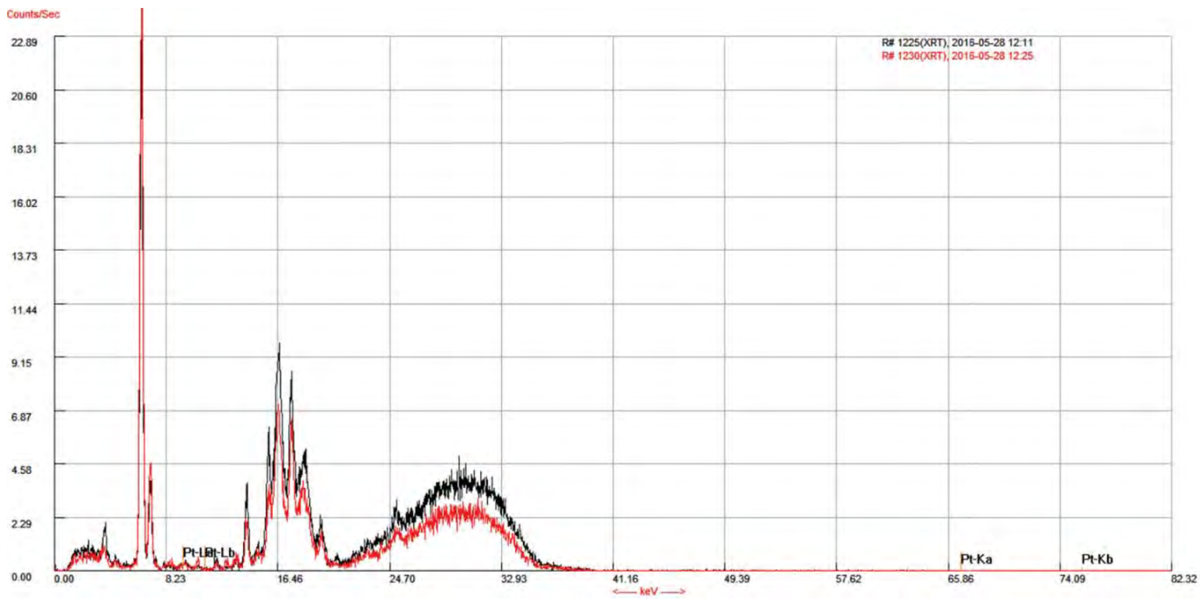
| MONOLITH <22> | Sr | Sr Error | Rb | Rb Error |
|---|---|---|---|---|
| (139) 3 cm | 102.42 | 8.98 | 62.75 | 7.5 |
| (139) 5 cm | 101.89 | 9.32 | 61.02 | 7.1 |
| (139) 10 cm | 101.98 | 9.25 | 64.14 | 7.8 |
| (139)15 cm | 103.33 | 8.49 | 58.54 | 6.85 |
| (139)20 cm | 102.22 | 9.31 | 57.69 | 7.49 |
| (139) 25 cm | 99.41 | 8.64 | 60.89 | 7.21 |
| (139) 28 cm | 105.27 | 8.77 | 62.26 | 7.21 |
| (154) 3 cm | 67.62 | 7.87 | 43.17 | 6.63 |
| (154) 7cm | 100.91 | 9.06 | 42.83 | 6.53 |
| (154) 12cm | 117.38 | 11.9 | 24.81 | 6.54 |

*Table 18: Metal content of silt tailings within upper saltern mound contexts (153) (154) & (139) (Monolith<22>) recorded in ppm*




*Appendix Figure 1: A record of the spectra recorded in counts per second at different energies (keV) for all of the salt slag samples from Marsh Lane (55 samples recorded between 11.57 and 12.33pm), for the purposes of comparison. These demonstrate a moderately good 'wiggle-match' fit, thus the composition of the slags appear quite consistent.*

5




*Appendix Figure 2: A graphic representation of the maximum difference in the amplitude of the spectra between the most metal-poor and most metal-rich salt slag samples from Marsh Lane. The range is quite small.*

***Discussion***

B.6.42 This exercise has been useful in so far that it has been shown that it is possible, to some degree, to chemically characterise salt working slag, and perhaps also the fired clay bricks/ clay lining/supports used to support the brine boiling pans, using pXRF. Care must be paid to ensuring that multiple measurements are taken, and also that both the data and the instrument itself are regularly and continually checked for consistent readings against blanks and appropriate Certified Reference Materials, and perhaps in this case a local background control sample.

B.6.43 Using this software package and suite of elements on the pXRF the Marsh Lane salt slags can be shown to have a significantly high strontium signal; in most cases > 100 ppm, but typically between 200-400 ppm Sr, and in some cases up to 900 ppm within certain laminae of the slag cakes as these form within the hearths below the brine boiling pans. The latter grow most likely as accumulations of 'spatter layers' when the brines boil over into the hearths, accidentally perhaps in response to the fanning of the sea-winds upon the exposed peat fires. Moreover these slag cakes or concretions build up as a result of the reaction between the hot brine (sea salt), peat and wood ash, and the clay lining of the hearth and the pan brick supports.

B.6.44 The levels of the strontium present within the Marsh Lane salt slags would appear to be 5x to 40x the concentration of strontium in sea salt, which is c. 22 ppm. However, its concentration within sea water is <1 ppm (Copeland *et al.* 2016). Given the relative loss of soluble salts from the slag (mostly sodium and potassium) compared to the trace elements which become fixed in the accompanying aluminosilicates, such a result is not unexpected, but instead serves to remind us of one of the key trace chemical indicators of this activity. Yet apart from the light alkali elements such as potassium and sodium which are not recorded by the pXRF, there is only a small but consistent rise in the level of rubidium which may be linked to seawater and/or the sleeching process used to wash out salt from the clay-rich silts. Thus the small elevations in the concentration of the other heavy metals recorded may not be due to the evaporation or boiling of seawater brines, but rather to the nature of the boiling pans themselves.

B.6.45 Probably the most interesting result of this study has been the detection of a small but significant lead contamination record, which appears to be highest in the salt slags formed directly as spillages from the pans (with levels consistently in the range 90 – 772 ppm Pb), but also in places upon the surfaces of the fired clay brick supports (in the range 50 – 326 ppm Pb). However, lead was also detected within the sleeching silt tailings, particularly at certain horizons associated with the clearance of hearth waste and ash, and in some cases at similar levels of concentration. The crustal average of lead is just 12.5 ppm, although it occurs in the granitic rocks from which the clay minerals are derived at around 20 ppm (Taylor 1986).

B.6.46 The practice of using lead pans during the medieval period for the boiling of brine at coastal saltcote sites associated with sleeching has been confirmed by archaeological excavation as well as by historic record. At Wainfleet St. Mary on the Lincolnshire coast a series of 15th century sleeching mounds, filtration tanks and pan boiling hearths were excavated in some detail (McAvoy 1994). The actual pans had been removed, yet a series of lead off-cuts from these remained, along with the arrangements of the brick supports. Meanwhile documentary reference to the use of such pans at saltern sites during the medieval – postmedieval period comes from both Brownrigg (1748) and Duncan (1812):

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

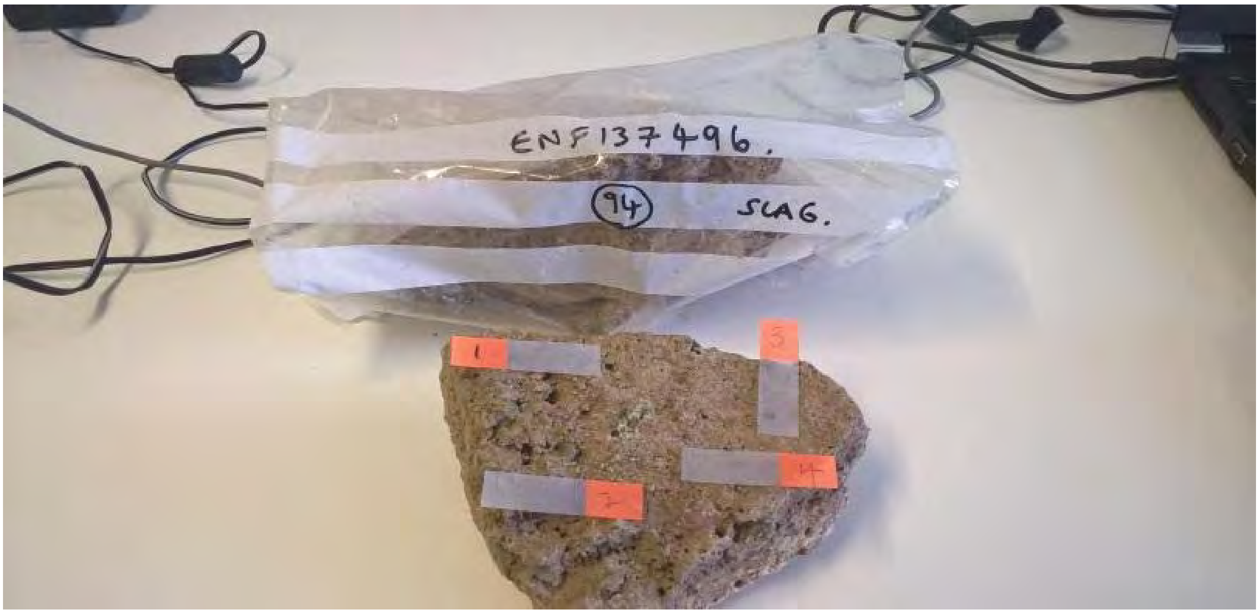
B.6.47 In fact the evidence from Marsh Lane would seem to suggest that lead pans were probably being used at Lynn as early as the 12th century AD, and perhaps earlier, given that lead contamination in the slags and brick supports has also been identified from the Period 1 phase of working.

***Conclusion***

B.6.48 The salt slags and fired clay bricks from the Marsh Lane saltern site show distinct elevations in strontium, an elemental increase which appears to be associated with the boiling of brine and the production of salt. Likewise a smaller but detectable increase in lead and some other heavy metals can only really be explained as a result of contamination associated with the use of lead boiling pans. These were used here as early as the 12th century AD, but probably also in the Late Saxon period; the pans being supported on clay bricks over peat-fuelled hearths.

B.6.49 Chemical analysis carried out on the putative iron smithing slag clearly differentiates this from the salt working slag. Equally the analyses carried out upon the surfaces of the pottery sherds distinguishes this particular non-local clay source from the locally-made fired clay bricks which in all probability were manufactured from the sleech mound silts.

**Examples of sample measurement points recorded on salt slags and fired clay:**




*Appendix B.6 Plate 1: Salt slag cake from (94) – measurements 1-4*


*Appendix B.6 Plate 2: Salt slag cake from (94) – side measurements 1-2*


*Appendix B.6 Plate 3: Salt[redacted]slag from (34) – measurements 1-4*


*Appendix B.6 Plate 4: Fired clay brick from (38) <1>*

## B.7 Iron smithing debris and ironworking evidence

*By Simon Timberlake*

***Introduction***

B.7.1 A total of 640g of ferrous iron smithing slag plus 151g of vitrified hearth lining & fuel ash which was probably associated with this activity was recognised amongst the collection of salt working slag from Marsh Lane. All of this came from the upper part of the saltern mound, and would have been medieval in date (Period 2). Additionally there were several samples of iron-contaminated salt slag which were likewise associated with the hearth/ hearth horizon that had been used for this ironworking on the mound top.

B.7.2 The smithing slag was visually recognized (see Table 13: slag characterisation) and recorded using standard parameters, although all the pieces were subsequently tested using a powerful magnet. In all cases there was a response in the powdered slag suggesting the presence of at least small amounts of free iron and wustite, although the smithing hearth base was more strongly magnetic.

***Smithing hearth base (SHB)*** context (34) 130mm x 90mm x 25mm (thick): weight 315g.

B.7.3 A broken third to half of an unusually wide and flat-topped plano-convex shallow round-bottomed SHB with the characteristic traces of the hinge fracture break with the tuyere on one side, and a slight pooling depression in the middle. The mass of the slag cake where broken reveals a dense sub-crystalline metallic interior with traces of gas bubbles in what is probably a fayalite-wustite eutectic. Reconstructing the dimensions of this sub-circular slag cake by projecting the curvature of the rounded rim it is possible to suggest an original diameter of approximately 250mm, which is almost exactly equivalent to the best-preserved salt slag cake from this site from context 94 (Table 13), but which is of a size unusually large for an iron forge hearth.

***Smithing slag and vitrified hearth lining*** context (94) 135mm x 15-25mm: weight 222g.

B.7.4 A vitrified clay sinter mixed with iron slag forming the edge of a shallow iron smithing hearth with the impression of the underside of a c.80mm diameter tuyere hole. The hearth was probably of the same diameter as the one suggested above (i.e. 250 mm).

***Smithing slag*** context (110) 60 x 20mm: weight 42g.

B.7.5 A small sintery mass of iron oxides.

***Slag smithing lumps*** (SSL) context (33) consisting of x6 pieces: total weight 58g.

B.7.6 Irregular-shaped lumps of dense metallic slag – 40mm x 8mm (15g), 50mm x 20mm (26g), 35mm x 10mm (6g), 30mm x 6mm (4g), 35mm x 8mm (5g), 17mm x 11mm (2g).

***Smithing slag*** context (41) <2> 17mm x 7mm: weight 3g.

B.7.7 Small lump of vitrified clay and slag.

***Fuel ash/ vitrified clay*** context (35) 70mm x 60mm: weight 103g.

B.7.8 A bubbly vitrified mass with some impressions of charcoal in it.

B.7.9 ***Vitrified clay and slag*** context (94) 70mm x 20mm: weight 48g.

Consists of vitrified clay, iron slag and iron oxides.

*Conclusions*

B.7.10 All of the above, though found separately, constitute what one would expect to find within the discarded debris of an iron smithing forge and hearth, presumably one associated with an iron anvil and probably a manually-operated bellows. Loose hammer scale is what one might expect to find also on the floor of a small open workshop (one that was presumably located on the top of the mound), or in the refuse swept into the mound silts. However, given the level of truncation and the dispersal of the existing smithing debris, the presence of hammer scale might be very difficult to find, and also its location if re-deposited, meaningless.

B.7.11 What is most interesting about this iron smithing debris is the unusual size of the smithing hearth base (SHB). Typically a large SHB would rarely exceed 150mm diameter, but may be 60-70mm deep. However, the Marsh Lane SHB and hearth debris seems to be much wider and shallower than this, perhaps as much as 250mm wide and 25mm deep.

B.7.12 Smithing hearths are formed from the melting down of the hammerscale and iron fragments entering the blackmith's hearth each time the object is re-heated during a weld or forge. Typically the melted scale *etc*. reacts with the shaped clay lining of the hearth; thus the shape and size of the hearth to some extent dictates the shape and size of the smithing hearth base which remains in the hearth until it becomes fused with the air blast tuyere, and the tuyere becomes blocked or obstructed, at which point the SHB is broken off and removed from the hearth.

B.7.13 Thus the correspondence in size between the salt slag cake (see salt slag from context (94): Table 13) and the SHB might well be because the same clay-moulded hearth is being used for both activities, at different times. Of course the use of this salt-making hearth by a blacksmith may be purely opportunistic, and could have been a one-off, yet it should be noted that salt-making sometimes requires the chiselling-out of salt cakes from metal pans, equally the tools used for digging the silts used in sleeching, and in cleaning out the hearths, will require re-forging and sharpening from time to time.

## Appendix C. Environmental Reports

### C.1 Faunal remains

*By Anthony Haskins*

***Introduction***

C.1.1 An assemblage of seven fragments of moderately preserved animal bone (6g) was recovered from the burnt hearth waste deposits of Group 200 within the upper medieval deposits of the saltern mound (Table 19).

***Quantification***

| Species | Context | Group | Quantity |
|---|---|---|---|
| Unidentified | 33 | 200 | 1 |
| Medium Mammal | 94 | 200 | 2 |
| Unidentified Fish | 94 | 200 | 3 |
| Small Mammal | 124 | 200 | 1 |

Table 19: Animal bone by context

C.1.2 No complete elements are present and the lack of remains identifiable to species do not allow for any detailed analysis.

### C.2 Shell

*By Alexandra Scard*

***Introduction and methodology***

C.2.1 A total of 0.760kg of marine shell was recovered from five contexts during the excavation (Table 20). This shell was quantified by apices and examined in order to assess the diversity and quantity of the ecofacts, as well as their potential to provide useful data as part of archaeological investigation. The assemblage is the result of shell collected by hand on site as well as recovery during the processing of environmental samples. Generally, preservation of the assemblage is good and there is no consistent evidence of taphonomic or man-made damage, aside from potential 'shuck' marks in some of the mussel (*Mytilus edulis*) valves retrieved from layer 67. This represents the mussels being prised open for consumption.

| Species | Common name | Habitat | Total weight (Kg) | Total number of contexts |
|---|---|---|---|---|
| *Mytilus edulis* | Common mussel | Intertidal, salt water | 0.148 | 4 |
| *Unionidae* | Freshwater mussel | Streams, rivers, lakes and ponds | 0.015 | 2 |
| *Cerastoderma edule* | Cockle | Intertidal, salt water, | 0.597 | 3 |

*Table 20: Overview of identified, quantified shell*

***Results***

C.2.2 Tables of quantification for the three species recovered can be seen below (Tables 21-23). Almost all of the assemblage was recovered from medieval layers (Period 2).

| Context | Cut | Group | Feature type | Weight (kg) | Total apices | MNI | Average Size (cm) | Comments |
|---|---|---|---|---|---|---|---|---|
| 67 | | 201 | Layer- dumping | 0.129 | 54 | 27 | 5 | Some potential shuck marks. Incl. shell from <4>. |
| 94 | | 200 | Layer- burnt mound | 0.013 | 7 | 4 | 4 | |
| 132 | 205 | | Pit | 0.001 | 1 | 1 | 3.5 | Shell from <17>. |
| 200 | | 200 | Layer – mound | 0.005 | 2 | 1 | 4.5 | Shell from <49>. |

*Table 21: Quantified common mussel shell*

| Context | Cut | Group | Feature type | Weight (kg) | Total apices | MNI | Average Size (cm) | Comments |
|---|---|---|---|---|---|---|---|---|
| 67 | | 201 | Layer- dumping | 0.129 | 54 | 27 | 5 | Some potential shuck marks. Incl. shell from <4>. |
| 94 | | 200 | Layer- burnt mound | 0.013 | 7 | 4 | 4 | |
| 132 | 205 | | Pit | 0.001 | 1 | 1 | 3.5 | Shell from <17>. |
| 200 | | 200 | Layer – mound | 0.005 | 2 | 1 | 4.5 | Shell from <49>. |

*Table 22: Quantified freshwater mussel shell*

| Context | Group | Feature type | Weight (kg) | Total apices | MNI | Average Size (cm) | Comments |
|---|---|---|---|---|---|---|---|
| 67 | 201 | Layer- dumping | 0.005 | 3 | 2 | 2 | Incl. shell from <4>. |
| 94 | 200 | Layer- burnt mound | 0.591 | 331 | 166 | 2.5 | Incl. shell from <21>. Hole in one valve: rooting? |
| 105 | 198 | Layer – natural | 0.001 | 0 | 1 | U/K | Incl. shell from <12>. Tiny frag with no apex. |

*Table 23: Quantified cockle shell*

C.2.3 Cockle (*Cerastoderma edule*) predominates the assemblage whilst, interestingly, both marine and freshwater (*Unionidae*) mussels were recovered on site. This could represent import of certain goods, or natural intrusion within deposits of alluvial processes.

***Discussion***

C.2.4 Consumption of molluscs is renowned during the medieval period and the shell assemblage recovered from Marsh Lane is indicative of this. On the whole, the presence of shell within layers of mounds and waste would suggest deliberate disposal during/after consumption. However, on this occasion, given the low quantity of shell recovered, a residual presence is more likely, with unintentional inclusions of shell appearing in the gradual infilling of such features.

C.2.5 The fairly low quantity of ecofacts retrieved, as well as the 'industrial' nature of the site suggests that these represent occasional consumption, with residual or unintentional deposition appearing in the archaeological record.

## C.3 Environmental samples

*By Rachel Fosberry*

***Introduction***

C.3.1 Sixty-seven bulk samples were taken during the excavation from deposits associated with Late Saxon and medieval salt-making (*c*.8th to 13th centuries AD). Forty-two additional samples were taken for pollen (Appendix C4) and diatom (Appendix C5) analysis.

C.3.2 Features sampled included hearths that had been specifically constructed for brine-boiling, silt filtration units and layers of burnt deposits representing waste-material from the salt-making process. Very little dating evidence had been found during the excavation of these industrial features and one of the aims of sampling was to retrieve material for dating in the form of preserved plant remains.

***Methodology***

C.3.3 For the initial assessment of environmental remains, a single bucket (approximately 10 litres) of each of the samples was processed by tank flotation using modified Siraff-type equipment. The floating component (flot) of the samples was collected in a 0.25mm 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 24 to 30. Identification of plant remains is with reference to the *Digital Seed Atlas of the Netherlands* and the authors' own reference collection. Nomenclature is according to Stace (1997). The identification of cereals has been based on the characteristic morphology of the grains and chaff as described by Jacomet (2006).

C.3.4 Based on the results of the initial samples, the remaining soil of some of the samples was processed to ensure maximum retrieval of preserved remains. Waterlogged preservation was noted in Samples 72 and 78 in the initial assessment and additional processing of 1L sub-samples was carried out to allow detailed examination of wet remains.

***Quantification***

C.3.5 For the purpose of this initial assessment, items such as seeds and cereal grains have been scanned and recorded qualitatively according to the following categories:

# = 1-5, ## = 6-10, ### = 11-50, #### = 51+ specimens, ##### = 100+ specimens.

C.3.6 Items that cannot be easily quantified such as charcoal, burnt flint and fired clay fragments have been scored for abundance:

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

***Results***

*Saltmarsh Deposits: Group 240*

C.3.7 Two samples were taken from the underlying saltmarsh deposits located beneath the saltern in the western part of the site (Table 24). Deposit 252 (Sample 73), is comprised of fine silts and contains occasional plant macrofossils that have been preserved by waterlogging (in a permanent anoxic environment) that include seeds of annual seablite (*Suaeda maritima*), thistles (*Carduus/Cirsium* sp.), sedges (cyperaceae), Sheep's sorrel (*Rumex acetosella*) and microscopic yellow seeds measuring 0.3 x 0.5mm that have been identified as rushes (*Juncus* sp.). Also present within this sample are black stems measuring 1mm in diameter (and up to 4mm in length) that appear to be charred.

C.3.8 Deposit 246 (Sample 91) has a larger organic component with small fragments of woody material as well as small charcoal fragments, charred stems and occasional insect fragments and foraminifera. Annual seablite seeds are frequent in this assemblage which also includes seeds of thistles, docks (*Rumex* sp.), bog bean (*Menyanthes trifoliata*), sedges including trigonous and lenticular species, field penny cress (*Thlaspi arvense*), buttercup (*Ranunculus acris/bulbosus/repens*) all preserved by waterlogging. A fragment of charred cereal grain has been tentatively identified by its characteristic 'honeycomb' appearance. Occasional shells of mudsnail (*Hydrobia ulvae*) occur in both samples.

| Sample No. | Cxt No. | Volume processed (L) | Flot Volume (ml) | Charred cereals | Waterlogged Seeds | Hydrobia ulvae | Foraminifera | Charcoal | Marine molluscs | fired clay |
|---|---|---|---|---|---|---|---|---|---|---|
| 73 | 252 | 7 | 15 | 0 | ## | # | ## | + | 0 | ++ |
| 91 | 246 | 8 | 40 | # | ## | # | # | + | # | 0 |

*Table 24: Bulk samples from saltmarsh deposits*

*Period 1: Late Saxon (AD850 – AD1066)*

*Saltern Mound Deposits*

C.3.9 Samples were taken from a sequence of deposits from the saltern mound that overlay marine deposits group 240.

*Saltern Feature Group 1*

C.3.10 Samples were taken from a lower group of silts from a group of features associated with salt making including silt filtration units **253**, **254**, **258**, **268**, **271** & **274** and open hearth **277** (Table 25). All of the samples contain fired clay fragments but the only samples found to contain preserved plant remains (other than sparse charcoal) are from filtration pits **253** and **258**. Both fills sampled from the deeper end of pit **253**, lower fill 265 (Sample 78) and upper fill 266 (Sample 77), contain waterlogged plant material that is comprised of fine rootlets with several larger stem fragments (diameter 3mm, length up to 5cm), occasional seeds of annual seablite and numerous rush seeds. A single buttercup seed was recovered from fill 266 otherwise there is very little variation between the two assemblages both of which also contain occasional mudsnails and foraminifera. Of the two samples taken from pit **258** only fill 264 (Sample 75) contains preserved remains other than fine rootlets, small stem fragments and sparse charcoal and these are limited to occasional seeds of annual seablite and a single sedge seed.

| Sample No. | Cxt No. | Cut No. | Feature Type | Volume processed (L) | Flot Volume (ml) | Waterlogged Seeds | Hydrobia ulvae | Foraminifera | Charcoal | fired clay | Slag |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 77 | 266 | 253 | Filtration unit | 8 | 10 | ## | # | # | + | +++ | 0 |
| 78 | 265 | 253 | Filtration unit | 7 | 30 | ### | ## | ## | 0 | +++ | 0 |
| 74 | 256 | 254 | Filtration unit | 9 | | 0 | 0 | 0 | 0 | ++ | + |
| 75 | 261 | 258 | Filtration unit | 8 | 10 | # | 0 | # | 0 | +++ | 0 |
| 76 | 264 | 258 | Filtration unit | 7 | 5 | 0 | 0 | 0 | + | +++ | 0 |
| 103 | 275 | 274 | Filtration unit | 8 | 20 | 0 | 0 | 0 | 0 | ++++ | 0 |
| 104 | 276 | 274 | Filtration unit | 8 | 20 | 0 | 0 | 0 | 0 | +++ | 0 |
| 99 | 281 | 277 | Hearth | 8 | 40 | 0 | 0 | 0 | 0 | ++++ | 0 |

*Table 25: Bulk samples taken from saltern Feature Group 1*

*Saltern Feature Group 2*

C.3.11 Samples were taken from salt making features including: silt filtration units **164**, **168**, **170**, **179**, **187**, **193**, **203**, **226**, **231**, **236** & **294**; open hearths **175**, **177** & **190**; and a water tank **223** (Table 26). The plant remains recovered from Group 2 do not contain any that are preserved by waterlogging (presumably due to the features being on higher ground). Charred plant remains are rare although a single charred grass seed, possibly Marram grass (*Ammophila arenaria*), was recovered from fill 176 of hearth **175** and a grain of rye (*Secale cereale*) was found in fill 189 of pit **187.** Charcoal is scarce in all of the samples; there are possible charred heather stem fragments in fill 225 of tank **223** which may relate to the use of dried heather as fuel. There are also small charcoal fragments that may be suitable for radiocarbon dating from features **168**, **170**, **177** and **193**.

| Sample No. | Cxt No. | Cut No. | Feature Type | Volume processed (L) | Flot Vol. (ml) | Charred cereals | Charred Seeds | Hydrobia ulvae | Charcoal | Burnt bone | Marine molluscs | fired clay | Slag |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 28 | 167 | 164 | Filtration unit | 7 | 2 | 0 | 0 | 0 | + | +++ | ++ | 28 | 167 |
| 34 | 173 | 164 | Filtration unit | 6 | 5 | 0 | 0 | 0 | + | ++ | + | 34 | 173 |
| 55 | 232 | 231 | Filtration unit | 8 | 1 | 0 | # | 0 | 0 | +++ | 0 | 55 | 232 |
| 29 | 169 | 168 | Filtration unit | 8 | 15 | 0 | 0 | 0 | + | 0 | 0 | + | 0 |
| 30 | 172 | 168 | Filtration unit | 8 | 30 | 0 | 0 | 0 | + | 0 | 0 | ++ | 0 |
| 27 | 171 | 170 | Hearth | 8 | 5 | 0 | 0 | 0 | + | # | 0 | ++ | 0 |
| 31 | 176 | 175 | Hearth | 8 | 40 | 0 | # | 0 | + | 0 | 0 | ++ | ++ |
| 32 | 178 | 177 | Hearth | 7 | 1 | 0 | 0 | 0 | + | 0 | # | ++ | 0 |
| 33 | 180 | 179 | Filtration unit | 8 | 1 | 0 | 0 | # | 0 | 0 | 0 | ++ | 0 |
| 37 | 189 | 187 | Filtration unit | 8 | 1 | # | 0 | 0 | + | 0 | 0 | ++ | 0 |
| 38 | 188 | 187 | Filtration unit | 10 | 5 | 0 | 0 | 0 | + | 0 | 0 | ++ | 0 |
| 35 | 192 | 190 | Filtration unit | 7 | 15 | 0 | 0 | # | + | 0 | 0 | +++ | + |

| Sample No. | Cxt No. | Cut No. | Feature Type | Volume processed (L) | Flot Vol. (ml) | Charred cereals | Charred Seeds | Hydrob ia ulvae | Charcoal | Burnt bone | Marine molluscs | fired clay | Slag |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 36 | 194 | 193 | Filtration unit | 7 | 1 | 0 | 0 | 0 | + | 0 | 0 | ++ | 0 |
| 41 | 204 | 203 | Filtration unit | 8 | 1 | 0 | 0 | 0 | + | 0 | 0 | ++ | 0 |
| 40 | 115 | 205 | Hearth | 7 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | ++++ | 0 |
| 51 | 225 | 223 | Water tank | 7 | 1 | 0 | 0 | 0 | + | 0 | 0 | + | ++ |
| 56 | 237 | 236 | Filtration unit | 8 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | ++ | 0 |
| 57 | 238 | 236 | Filtration unit | 10 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | + | 0 |

*Table 26: Bulk samples taken from saltern Feature Group 2*

*Filtration units **78** and **168***

C.3.12 Samples taken from filtration units **78** and **168** did not contain preserved remains other than fired clay (Table 27).

| Sample No. | Context No. | Cut No. | Volume processed (L) | Flot Volume (ml) | Charcoal | fired clay |
|---|---|---|---|---|---|---|
| 6 | 79 | 78 | 7 | 1 | 0 | ++ |
| 29 | 169 | 168 | 8 | 15 | + | + |
| 30 | 172 | 168 | 8 | 30 | + | ++ |

*Table 27: Filtration units **78** and **168***

*Hearth waste deposits*

C.3.13 Deposit 251 (Sample 72) within the layers of waste silts from the lower mound sequence is very similar in content to the samples from pits **253** and **258** in saltern feature group 1 (Table 28). Plant remains are preserved by waterlogging and include several annual seablite seeds with occasional seeds of bogbean, thistle, sedges, docks, knotgrass (*Polygonum aviculare*), nettle (*Urtica diocia*) and rushes. Foraminifera and mudsnails are also present.

| Sample No. | Cxt No. | Feature Type | Volume processed (L) | Flot Volume (ml) | Water -logged Seeds | Water -logged stems | Hydrobia ulvae | Foraminifera | Char-coal | Marine molluscs | fired clay | Slag |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 72 | 251 | Mound | 8 | 30 | ## | +++ | # | # | 0 | # | +++ | +++ |

*Table 28: Bulk samples from hearth waste deposits*

*Period 2: Medieval (AD1066 – c.AD1500)*

C.3.14 Eight samples were taken from across hearth waste tip 200 (Table 29). All of the samples are comprised mainly of fired clay with non-metalurgical slag and burnt flint. Charcoal volumes are small and there is evidence of burnt heather (*Calluna vulgaris*) in Samples 46, 49 and 50. A single grain of rye in addition to an unidentifiable, abraded cereal grain is present in Sample 49. A tentative identification of sea beet (*Beta vulgaris subsp. maritima*) fragments were noted in Sample 46 and a grass (Poaceae) seed in sample 48.

| Sample No. | Cxt No. | Volume processed (L) | Flot Volume (ml) | Charred cereals | Charred Seeds | FAS/ slag | Hydrobia ulvae | Char -coal | Fishbone | Marine molluscs | fired clay | Slag | Burnt flint |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 43 | 200 | 10 | 10 | 0 | 0 | # | 0 | 0 | 0 | 0 | ++ | ++++ | ++ |
| 44 | 200 | 10 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | # | +++ | +++ | +++ |
| 45 | 200 | 10 | 15 | 0 | 0 | 0 | 0 | + | 0 | 0 | +++ | +++ | ++ |
| 46 | 200 | 10 | 20 | 0 | # | 0 | 0 | + | 0 | 0 | +++ | +++ | 0 |
| 47 | 200 | 10 | 10 | 0 | 0 | 0 | 0 | + | 0 | 0 | ++ | +++ | ++ |
| 48 | 200 | 9 | 20 | 0 | # | # | 0 | + | #b | # | ++ | +++ | ++ |
| 49 | 200 | 9 | 10 | # | 0 | # | # | + | 0 | ## | ++++ | +++ | ++ |
| 50 | 200 | 9 | 15 | 0 | 0 | 0 | 0 | ++ | 0 | 0 | +++ | +++ | +++ |

*Table 29: Bulk samples from hearth waste tip 200*

*Saltern feature Group 3*

C.3.15 Preservation of plant remains was particularly poor in the samples taken from Saltern Feature Group 3 (Table 30). Small fragments of charcoal were recovered from fill 76 of oven **75** which may be suitable for radiocarbon dating.

C.3.16 None of the other ovens/hearths that were sampled contain any surviving charcoal other than occasional specks.

| Sample No. | Cxt No. | Cut No. | Feature Type | Volume processed (L) | Flot Volume (ml) | Charcoal | Burnt bone | Marine molluscs | fired clay | Slag | Burnt flint |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 39 | 12 | 11 | Hearth | 10 | 10 | 0 | 0 | 0 | +++ | 0 | 0 |
| 42 | 229 | 11 | Hearth | 3 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 | 41 | 42 | Hearth | 8 | 15 | + | # | # | + | + | # |
| 7 | 76 | 75 | Hearth | 5 | 1 | 0 | 0 | 0 | +++ | 0 | 0 |
| 25 | 76 | 75 | Hearth | 8 | 2 | + | 0 | 0 | ++ | 0 | 0 |
| 17 | 132 | 205 | Hearth | 6 | 5 | 0 | 0 | 0 | ++++ | ++++ | 0 |
| 52 | 162 | 205 | Hearth | 6 | 1 | 0 | 0 | 0 | ++++ | 0 | 0 |
| 40 | 115 | 205 | Hearth | 7 | 5 | 0 | 0 | 0 | ++++ | 0 | 0 |

*Table 30: Bulk samples taken from Saltern Group 3*

***Discussion***

C.3.17 Despite extensive sampling of the deposits at Marsh Lane, very few plant remains have been recovered. Similar results were obtained from a contemporary site at Queen Mary's Nurses Home (Fryer 2014, 810) which had better recovery of charcoal but lacked the salt-marsh indicators, possibly because this site was further inland.

C.3.18 The site at Marsh Lane would have been on the coastline in the medieval period in an area of tidal marsh (Owen 1975, 42). The medieval salt industry at coastal sites in North Norfolk involved a process of 'sand washing' through which brine-impregnated sand and silt was filtered and the resulting solution then boiled (Albone, Massey & Tremlett 2007, 116). It is presumed that organic material such as turf, straw or possibly even peat was used as a filter through which the salt-impregnated silts were washed through. The filtration tanks excavated at Wainfleet St Mary, Lincolnshire were thought to have contained turves (McAvoy 1994, 140–41) but the samples from the tanks at Marsh Lane did not contain surviving organic material. The resultant waste sand and silts were piled into mounds and the black tip lines noted in the sections (Fig. 11) suggest that burnt material also contributed to the mound build-up. The acidic nature of these materials would not be conducive to preservation of plant remains unless the deposits had remained wet (allowing preservation by waterlogging in an anoxic environment) or if the plant remains had been charred.

C.3.19 The hearths used to fire the boiling of the salt solutions were evident by the presence of burnt clay and briquetage and the layers of burnt material recovered from the mound were presumably deliberate depositions of spent fuel raked from the flues of these hearths. Very little charcoal has been recovered from any of the samples and it can only be assumed that it hasn't survived or that wood was not the fuel used. The few fragments of charred heather recovered may possibly represent its use as fuel; heather would have been growing locally and would have been a convenient resource, but it is most likely that dried peat was used to fire the hearths. Burnt peat can be difficult to identify as the organic components are often reduced to ash but any seeds, stems and molluscs present can survive in significant quantities. Another contemporary salt-making site at Walpole St. Peter had more substantial evidence of the use of peat as fuel (Fosberry 2009, 78) in the form of charred reed stems. The lack of these remains from the black layers at Marsh Lane suggest that the burnt peat deposits have decayed to leave only a carbon-rich, black-stained soil. Samples from deposits that were described as being 'charcoal-rich' on excavation (eg fill 118 of pit **130**, burnt spread 94) did not subsequently produce significant amounts of charcoal fragments in the flot or residue suggesting that if charcoal was originally present, it has become unconsolidated. Degraded charcoal forms a suspension in water and passes through the flot mesh if smaller than 0.3mm. It is also possible that degrading turves can also result in dark soil-stained deposits.

C.3.20 There are occasional charred plant remains present; predominantly as single specimens of seeds and cereal grains. Whilst it would be expected that the salt workers would have brought food with them on site, it is unlikely that whole grains would have been consumed and subsequently burnt. Rye is a cereal that was extremely popular in the medieval period and was grown in vast quantities in Norfolk as it is a variety that tolerates sandy soils. The grain may represent the use of straw in the filtration process and it is possible that the grain is contemporary with the deposits as it was recovered from a well-sealed layer.

C.3.21 Preservation of the seeds of both salt marsh and terrestrial plants (mainly disturbed ground) is predominantly by waterlogging which has occurred in the marine silts found beneath the saltern mound, occasional pit fills within saltern Feature Group 1 and a hearth waste deposit (251) in the lower mound deposit sequence. The most frequent seeds are of annual seablite, a native plant that grows in a spreading habitat in middle and lower coastal salt-marshes (Stace, 150) in addition to seeds plants such as rushes, sedges and bog-bean which are all plants that thrive in wet-habitats and could also be peat components. Pollen samples taken from the mound sequence include one contemporary deposit (246) and also indicate a saltmarsh environment with evidence of nearby cereal cultivation and disturbed ground (Boreham *op cit*).

C.3.22 The plant remains recovered from bulk samples taken at Marsh Lane have limited archaeobotanical potential due to low density and diversity. This appears to be the case with contemporary salt-making sites in the area and it seems that processes involved are not conducive to the preservation of plant remains. It is possible that salt making was a seasonal occupation that exploited the salt deposited by the spring tides (Rudkin 1975, 37) which may explain the lack of seeds.

## C.4 Pollen analysis

*By Steve Boreham*

***Introduction***

C.4.1 This study focuses on the palynology of sediments obtained from two archaeological sections (45 & 58; Figs 11a &11c) excavated at the saltern site.

C.4.2 Section 45 was sampled with three overlapping 30cm monolith tins (Samples 53 A, B & C) through the basal part of the salt mound complex, capturing a series of contexts (239, 219, 218, 217, 212 & 206). The basal buff-brown silty clay (0-16cm) (context 239) formed a definite rise in topography at the site. This unit was thought to be either an initial dump of waste silt, or a relatively higher island of banked natural sediment. It was sub-sampled for pollen at 5cm. Overlying this was a black-grey silty clay with charcoal (16-20cm) (context 219a) sub-sampled for pollen at 18cm, and a orange-buff weathered silt (20-24cm) (context 219b) sub-sampled for pollen at 22cm. Above this was a black charcoal-rich silt (24-27cm) (context 218), which was thought to be a weathered soil. This unit was sub-sampled for pollen at 26cm. This was overlain by a brown-buff silt (27-34cm) (context 217) and a light brown-buff silt (34-59cm) (context 212), both presumed to be dumps of waste saltern material. Pollen sub-samples were taken at 32cm and 50cm from these units. These were in turn overlain by a unit of dark brown silty clay (59-70cm) (context 206), thought to be burnt hearth waste deposits, and sub-sampled for pollen at 62cm.

C.4.3 Section 58 was located in a different part of the site. It was also sampled with three overlapping 30cm monolith tins (samples 85 A, B & C) to provide a sequence through the sediments. The basal buff-brown silty clay (0-25cm) (context 243) was thought to represent mudflat deposits. This unit was sub-sampled for pollen at 5cm and 20cm. The overlying sediments comprised a buff and brown silty clay with thin lenses of black-grey macrofossil inclusions (25-50cm) (context 246) and a brown-buff slightly oxidised silty clay (50-60cm) (context 247). These sediments appear to fill a saltmarsh creek channel or ‘cut’ and were sub-sampled for pollen at 30cm, 44cm and 55cm.

C.4.4 The twelve pollen samples were prepared using the standard hydrofluoric acid technique, in the Geography Science Laboratories, University of Cambridge and counted for pollen using a high-power stereo microscope at x400 magnification. The percentage pollen data from these 12 samples is presented in Table 31 and in Appendix Figures 1a, 1b, 2a & 2b.

***Results***

*Section 45 – Samples 53A, B & C*

C.4.5 Sediment sub-samples for pollen analysis were taken from the following points along the Sample 53 monoliths; 5, 18, 22, 26, 32, 50 & 62cm. The results of the pollen analyses appear in Table 31 and are presented graphically as percentage pollen diagrams in Figure 1a (Trees, shrubs & summary) and Figure 1b (Herbs, spores & aquatics).

C.4.6 Unfortunately, the upper pollen sub-sample from 62cm (context 206) proved to be essentially barren containing only reworked and degraded grains, with a calculated concentration far below 1052 grains per ml. The remaining six pollen sub-samples had pollen concentrations that ranged between 17,528 and 80,478 grains per ml. Pollen preservation was rather variable in these sub-samples and finely divided organic material hampered pollen counting to some degree. Micro-charcoal was particularly abundant in the sub-samples from 22cm and 26cm. Assessment pollen counts were made from single slides for these six sub-samples. The pollen sums achieved for these slides were all above 50 grains, and two were greater than 100 grains. However, none exceeded the statistically desirable total of 300 pollen grains main sum. As a consequence caution must be employed during the interpretation of these results.

C.4.7 It is immediately clear that the majority of these sub-samples are dominated by grass (Poaceae) pollen (c.10-40%), alder (Alnus) pollen (c.6-23%), hazel (Corylus) pollen (c.6-13%) and undifferentiated monolete Pteropsid fern spores (c.7-17%). Arboreal (tree and shrub) pollen from this sequence reached 55% in the sub-sample from 18cm, indicating the proximity of woodland to the site. Figure 1a shows a remarkably consistent assemblage of arboreal pollen including dry-land trees and shrubs such as oak (Quercus), lime (Tilia), ash (Fraxinus), birch (Betula), pine (Pinus) and hazel (Corylus). This mixed-oak woodland signal is strongly reminiscent of a pre- or peri-clearance landscape. Pollen of the damp-loving tree alder (Alnus) rises to a peak of 23.3% in sub-sample 22cm (ctx 219b) indicating the proximity of wet carr woodland. Figure 1b shows a variable proportion of grass pollen, which may in part represent common reed (Phragmites), whilst further evidence for emergent aquatic and reedswamp vegetation comes from sedges (Cyperaceae) and reedmace (Typha latifolia) at the base of the sequence, and bur-reed (Sparganium) towards the top. Cereal pollen is present (c.1-3%) in the middle of the sequence, and the herb assemblage has representatives of tall-herb, meadow and riparian (bank-side) communities. There is a small heathland component to the signal from the Ericaceae, and a little evidence for trampled ground (Plantago undif.) and eutrophication (Urtica) is some sub-samples.

C.4.8 Taken together, the pollen sequence appears to represent deposition in a shallow reedbed relatively cut off from the surrounding landscape. There is no indication of deeper water, and possible saltmarsh indicators (for example Chenopodiaceae) are present at very low levels. It appears that whilst reedswamp and alder carr became established locally, the surrounding landscape had a mosaic of arable fields and meadows, mixed oak woodland with lime and hazel, and heathland with birch and pine woodland on drier more acid soils (probably the Sandringham Sands). Elsewhere in southern England, this kind of patchwork of oak woodland, pasture and arable fields persists until the Mid- to Late- Bronze Age. This pollen assemblage therefore appears mismatched to its presumed saltmarsh-proximal, salt mound-derived medieval origins.

*Section 58 – Samples 85A, B & C*

C.4.9 Sediment sub-samples for pollen analysis were taken from the following points along the Sample 85 monoliths; 5, 20, 30, 44 & 55cm. The results of the pollen analyses appear in Appendix Figures 1a, 1b & Table 31 and are presented graphically as percentage pollen diagrams in Appendix Figure 2a (Trees, shrubs & summary) and Appendix Figure 2b (Herbs, spores & aquatics).

C.4.10 The five pollen sub-samples had pollen concentrations that ranged between 15,164 and 90,204 grains per ml. Pollen preservation was in general quite good in these sub-samples, although finely divided organic material hampered pollen counting to some extent. Micro-charcoal was particularly abundant in the sub-samples from 5cm, 44cm and 55cm, and pre-Quaternary microspores presumably re-worked from the bedrock were seen throughout. The chitinous linings of foraminifera were also encountered in the sub-samples from 5cm and 44cm, and confirm a marine influence. Assessment pollen counts were made from single slides for these five sub-samples. The pollen sums achieved for these slides were all above 50 grains, two were above 100 grains, and two were greater than 200 grains. However, none exceeded the statistically desirable total of 300 pollen grains main sum. As a consequence caution must be employed during the interpretation of these results.

C.4.11 These sub-samples were dominated by grass pollen (Poaceae) (c.8-29%) and by pollen of the fat-hen family (Chenopodiaceae) (11-52%). Such large proportions of Chenopodiaceae are usually taken to indicate saltmarsh conditions close by. The abundant grass pollen may in part represent the common reed (Phragmites), and representatives of reedswamp and emergent vegetation such as sedges (Cyperaceae), reedmace (Typha latifolia) and bur-reed (Sparganium) are present at low proportions throughout. It is interesting to note from Figure 2a that the arboreal (tree and shrub) pollen from this sequence reached no more than 16% in total and comprised mostly alder (Alnus) and hazel (Corylus). Figure 2b shows that cereal pollen (c.1-3%) is present throughout the sequence, and that the herb assemblage has representatives of both meadow and riparian (bank-side) communities, and has trampled ground and disturbed ground indicators. The presence of tall herbs such as sea lavender (Limonium), the daisy/thistle/lettuce family (Asteraceae) and mugwort (Artemisia) is not inconsistent with rank vegetation associated with the marine limit.

C.4.12 In general, it is perhaps not surprising that these sub-samples from a presumed tidal mudflat or saltmarsh and associated creek system should have such an overwhelming signal from saltmarsh vegetation, and from the reedswamp that must have fringed the estuary environment at the time of deposition. It is the minor components of the pollen spectrum that hint at the mixed arable and pastoral land use on drier ground. The arboreal signal appears to be post-clearance with a little alder carr wet woodland, and a little hazel scrub. Indeed the presence of beech (Fagus) in the pollen signal intimates at how relatively late in the Holocene this assemblage could be. There is just a hint of birch-pine woodland and of heathland (Ericaceae pollen and bracken (Pteridium) spores), which probably originates from the more distant Sandringham Sands outcrop.

#### ***Discussion and conclusions***

C.4.13 These two sediment sequences from Sections 45 & 58 at the site of the Marsh Lane Saltern have presented entirely different pollen assemblages, and are of potentially rather different ages. The apparently Mid to Late- Bronze Age spectra from Samples 53 A, B & C show little sign of saltmarsh or marine influence and seem to come from a reedswamp environment. It appears that the suggestion of basal context 239 representing a pre-existing embankment of silt at the site may be correct. However, from these pollen analyses it seems that the overlying contexts 219, 218, 217 & 212 may either also represent natural *in situ* sedimentation in a reedswamp environment, or at least be dumped material derived directly from this source. Only the upper oxidised and barren context 206 appears to fill scours and hollows in the surface of context 212 and looks incongruous both spatially and from a palynological perspective.

C.4.14 In stark contrast the saltmarsh-dominated pollen signal from Samples 85 A, B & C fits the presumed environment of deposition very well. The post-clearance signal could be Iron Age or later, and this implies that the mudflat, saltmarsh and tidal creek environment might belong to the Terrington Beds, rather than the earlier Barroway Drove Beds. It is of course possible that taphonomy and reworking could skew the dry land pollen signal in these samples, reducing the mixed-oak woodland signal and giving a false impression in these assessment pollen counts. However, the presence of beech pollen seems somewhat unlikely in a Bronze Age setting.

C.4.15 It is clear that these pollen data should be seen in the context of multi-proxy evidence from the archaeology and the diatom investigation. Whilst palynology is usually successful in elucidating ancient environments and predicting the broad age-range of deposits, as always care must be taken not to over-interpret assessment pollen counts.

Marsh Lane Saltern - Percentage Pollen Diagram - Section 45 - Samples 53ABC - Trees, shrubs & summary

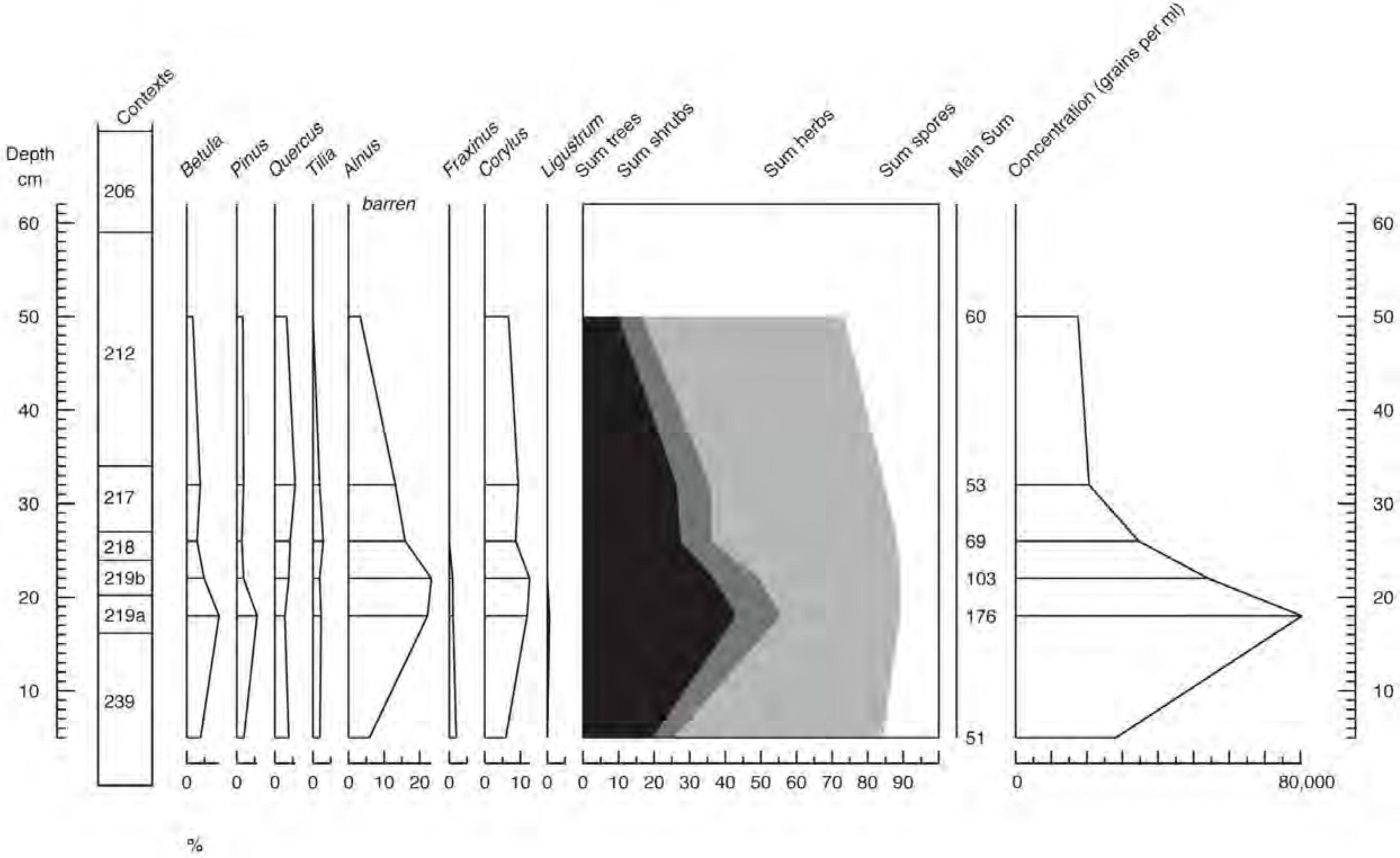



Figure 1a

# Marsh Lane Saltern - Percentage Pollen Diagram - Section 45 - Samples 53ABC - Herbs, spores & aquatics

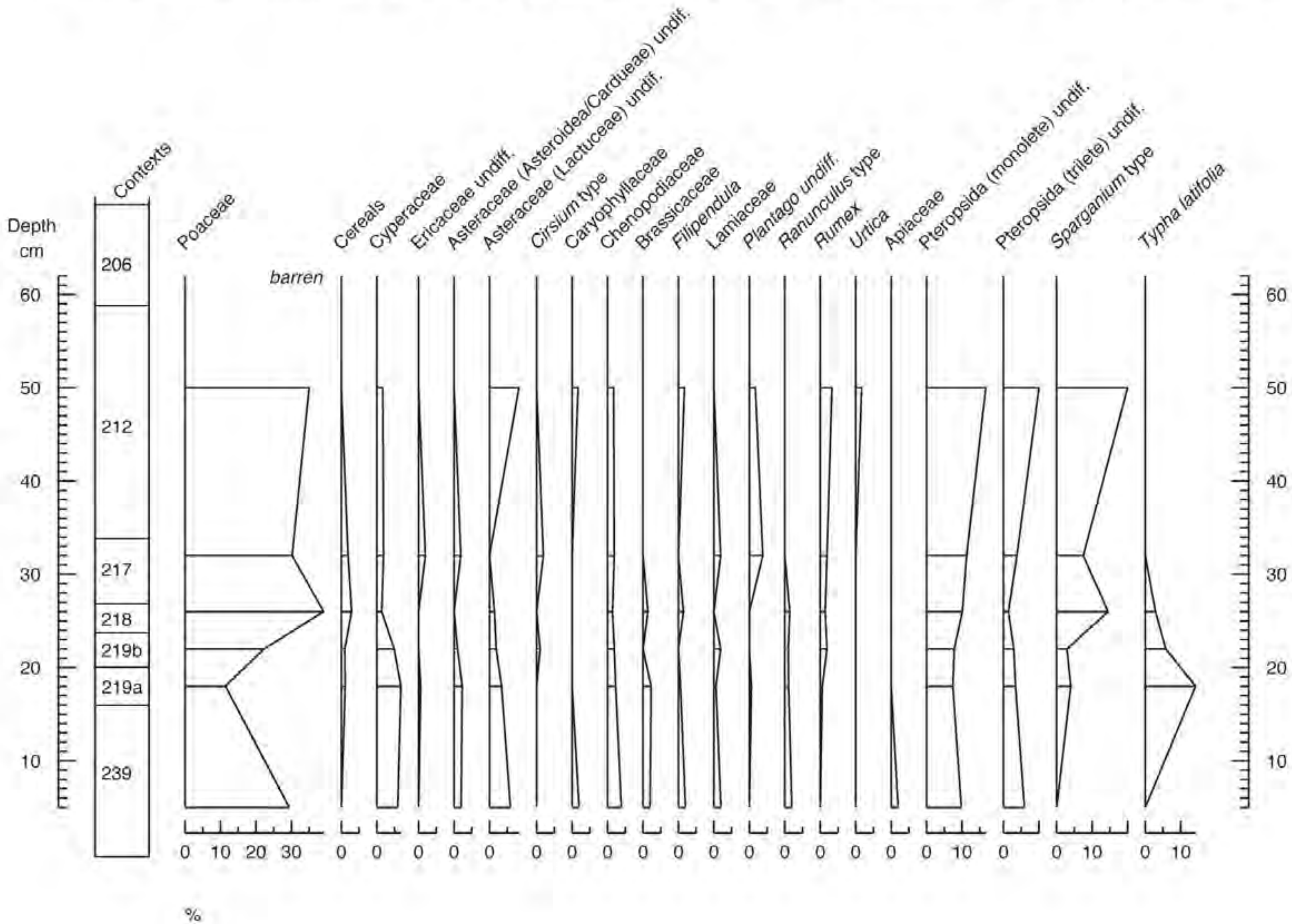



Figure 1b

Marsh Lane Saltern - Percentage Pollen Diagram - Section 58 - Samples 85ABC - Trees, shrubs & summary

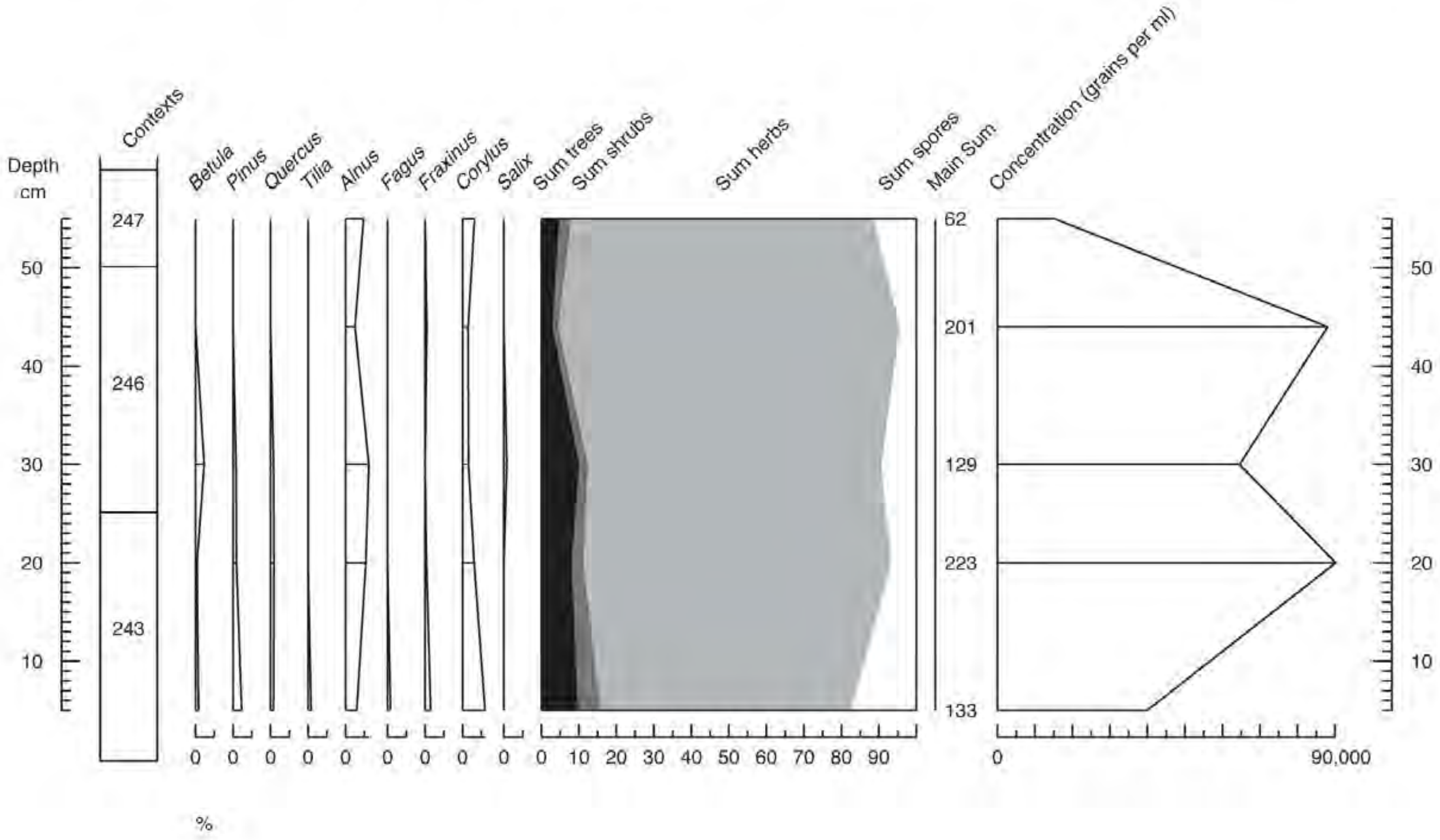



Figure 2a

Marsh Lane Saltern - Percentage Pollen Diagram - Section 58 - Samples 85ABC - Herbs, spores & aquatics

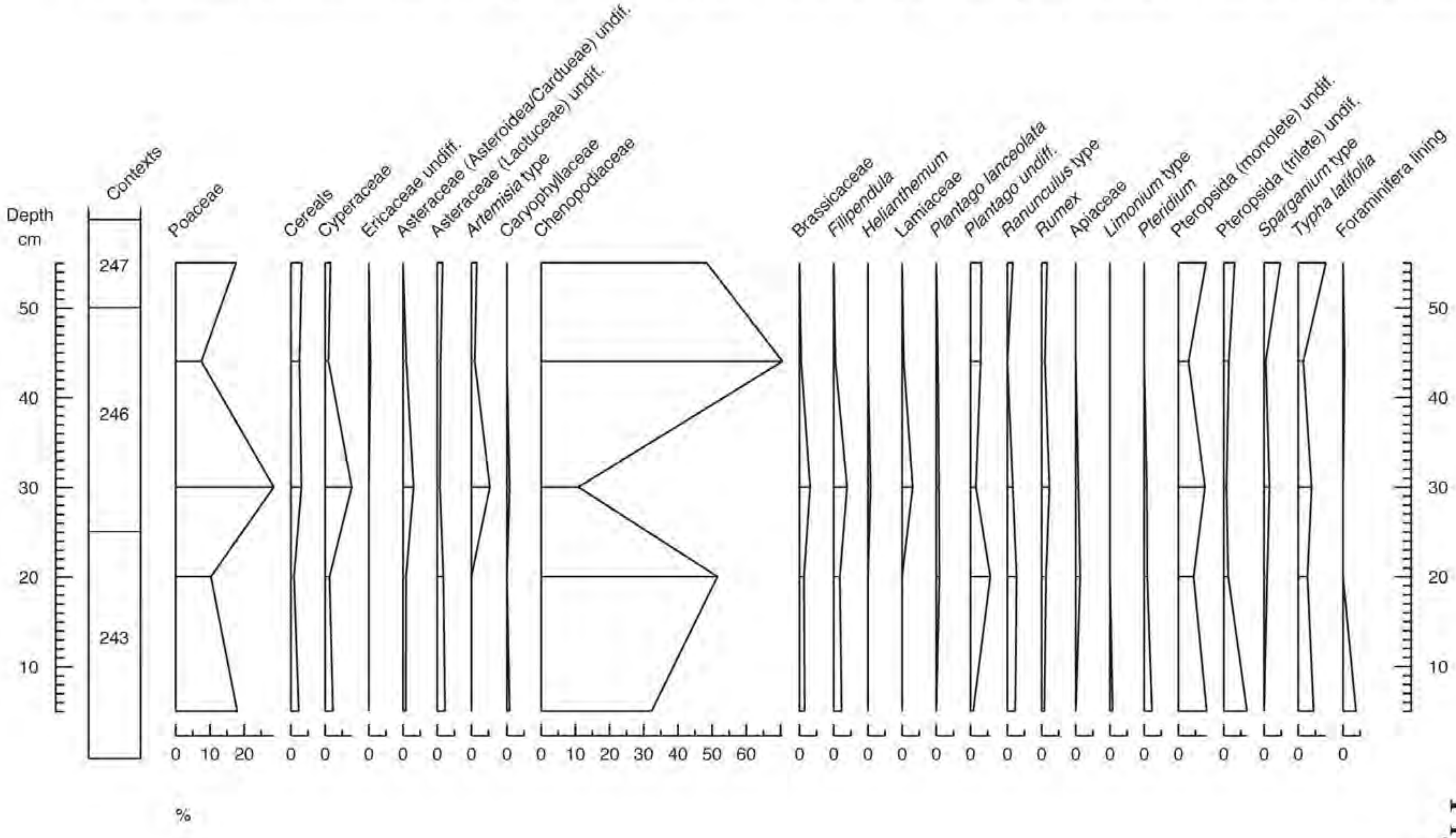



Figure 2b

## *Table 31: Results of pollen analyses. Percentage pollen data*

| Section | 58 | 58 | 58 | 58 | 58 | | 45 | 45 | 45 | 45 | 45 | 45 | 45 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample | 85A | 85A | 85B | 85B | 85C | | 53A | 53A | 53A | 53A | 53B | 53C | 53C |
| Context | 243 | 243 | 246 | 246 | 247 | | 239 | 219a | 219b | 218 | 217 | 212 | 206 |
| Pollen sub-sample | 5cm | 20cm | 30cm | 44cm | 55cm | | 5cm | 18cm | 22cm | 26cm | 32cm | 50cm | 62cm |
| *Trees & Shrubs* | | | | | | | | | | | | | |
| *Betula* | 0.8 | 0.4 | 2.3 | 0.0 | 0.0 | | 3.9 | 9.1 | 4.9 | 2.9 | 3.8 | 1.7 | |
| Pinus | 2.3 | 0.9 | 0.8 | 0.0 | 0.0 | | 2.0 | 5.7 | 1.9 | 1.4 | 1.9 | 1.7 | |
| Quercus | 0.8 | 0.9 | 0.8 | 0.0 | 0.0 | | 3.9 | 2.8 | 3.9 | 4.3 | 5.7 | 3.3 | |
| Tilia | 0.8 | 0.0 | 0.0 | 0.0 | 0.0 | | 2.0 | 2.3 | 1.9 | 2.9 | 1.9 | 0.0 | |
| Alnus | 3.0 | 5.4 | 6.2 | 2.5 | 4.8 | | 5.9 | 22.2 | 23.3 | 15.9 | 13.2 | 3.3 | |
| Fagus | 0.8 | 0.0 | 0.0 | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| Fraxinus | 1.5 | 0.4 | 0.0 | 0.5 | 0.0 | | 2.0 | 1.1 | 1.0 | 0.0 | 0.0 | 0.0 | |
| Corylus | 6.0 | 3.1 | 1.6 | 1.5 | 3.2 | | 5.9 | 11.9 | 12.6 | 8.7 | 9.4 | 6.7 | |
| Salix | 0.0 | 0.0 | 0.8 | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| Ligustrum | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | 0.0 | 0.6 | 0.0 | 0.0 | 0.0 | 0.0 | |
| | | | | | | | | | | | | | |
| *Herbs* | | | | | | | | | | | | | |
| Poaceae | 18.0 | 10.3 | 28.7 | 7.5 | 17.7 | | 29.4 | 11.4 | 22.3 | 39.1 | 30.2 | 35.0 | |
| Cereals | 2.3 | 0.9 | 3.1 | 2.5 | 3.2 | | 0.0 | 1.1 | 1.0 | 2.9 | 1.9 | 0.0 | |
| Cyperaceae | 2.3 | 1.3 | 7.8 | 1.0 | 1.6 | | 5.9 | 6.8 | 4.9 | 1.4 | 1.9 | 1.7 | |
| Ericaceae undiff. | 0.0 | 0.0 | 0.0 | 0.5 | 0.0 | | 0.0 | 0.6 | 0.0 | 0.0 | 1.9 | 0.0 | |
| Asteraceae (Asteroidea/Cardueae) undif. | 0.8 | 0.9 | 3.1 | 1.0 | 0.0 | | 2.0 | 2.3 | 1.0 | 0.0 | 1.9 | 0.0 | |
| Asteraceae (Lactuceae) undif. | 2.3 | 1.8 | 0.8 | 1.0 | 1.6 | | 5.9 | 3.4 | 1.9 | 1.4 | 0.0 | 8.3 | |
| Artemisia _type | 0.0 | 0.0 | 5.4 | 1.0 | 1.6 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| Cirsium _type | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | 0.0 | 0.0 | 1.0 | 0.0 | 1.9 | 0.0 | |
| Caryophyllaceae | 0.8 | 0.0 | 0.8 | 0.0 | 0.0 | | 2.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.7 | |
| Chenopodiaceae | 32.3 | 51.6 | 10.9 | 70.6 | 48.4 | | 3.9 | 2.3 | 1.9 | 1.4 | 1.9 | 1.7 | |

| Section | 58 | 58 | 58 | 58 | 58 | | 45 | 45 | 45 | 45 | 45 | 45 | 45 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample | 85A | 85A | 85B | 85B | 85C | | 53A | 53A | 53A | 53A | 53B | 53C | 53C |
| Context | 243 | 243 | 246 | 246 | 247 | | 239 | 219a | 219b | 218 | 217 | 212 | 206 |
| Pollen sub-sample | 5cm | 20cm | 30cm | 44cm | 55cm | | 5cm | 18cm | 22cm | 26cm | 32cm | 50cm | 62cm |
| Brassicaceae | 1.5 | 1.3 | 3.1 | 0.5 | 0.0 | | 2.0 | 2.3 | 0.0 | 1.4 | 0.0 | 0.0 | |
| Filipendula | 2.3 | 1.8 | 3.9 | 0.5 | 0.0 | | 2.0 | 0.6 | 0.0 | 1.4 | 0.0 | 1.7 | |
| Helianthemum | 0.0 | 0.0 | 0.8 | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| Lamiaceae | 0.0 | 0.0 | 3.1 | 0.5 | 0.0 | | 2.0 | 0.6 | 1.9 | 0.0 | 1.9 | 0.0 | |
| Plantago lanceolata | 0.0 | 0.9 | 0.8 | 0.5 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | *barren* |
| Plantago undiff. | 0.8 | 5.8 | 1.6 | 3.0 | 3.2 | | 0.0 | 0.6 | 0.0 | 0.0 | 3.8 | 1.7 | |
| Ranunculus _type | 2.3 | 2.7 | 1.6 | 0.0 | 1.6 | | 2.0 | 1.1 | 1.0 | 1.4 | 0.0 | 0.0 | |
| Rumex | 0.8 | 1.3 | 2.3 | 1.0 | 1.6 | | 0.0 | 0.6 | 1.9 | 1.4 | 1.9 | 3.3 | |
| Thalictrum | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | 0.0 | 0.0 | 1.0 | 0.0 | 0.0 | 0.0 | |
| Urtica | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.7 | |
| Apiaceae | 0.0 | 1.3 | 0.8 | 0.0 | 0.0 | | 2.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| Limonium type | 0.8 | 0.0 | 0.0 | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| | | | | | | | | | | | | | |
| *Lower plants* | | | | | | | | | | | | | |
| *Pteridium* | 2.3 | 0.9 | 0.8 | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| Pteropsida (monolete) undif. | 8.3 | 4.5 | 7.8 | 3.0 | 8.1 | | 9.8 | 7.4 | 7.8 | 10.1 | 11.3 | 16.7 | |
| Pteropsida (trilete) undif. | 6.8 | 1.3 | 0.8 | 1.5 | 3.2 | | 5.9 | 3.4 | 2.9 | 1.4 | 3.8 | 10.0 | |
| | | | | | | | | | | | | | |
| Foraminifera lining | 3.8 | 0.0 | 0.0 | 0.5 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| | | | | | | | | | | | | | |
| *Aquatics* | | | | | | | | | | | | | |
| *Sparganium _type* | 0.0 | 0.9 | 1.6 | 0.5 | 4.8 | | 0.0 | 4.0 | 2.9 | 14.5 | 7.5 | 20.0 | |
| Typha latifolia | 4.5 | 2.7 | 3.9 | 1.5 | 8.1 | | 0.0 | 14.2 | 5.8 | 2.9 | 0.0 | 0.0 | |
| | | | | | | | | | | | | | |

| Section | 58 | 58 | 58 | 58 | 58 | | 45 | 45 | 45 | 45 | 45 | 45 | 45 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample | 85A | 85A | 85B | 85B | 85C | | 53A | 53A | 53A | 53A | 53B | 53C | 53C |
| Context | 243 | 243 | 246 | 246 | 247 | | 239 | 219a | 219b | 218 | 217 | 212 | 206 |
| Pollen sub-sample | 5cm | 20cm | 30cm | 44cm | 55cm | | 5cm | 18cm | 22cm | 26cm | 32cm | 50cm | 62cm |
| Sum trees | 9.8 | 8.1 | 10.1 | 3.0 | 4.8 | | 19.6 | 43.2 | 36.9 | 27.5 | 26.4 | 10.0 | |
| Sum shrubs | 6.0 | 3.1 | 2.3 | 1.5 | 3.2 | | 5.9 | 12.5 | 12.6 | 8.7 | 9.4 | 6.7 | |
| Sum herbs | 66.9 | 82.1 | 78.3 | 91.0 | 80.6 | | 58.8 | 33.5 | 39.8 | 52.2 | 49.1 | 56.7 | |
| Sum spores | 17.3 | 6.7 | 9.3 | 4.5 | 11.3 | | 15.7 | 10.8 | 10.7 | 11.6 | 15.1 | 26.7 | |
| | | | | | | | | | | | | | |
| Main Sum | 133 | 223 | 129 | 201 | 62 | | 51 | 176 | 103 | 69 | 53 | 60 | |
| | | | | | | | | | | | | | |
| Concentration (grains per ml) | 39965 | 90204 | 64604 | 88080 | 15164 | | 28230 | 80478 | 54163 | 34556 | 20644 | 17528 | <1052 |

## C.5 Diatoms

*By Dr Caroline Hillier*

***Introduction***

C.5.1 This study focuses on the diatom assemblages obtained from one of two archaeological sections (45 & 58; Figs 11a & 11c) excavated at the saltern site.

C.5.2 The study concentrated on two areas where sections were sampled with monolith tins for microfossil analysis.

C.5.3 Section 45 was sampled with three overlapping 30cm monolith tins (Samples 53 A, B & C) through the basal part of the salt mound complex, capturing a series of contexts (239, 219, 218, 217, 212 & 206). The basal buff-brown silty clay (0-16cm) (context 239) formed a definite rise in topography at the site. This unit was thought to be either an initial dump of waste silt, or a relatively higher island of banked natural sediment. It was sub-sampled for diatoms at 5cm. Overlying this was a black-grey silty clay with charcoal (16-20cm) (context 219a) sub-sampled for diatoms at 18cm, and a orange-buff weathered silt (20-24cm) (context 219b) sub-sampled for diatoms at 22cm. Above this was a black charcoal-rich silt (24-27cm) (context 218), which was thought to be a weathered soil. This unit was sub-sampled for diatoms at 26cm. This was overlain by a brown-buff silt (27-34cm) (context 217) and a light brown-buff silt (34-59cm) (context 212), both presumed to be dumps of waste saltern material. Diatom sub-samples were taken at 32cm and 50cm from these units. These were in turn overlain by a unit of dark brown silty clay (59-70cm) (context 206), thought to be burnt hearth waste deposits, and sub-sampled for diatoms at 62cm. Unfortunately diatoms were not preserved in these sediments and diatom analysis could not be undertaken.

C.5.4 Section 58 was located in a different part of the site. It was also sampled with three overlapping 30cm monolith tins (samples 85 A, B & C) to provide a sequence through the sediments. The basal buff-brown silty clay (0-25cm) (context 243) was thought to represent mudflat deposits. This unit was sub-sampled for diatom at 5cm and 20cm. The overlying sediments comprised a buff and brown silty clay with thin lenses of black-grey macrofossil inclusions (25-50cm) (context 246) and a brown-buff slightly oxidised silty clay (50-60cm) (context 247). These sediments appear to fill a saltmarsh creek channel or ‘cut’ and were sub-sampled for diatoms at 30cm, 42cm and 58cm. Diatom preservation was very poor in these samples but enough valves were present to give an indication of the likely depositional environment.

***Methodology***

*Diatom sample preparation*

C.5.5 The preparation of diatom samples for investigation using light microscopy was undertaken at Durham University Science Laboratories following standard methodology (e.g. Plater et al. 2000). 0.5g of each sample was digested in 20ml of 20% H2O2 by heating gently in a water bath for up to 24 hours, or until all organic matter was removed from the sample. For each sample five drops and seven drops of digested sample were pipetted on to two cover slips with 10 drops of distilled water and dried on a warm hotplate. The duplicate cover slips (a) and (b) were then inverted and placed onto a glass slide, using naphrax UK, a high refractive index medium mountant with a refractive index of 1.73. After further gentle heating and cooling to set the mountant the diatom slides are ready to be counted.

*Diatom counting and identification*

C.5.6 Where possible a minimum of 250 diatoms is normally identified from each of the samples at a magnification of 1000 times using the keys of Hartley (1996) and Van der Werff & Huls (1958 –74). As preservation was very poor the diatoms in each slide were identified for a period of 1.5 hours per slide.

C.5.7 Broken or obscured diatom valves were only counted if the over 50% of the valve was present/visible. The preservation in all of the samples was quite poor, and samples would be described as partially preserved. In these instances the assemblages are partially dissolved and the samples can vary from countable assemblages dominated by robust species, often with the valve rim missing or only the central area preserved, to uncountable samples with dissolved fragments only.

*Diatom salinity classification*

C.5.8 Once the diatoms counts were completed the diatom species were assigned a salinity classification. The system used to classify diatoms according to their salinity tolerance is called the halobian system of classification. This system was first devised by Kolbe (1927) and has been subsequently modified by Hudstedt (1953; 1957) and Hemphill-Haley (1993) amongst others. The halobian system of classification has four main groups, an explanation of which is shown in Table 32.

| **Classification** | **Salinity range (‰)** | **Description** |
|---|---|---|
| Polyhalobous | >30 | Marine |
| Mesohalobous | 0.2 to 30 | Brackish |
| Oligohalobous-halophile | <0.2 | Freshwater – stimulated at low salinity |
| Oligohalobous-indifferent | <0.2 | Freshwater – tolerates low salinity |
| Halophobous | 0 | Salt-intolerant |

*Table 32: The halobian classification system (Hemphill-Haley 1993)*

C.5.9 A basic interpretation of this classification system should see a change in the salinity classes of the diatom assemblages, for example, as one moves from the tidal flat through the salt marsh and into the freshwater environments above the Highest Astronomical Tide (HAT). As one would expect, polyhalobous species occur in sub-tidal areas and on the tidal flat along with mesohalobous diatom species. As marine influence decreases oligohalobous-halophilous and oligohalobous-indifferent species will increase as polyhalobous and mesohalobous species decrease. Finally halophobous species will occur above the HAT in the freshwater environments.

C.5.10 Diatom assemblages from coastal depositional environments have high species diversity, with each habitat type potentially having a distinct diatom community. As in this study, the halobian classification can be utilised in the production of a percentage abundance diagram as a simple visual aid that shows a basic summary of the marine influence (or salinity tolerance) for each diatom assemblage from the monolith samples.

C.5.11 The ecology of the diatoms followed Vos & de Wolf (1993) and Denys (1992) and is summarised in Table 33. It must be noted that if diatoms were not identified to species, or there salinity preference is unknown, they were categorised as unclassified.

***Results***

C.5.12 The percentage of diatom species are illustrated in Appendix C.5 Figure 1. The proportion of diatoms of each salinity classification in the total assemblage is summarised to the right of the diagram. The ecological preferences of the diatom species (after Vos & de Wolf, 1993 & Denys, 1992) are summarised in Table 33 where possible.

*Section 45*

C.5.13 No diatoms were recorded from the sub-samples.

*Section 58*

C.5.14 Sediment sub-samples for diatom analysis were taken from the following points along the sample 85 monoliths 5cm, 20cm, 30cm, 42cm and 58cm. Due to poor preservation diatoms were very sparse. The diatoms in each sub-sample were identified and recorded for a duration of 1.5 hours. The sub-samples yielded 59, 26, 36, 42 and 6 diatoms respectively. The counts are not statistically viable, this is therefore a tentative interpretation of the depositional environment.

C.5.15 The diatoms from Section 58 are dominated by fully marine (polyhalobous) and brackish (mesohalobous) taxa with very little freshwater input. The dominant diatom species include the marine plankton species Paralia sulcata and the marine/brackish epipelon Diploneis didyma. Other marine planktonic species represented in the assemblages include Actinoptychus senarius, Aulacodiscus argus and Thalassiosira eccentrica. The marine tychoplanktonic species include Rhaphoneis amphiceros and Auliscus sculptus. Where the ecology of the brackish diatom taxa is known, they are all considered to be epipelic species, i.e. species found on the surface of fine sediments, such as mud flats. The only exception is Diploneis interrupta, which is recorded in all sub-samples except 58cm and is considered to be an aerophilus species. Denys (1992) describes this species as commonly found in periodic water or wet sub-aerial habitats. Vos and De Wolf (1998) determine that an assemblage with a relative abundance (%) of marine/brackish aerophilus species exceeding 10% is indicative of a supratidal area (i.e. saltmarshes around or just above Mean High Water) rather than intertidal mudflats.

C.5.16 Cocconeis disculus is recorded from sub-samples at 5cm, 20cm and 30cm, and although classified as a brackish/freshwater epiphyte it is often recorded in marine, brackish and freshwater habitats.

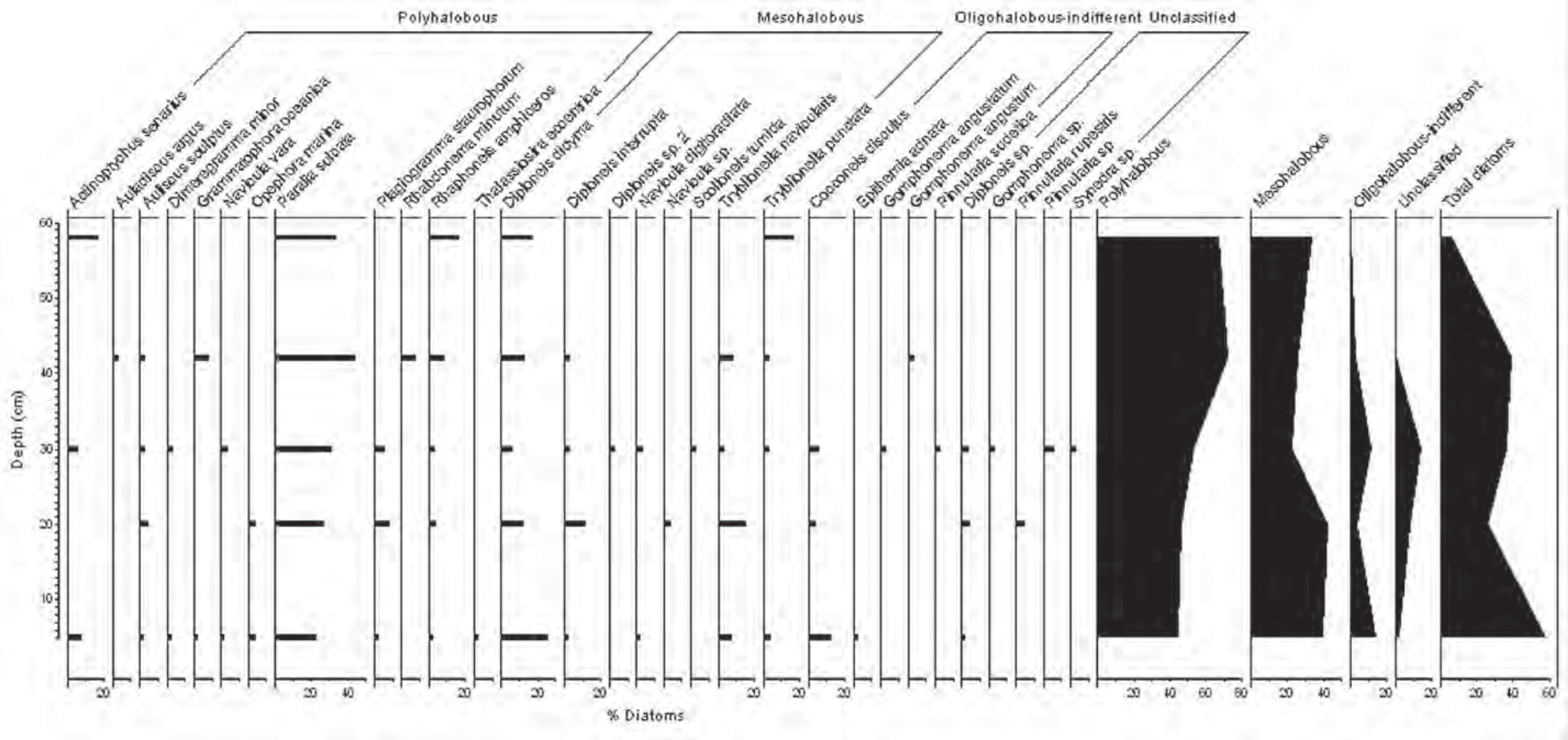
C.5.17 Given the low numbers of diatoms and the potential for differential preservation within the assemblage it can only be concluded that the assemblages are from a mudflat/saltmarsh environment.

***Discussion and conclusion***

C.5.18 The diatom assemblages from Section 58, samples 85A, B and C are dominated by fully marine and brackish diatoms indicative of a mudflat/saltmarsh environment.

C.5.19 These diatom data concur with findings of the pollen analysis which concluded that the pollen signal from samples 85 A, B and C was saltmarsh dominated and implied that the mudflat, saltmarsh and tidal creek environment might belong to the Terrington Beds saltmarsh deposits.

Marsh Lane Saltern diatom assemblages




Appendix C.5 Figure 1   Percentage diatom diagram illustrating the results from Section 58, samples 85A, B and C. The proportion of diatoms of each salinity classification within the dataset is shown on the right of the diagram.

| Species name | Salinity classification | Ecology | Notes |
|---|---|---|---|
| *Actinoptychus senarius* | Polyhalobous | Marine plankton | |
| *Aulacodiscus argus* | Polyhalobous | Marine plankton | |
| *Auliscus sculptus* | Polyhalobous | Tychoplanktonic, epontic origin | |
| *Dimeregramma minor* | Polyhalobous | Marine/brackish epipsammon | |
| *Grammatophora oceanica* | Polyhalobous | Marine epiphyte | |
| *Navicula vara* | Polyhalobous | | |
| *Opephora marina* | Polyhalobous | Marine, epontic | |
| *Paralia sulcata* | Polyhalobous | Marine plankton | |
| *Plagiogramma staurophorum* | Polyhalobous | Marine/brackish epipsammon | |
| *Rhabdonema minutum* | Polyhalobous | Marine, epontic | |
| *Rhaponeis amphiceros* | Polyhalobous | Marine tychoplankton | |
| *Thalassiosira eccentrica* | Polyhalobous | Marine plankton | |
| *Diplonies didyma* | Mesohalobous | Marine/brackish epipelon | |
| *Diploneis interrupta* | Mesohalobous | Marine/brackish aerophilus | |
| *Diploneis sp. 2* | Mesohalobous | | Hartley, Plate 89, Fig No. 3. |
| *Navicula digitoradiata* | Mesohalobous | Marine/brackish benthic epipelon | |
| *Navicula sp* | Mesohalobous | Marine/brackish benthic epipelon | Hartley, Plate 168, Fig No.6 |
| *Scoloneis tumida* | | | |
| *Tryblionella navicularis* | Mesohalobous | Marine/brackish benthic epipelon | |
| *Tryblionella punctata* | Mesohalobous | Marine/brackish benthic epipelon | |
| *Cocconeis disculus* | Oligohalobous-indifferent | Brackish/freshwater epiphyte | |
| *Epithemia adnata* | Oligohalobous-indifferent | Freshwater/brackish epontic | |
| *Gomphonema angustatum* | Oligohalobous-indifferent | Freshwater/brackish epontic | |
| *Gomphonema angustum* | Oligohalobous-indifferent | Freshwater/brackish epontic | |
| *Pinnularia sudetica* | Oligohalobous-indifferent | Benthic, also commonly moist sub-aerial. | |
| *Diploneis sp.* | Unclassified | | |
| *Gomphonema sp.* | Unclassified | | |
| *Pinnularia rupestris* | Unclassified | | |
| *Pinnularia sp.* | Unclassified | | |
| *Synedra sp.* | Unclassified | | |

*Table 33: Diatom ecology*

## C.6 Radiocarbon Dating Certificates

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

RADIOCARBON DATING CERTIFICATE
27 January 2016

| | |
|---|---|
| **Laboratory Code** | SUERC-65057 (GU39617) |
| **Submitter** | Rachel Fosberry<br>Oxford Archaeology East<br>15 Trafalgar Way<br>Bar Hill<br>Cambs. CB23 8SQ |
| **Site Reference** | ENF137496 |
| **Context Reference** | 218 |
| **Sample Reference** | 53 |
| **Material** | Charcoal : Unidentified |
| **$\delta^{13}C$ relative to VPDB** | -25.6 ‰ |
| **Radiocarbon Age BP** | 1033 ± 35 |

**N.B.** The above $^{14}C$ age is quoted in conventional years BP (before 1950 AD). The error, which is 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.

The calibrated age ranges are determined from the University of Oxford Radiocarbon Accelerator Unit calibration program (OxCal4).

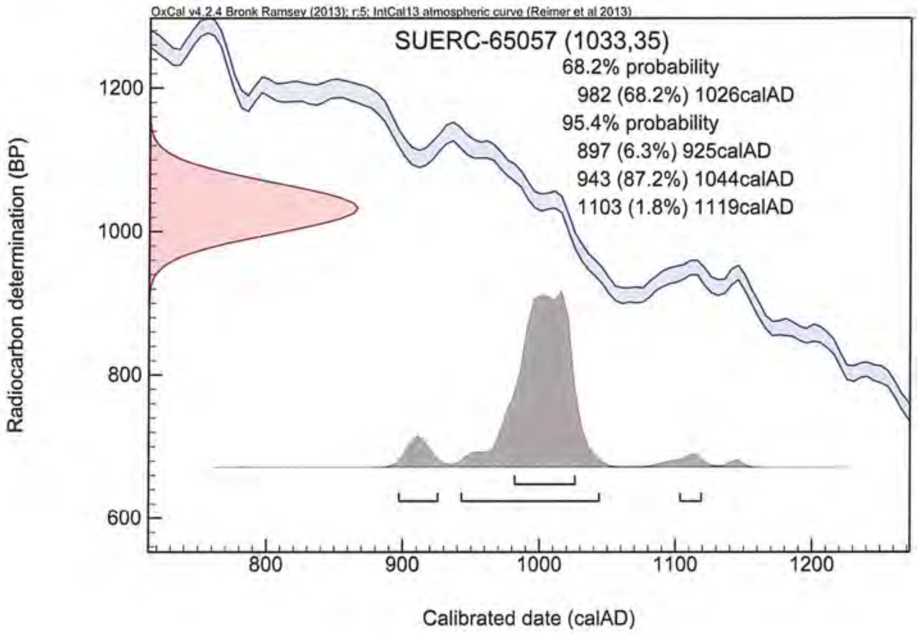
Samples with a SUERC coding are measured at the Scottish Universities Environmental Research Centre AMS Facility and should be quoted as such in any reports within the scientific literature. Any questions directed to the Radiocarbon Laboratory should also quote the GU coding given in parentheses after the SUERC code. The contact details for the laboratory are email Gordon.Cook@glasgow.ac.uk or telephone 01355 270136 direct line.

Conventional age and calibration age ranges calculated by :- B Tagney Date :- 27/01/2016

Checked and signed off by :- G. Dunbar Date :- 27/01/2016

University of Glasgow

**Calibration Plot**



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

# RADIOCARBON DATING CERTIFICATE

27 January 2016

| | |
|---|---|
| **Laboratory Code** | SUERC-65061 (GU39618) |
| **Submitter** | Rachel Fosberry<br>Oxford Archaeology East<br>15 Trafalgar Way<br>Bar Hill<br>Cambs. CB23 8SQ |
| **Site Reference** | ENF137496 |
| **Context Reference** | 246 |
| **Sample Reference** | 91 |
| **Material** | Charcoal : Unidentified |
| **$\delta^{13}C$ relative to VPDB** | -29.6 ‰ |
| **Radiocarbon Age BP** | 3462 ± 35 |

**N.B.** The above $^{14}C$ age is quoted in conventional years BP (before 1950 AD). The error, which is 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.

The calibrated age ranges are determined from the University of Oxford Radiocarbon Accelerator Unit calibration program (OxCal4).

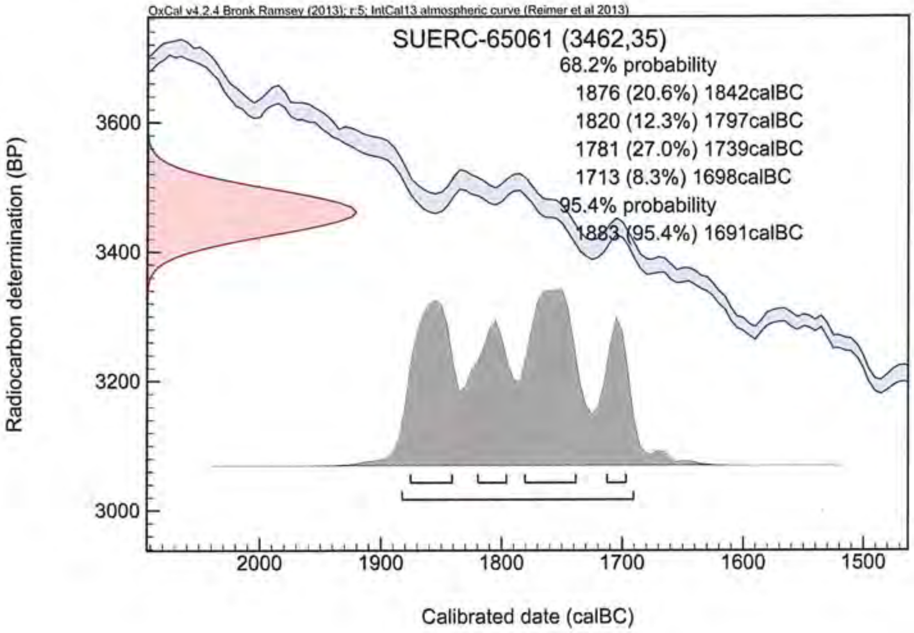
Samples with a SUERC coding are measured at the Scottish Universities Environmental Research Centre AMS Facility and should be quoted as such in any reports within the scientific literature. Any questions directed to the Radiocarbon Laboratory should also quote the GU coding given in parentheses after the SUERC code. The contact details for the laboratory are email Gordon.Cook@glasgow.ac.uk or telephone 01355 270136 direct line.

Conventional age and calibration age ranges calculated by :- B Tagney Date :- 27/01/2016

Checked and signed off by :- E Dunbar Date :- 27/01/2016

University of Glasgow

**Calibration Plot**



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# RADIOCARBON DATING CERTIFICATE

27 January 2016

| | |
|---|---|
| **Laboratory Code** | SUERC-65062 (GU39619) |
| **Submitter** | Rachel Fosberry<br>Oxford Archaeology East<br>15 Trafalgar Way<br>Bar Hill<br>Cambs. CB23 8SQ |
| **Site Reference** | ENF137496 |
| **Context Reference** | 200 |
| **Sample Reference** | 46 |
| **Material** | Charred root/tuber : Unidentified |
| **$\delta^{13}C$ relative to VPDB** | -27.5 ‰ |
| **Radiocarbon Age BP** | 1177 ± 35 |

**N.B.** The above $^{14}C$ age is quoted in conventional years BP (before 1950 AD). The error, which is 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.

The calibrated age ranges are determined from the University of Oxford Radiocarbon Accelerator Unit calibration program (OxCal4).

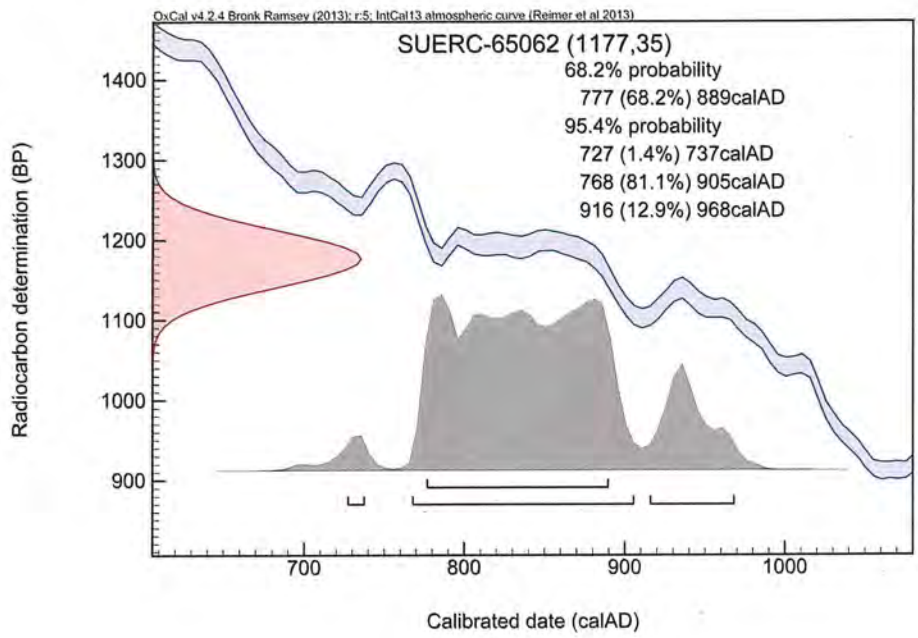
Samples with a SUERC coding are measured at the Scottish Universities Environmental Research Centre AMS Facility and should be quoted as such in any reports within the scientific literature. Any questions directed to the Radiocarbon Laboratory should also quote the GU coding given in parentheses after the SUERC code. The contact details for the laboratory are email Gordon.Cook@glasgow.ac.uk or telephone 01355 270136 direct line.

Conventional age and calibration age ranges calculated by :- B Tagney Date :- 27/01/2016

Checked and signed off by :- E Dunbar Date :- 27/01/2016

University of Glasgow

**Calibration Plot**



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27 January 2016

| | |
|---|---|
| **Laboratory Code** | SUERC-65063 (GU39620) |
| **Submitter** | Rachel Fosberry<br>Oxford Archaeology East<br>15 Trafalgar Way<br>Bar Hill<br>Cambs. CB23 8SQ |
| **Site Reference** | ENF137496 |
| **Context Reference** | 266 |
| **Sample Reference** | 77 |
| **Material** | Charcoal : Unidentified |
| **$\delta^{13}C$ relative to VPDB** | -27.0 ‰ |
| **Radiocarbon Age BP** | 1225 ± 35 |

**N.B.** The above $^{14}C$ age is quoted in conventional years BP (before 1950 AD). The error, which is 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.

The calibrated age ranges are determined from the University of Oxford Radiocarbon Accelerator Unit calibration program (OxCal4).

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. Any questions directed to the Radiocarbon Laboratory should also quote the GU coding given in parentheses after the SUERC code. The contact details for the laboratory are email Gordon.Cook@glasgow.ac.uk or telephone 01355 270136 direct line.

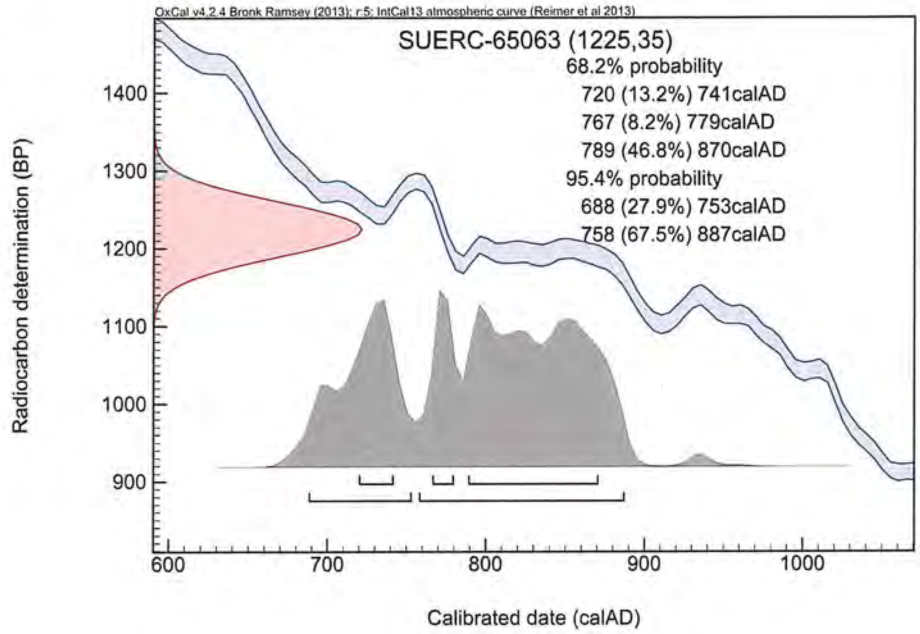
Conventional age and calibration age ranges calculated by :- B Tagney Date :- 27/01/2016

Checked and signed off by :- E Dunbar Date :- 27/01/2016

University of Glasgow

The University of Edinburgh

**Calibration Plot**



Scottish Universities Environmental Research Centre

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

# RADIOCARBON DATING CERTIFICATE

27 January 2016

| | |
|---|---|
| **Laboratory Code** | SUERC-65064 (GU39621) |
| **Submitter** | Rachel Fosberry<br>Oxford Archaeology East<br>15 Trafalgar Way<br>Bar Hill<br>Cambs. CB23 8SQ |
| **Site Reference** | ENF137496 |
| **Context Reference** | 189 |
| **Sample Reference** | 37 |
| **Material** | Charred grain : Secale cereal |
| **$\delta^{13}C$ relative to VPDB** | -21.1 ‰ |
| **Radiocarbon Age BP** | 941 ± 35 |

**N.B.** The above $^{14}C$ age is quoted in conventional years BP (before 1950 AD). The error, which is 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.

The calibrated age ranges are determined from the University of Oxford Radiocarbon Accelerator Unit calibration program (OxCal4).

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. Any questions directed to the Radiocarbon Laboratory should also quote the GU coding given in parentheses after the SUERC code. The contact details for the laboratory are email Gordon.Cook@glasgow.ac.uk or telephone 01355 270136 direct line.

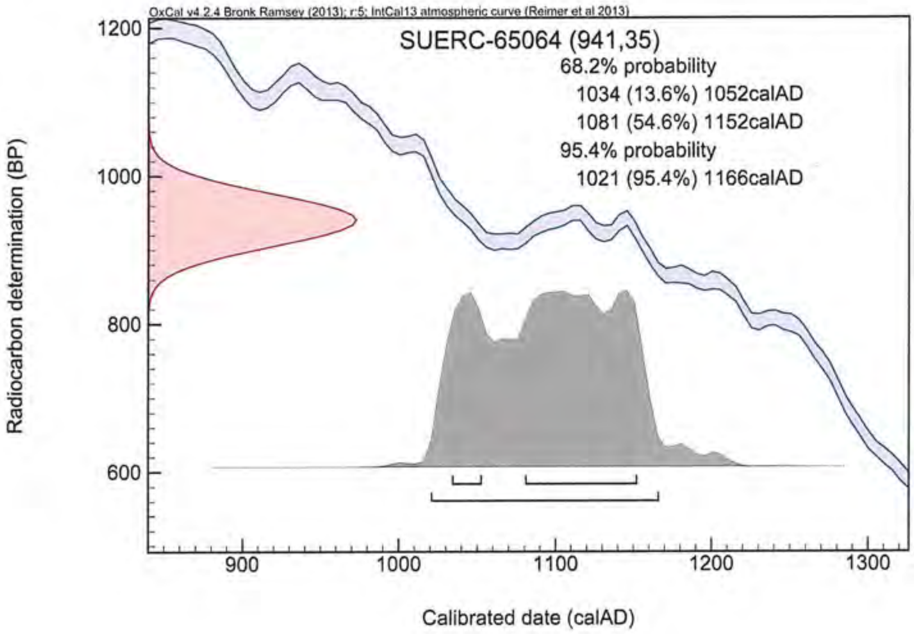
Conventional age and calibration age ranges calculated by :- Date :- 27/01/2016

Checked and signed off by :- E Dunbar Date :- 27/01/2016

University of Glasgow

The University of Edinburgh

**Calibration Plot**



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## Appendix E. OASIS Report Form

All fields are required unless they are not applicable.

### *Project Details*

| | |
|---|---|
| OASIS Number | oxfordar3-219959 |
| Project Name | Medieval Saltern at Marsh Lane (West), King's Lynn, Norfolk. Archaeological Excavation |
| Project Dates (fieldwork) Start | 26-05-2015 |
| Finish | 28-07-2015 |
| Previous Work (by OA East) | No |
| Future Work | No |

### Project Reference Codes

| | | | |
|---|---|---|---|
| Site Code | XNFMLL15 | Planning App. No. | Pre-application |
| HER No. | ENF137496 | Related HER/OASIS No. | ENF137497 |

### 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 |
|---|---|---|---|
| hearths | Medieval 1066 to 1540 | pottery | Medieval 1066 to 1540 |
| filtration units | Medieval 1066 to 1540 | fired clay | Medieval 1066 to 1540 |
| waste deposits | Medieval 1066 to 1540 | industrial slags | Medieval 1066 to 1540 |

### *Project Location*

| | |
|---|---|
| County | Norfolk |
| District | King's Lynn & W. Norfolk |
| Parish | Gaywood |
| HER | Norfolk museum |
| Study Area | 1.5 ha |
| Site Address (including postcode if possible) | Marsh Lane, King's Lynn, Norfolk, PE30 3AD |
| National Grid Reference | TF 6331 2163 |

## 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 | OA East | Norfolk Museum |
| ENF137496 | ENF137496 | ENF137496 |

### Archive Contents/Media

| | Physical Contents | Digital Contents | Paper Contents |
|---|---|---|---|
| Animal Bones | [x] | [ ] | [ ] |
| Ceramics | [x] | [ ] | [ ] |
| Environmental | [x] | [ ] | [ ] |
| Glass | [ ] | [ ] | [ ] |
| Human Bones | [ ] | [ ] | [ ] |
| Industrial | [x] | [x] | [x] |
| Leather | [ ] | [ ] | [ ] |
| Metal | [ ] | [ ] | [ ] |
| Stratigraphic | | [ ] | [x] |
| Survey | | [x] | [x] |
| Textiles | [ ] | [ ] | [ ] |
| Wood | [ ] | [ ] | [ ] |
| Worked Bone | [ ] | [ ] | [ ] |
| Worked Stone/Lithic | [ ] | [ ] | [ ] |
| None | [ ] | [ ] | [ ] |
| Other | [ ] | [ ] | [ ] |

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

**Notes:**

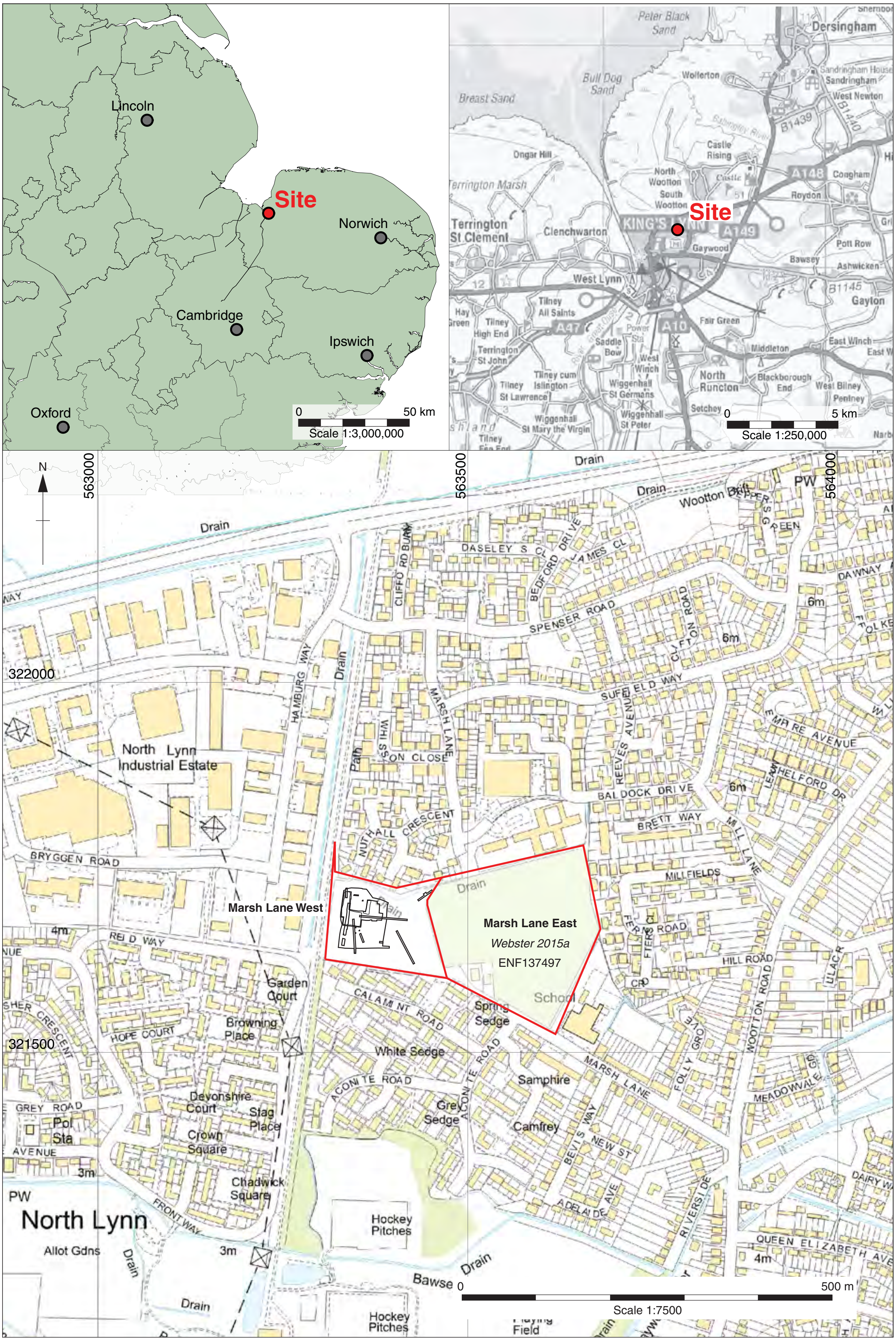




Figure 1: Site location showing overall development (red) and excavation areas (black)

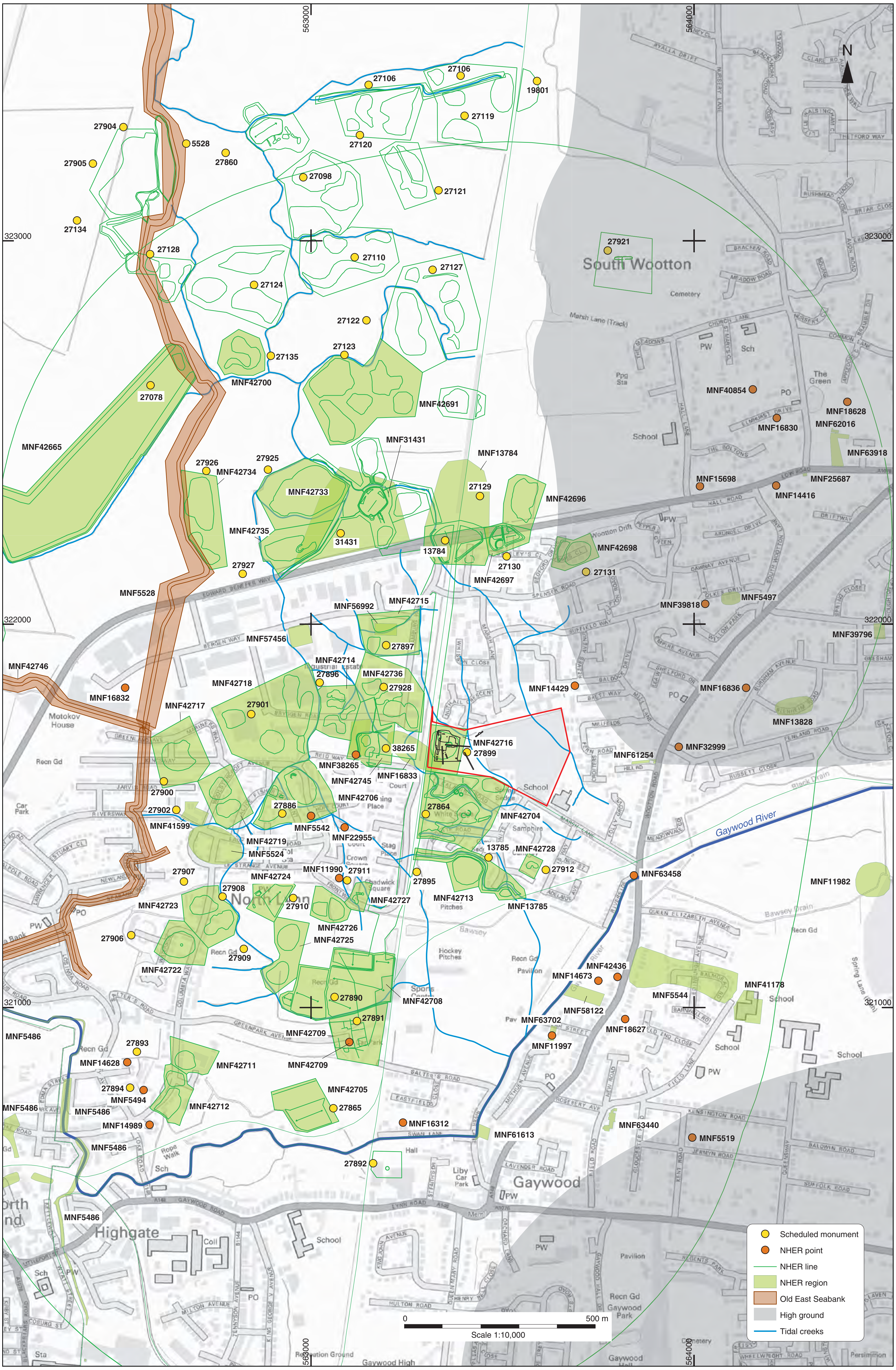


Figure 2: Map showing location of NHER records with NMP data, sea banks & pre-existing tidal creeks mapped from historic photograph (NHER reference: TF62_TF6321_A_RAF_16Apr1946.tif)

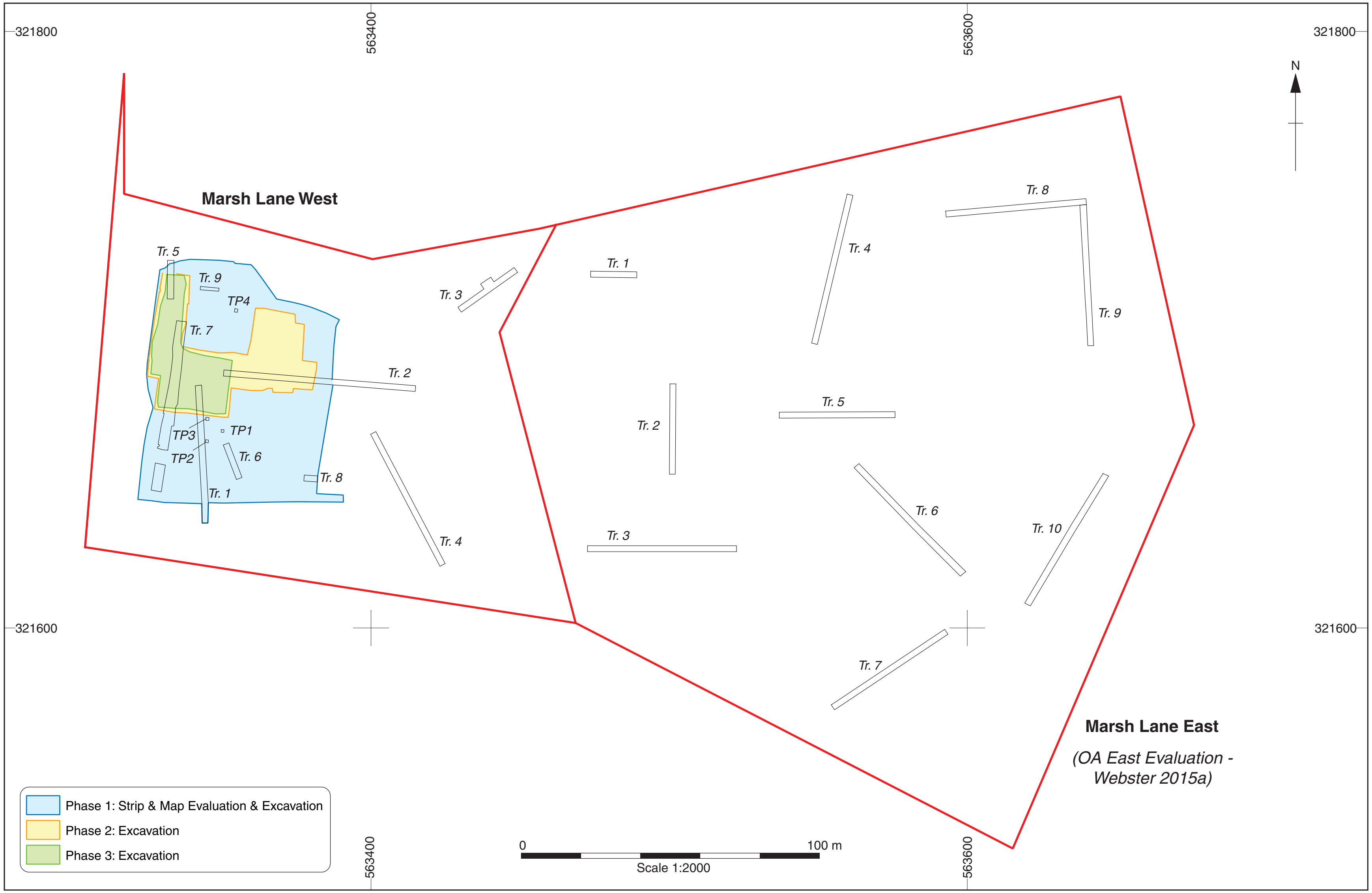


Figure 3: Site layout plan showing phases of evaluation and excavation

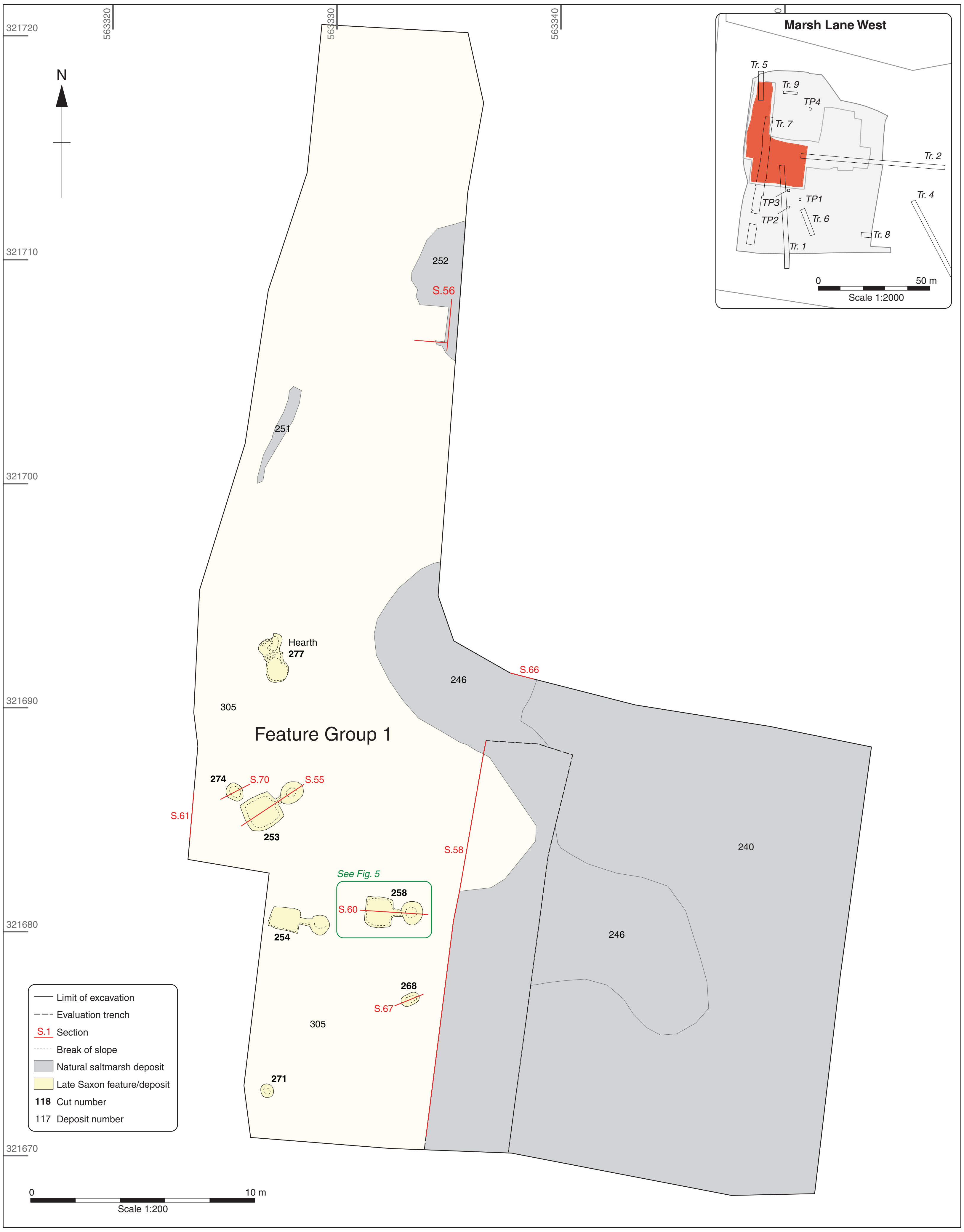


Figure 4: Period 1: Late Saxon salt-making features (excavation phase 3)

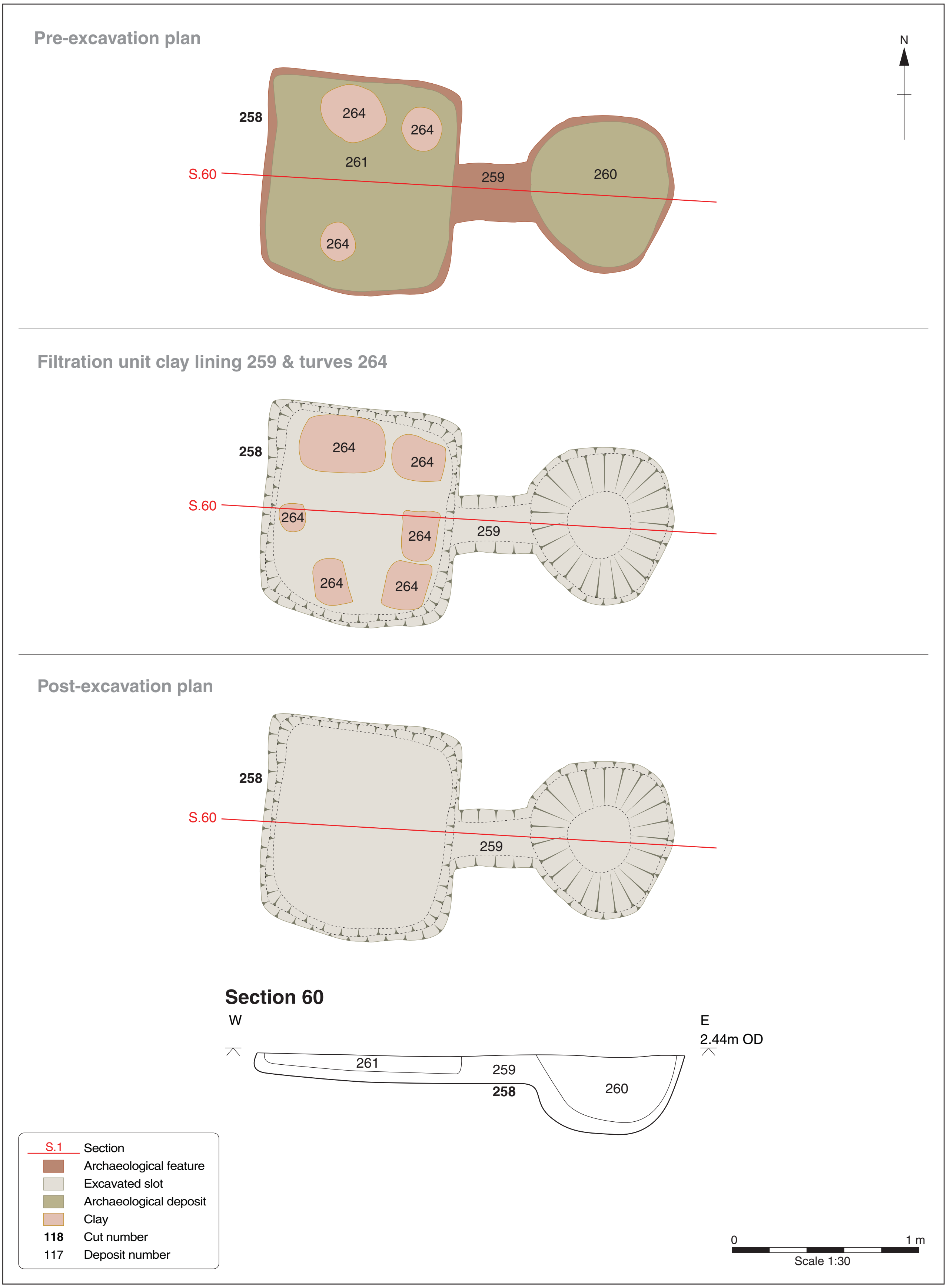


Figure 5: Plan and section of Period 1 silt filtration unit **258**


Figure 6: Excavation phase 3 overlain on contour map


Figure 7: Period 1: Late Saxon salt-making features (excavation phase 2)

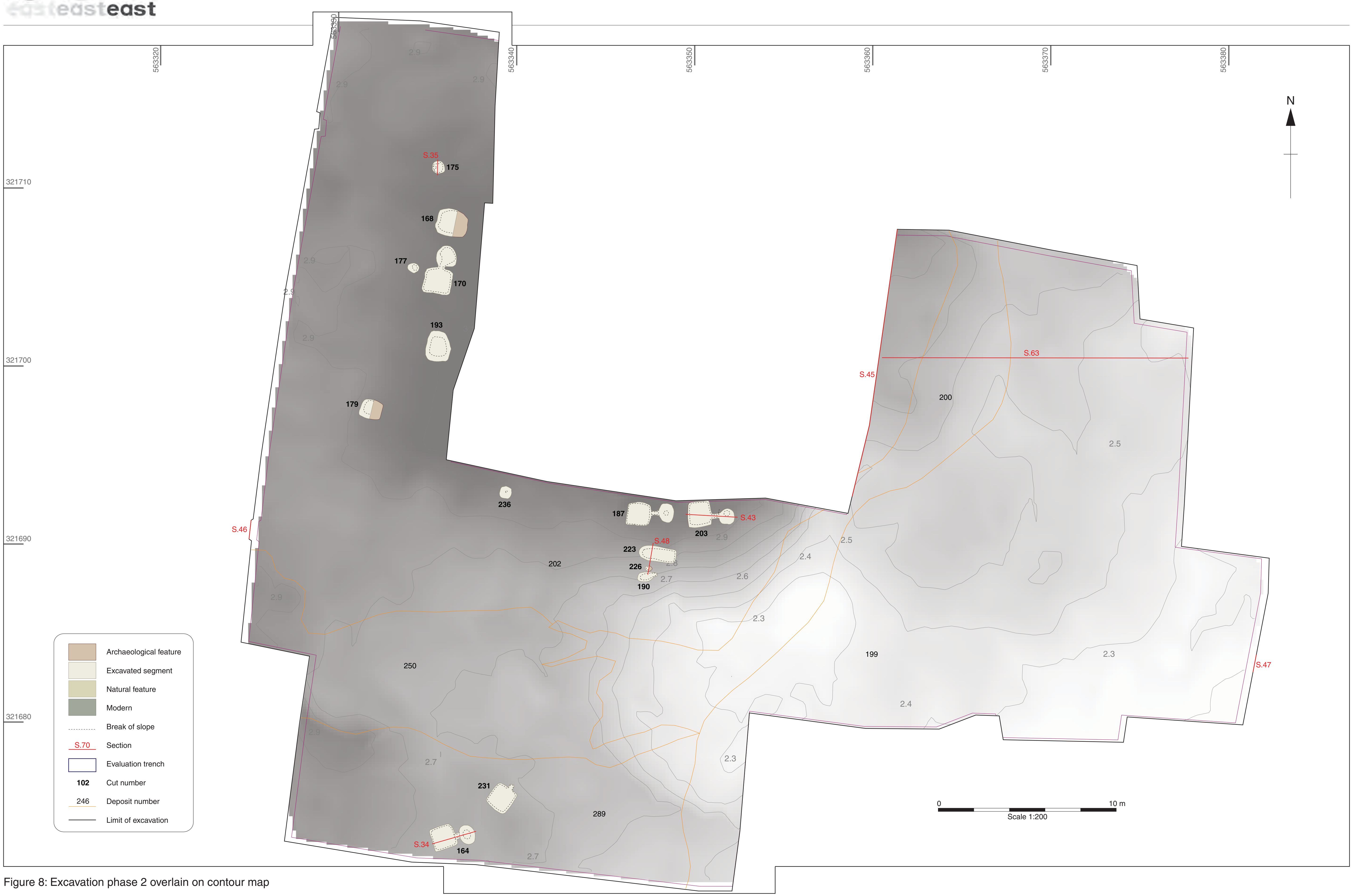


Figure 8: Excavation phase 2 overlain on contour map

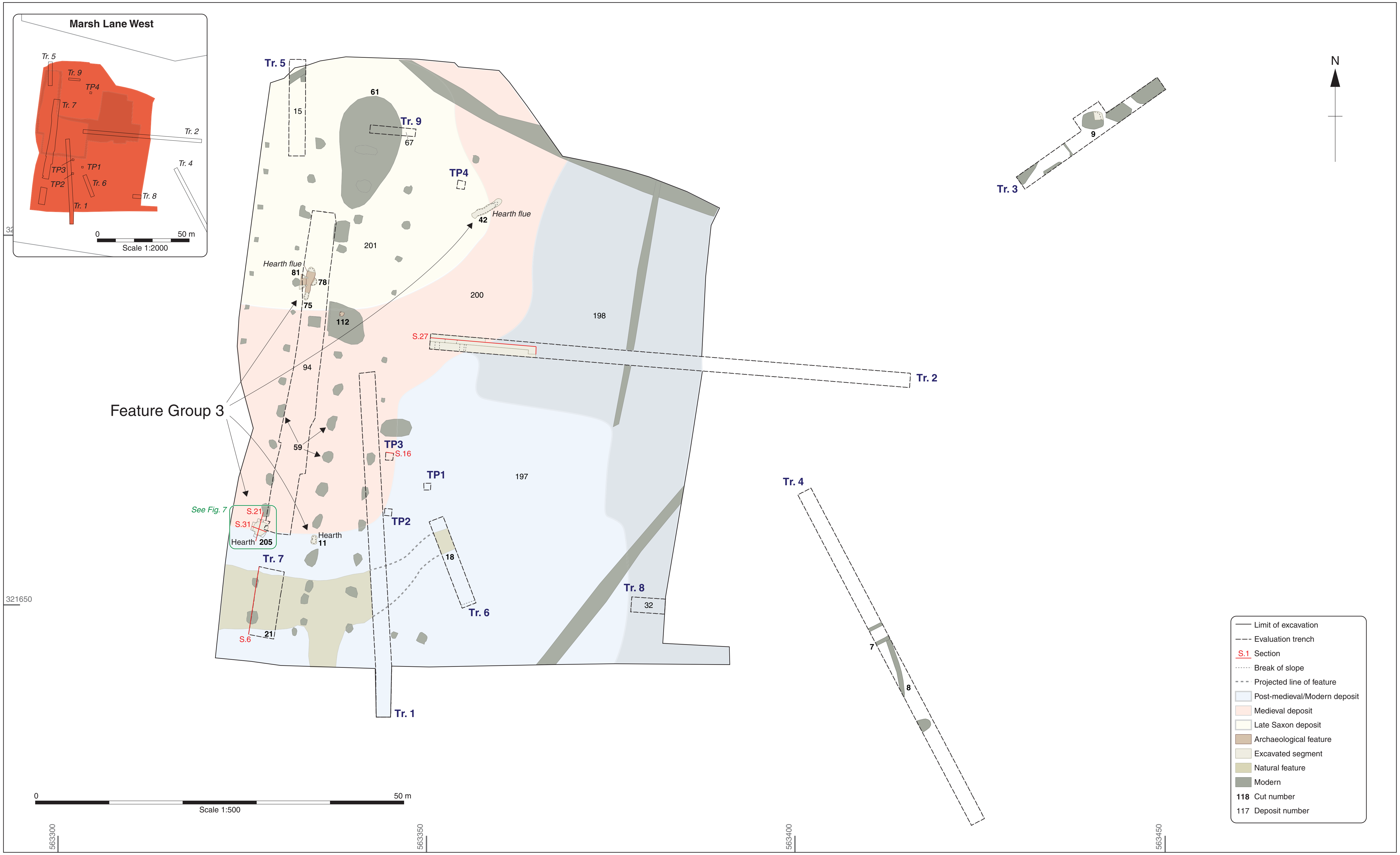


Figure 9: Evaluation and strip & map excavation (excavation phase 1)

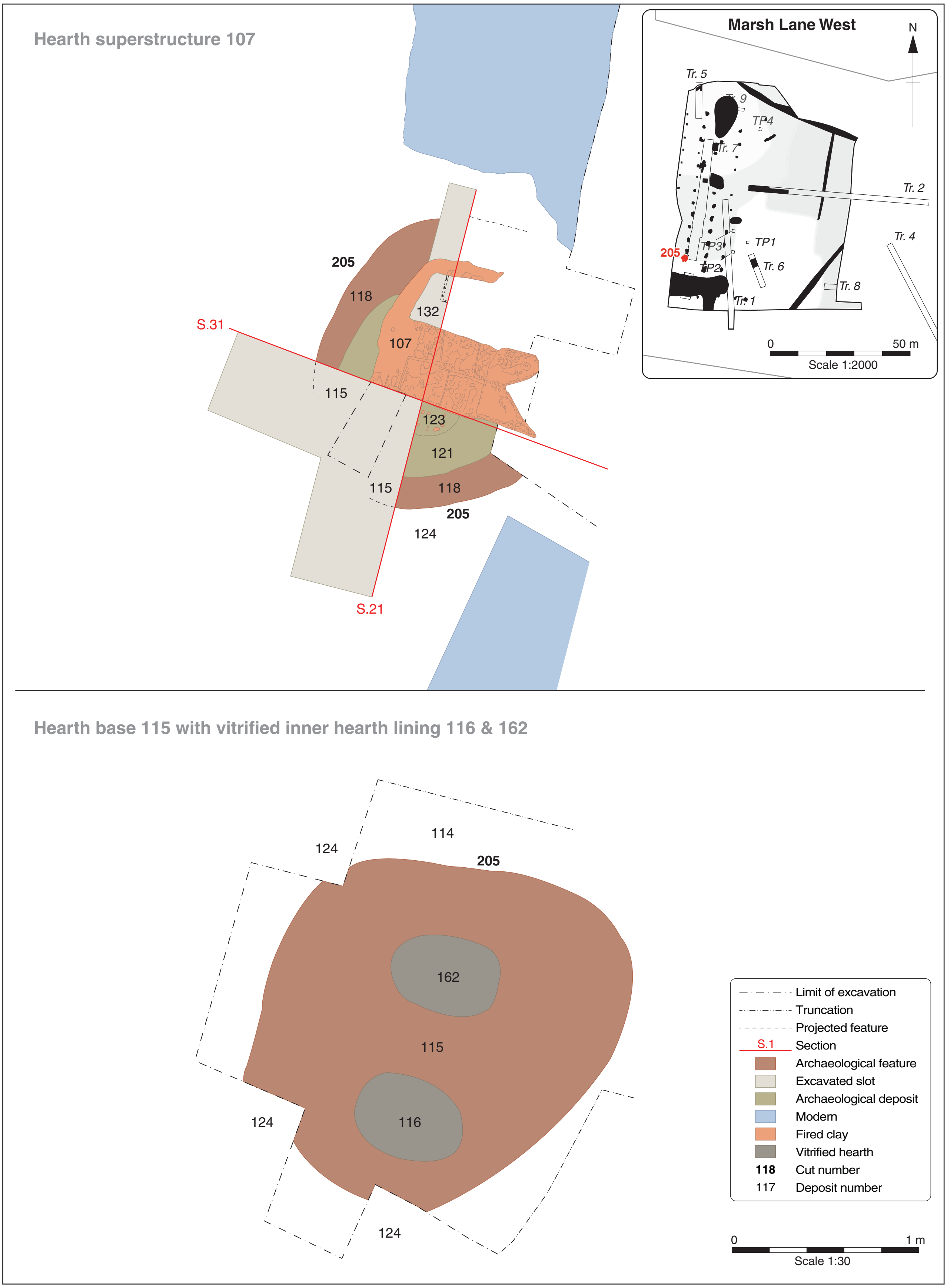


Figure 10: Plan of Period 2 brine boiling hearth **205**

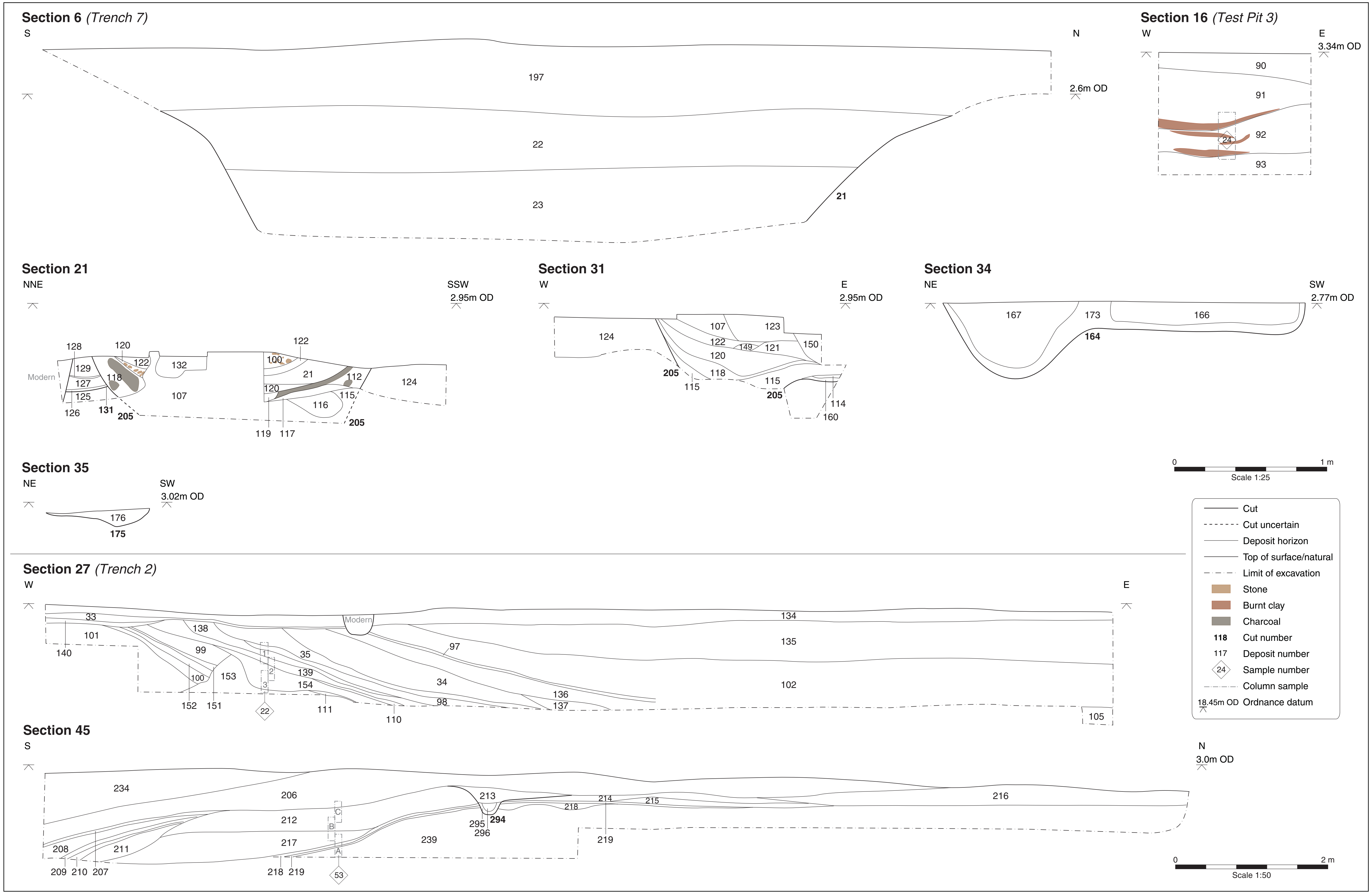


Figure 11a: Selected sections

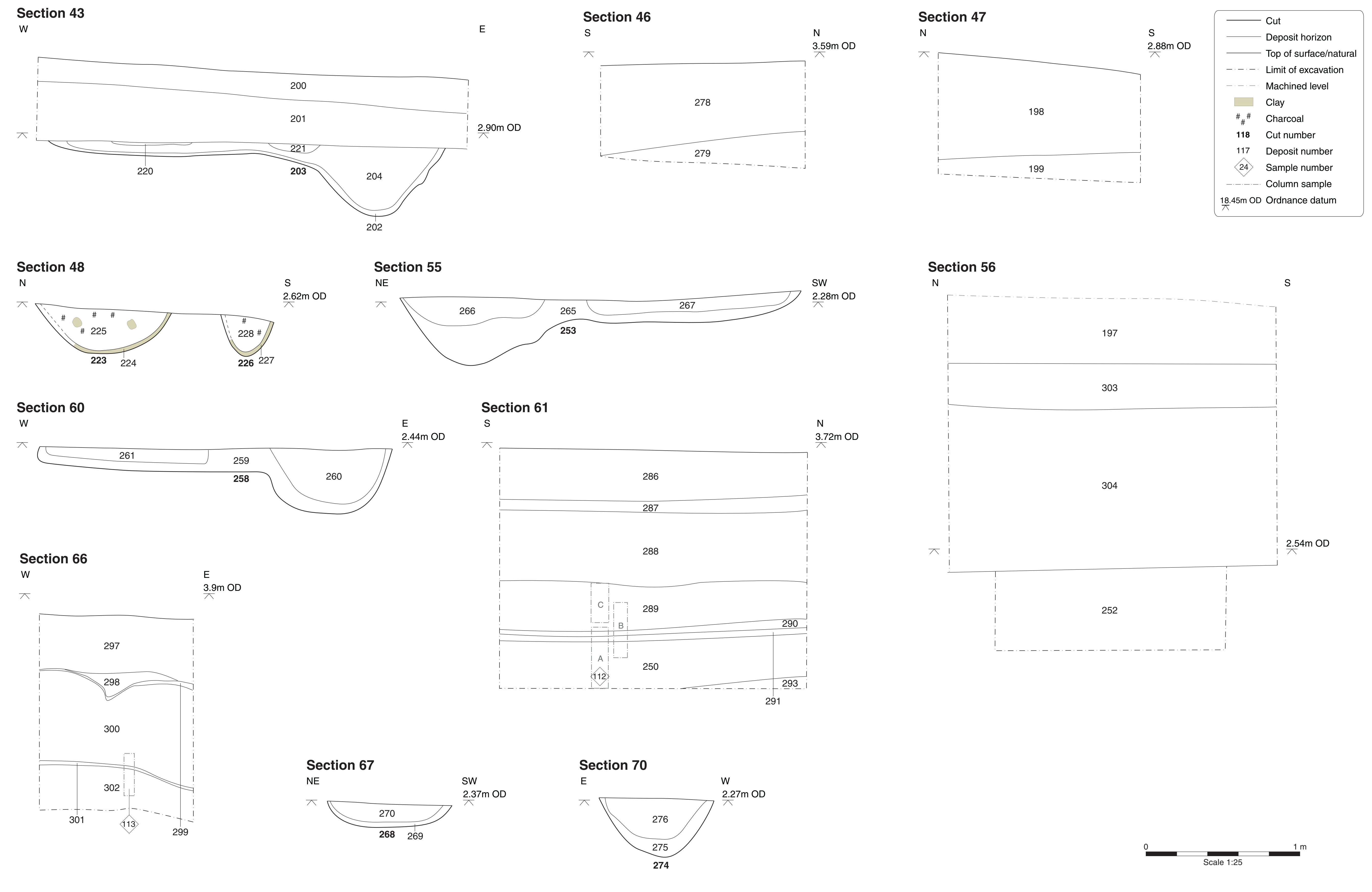


Figure 11b: Selected sections

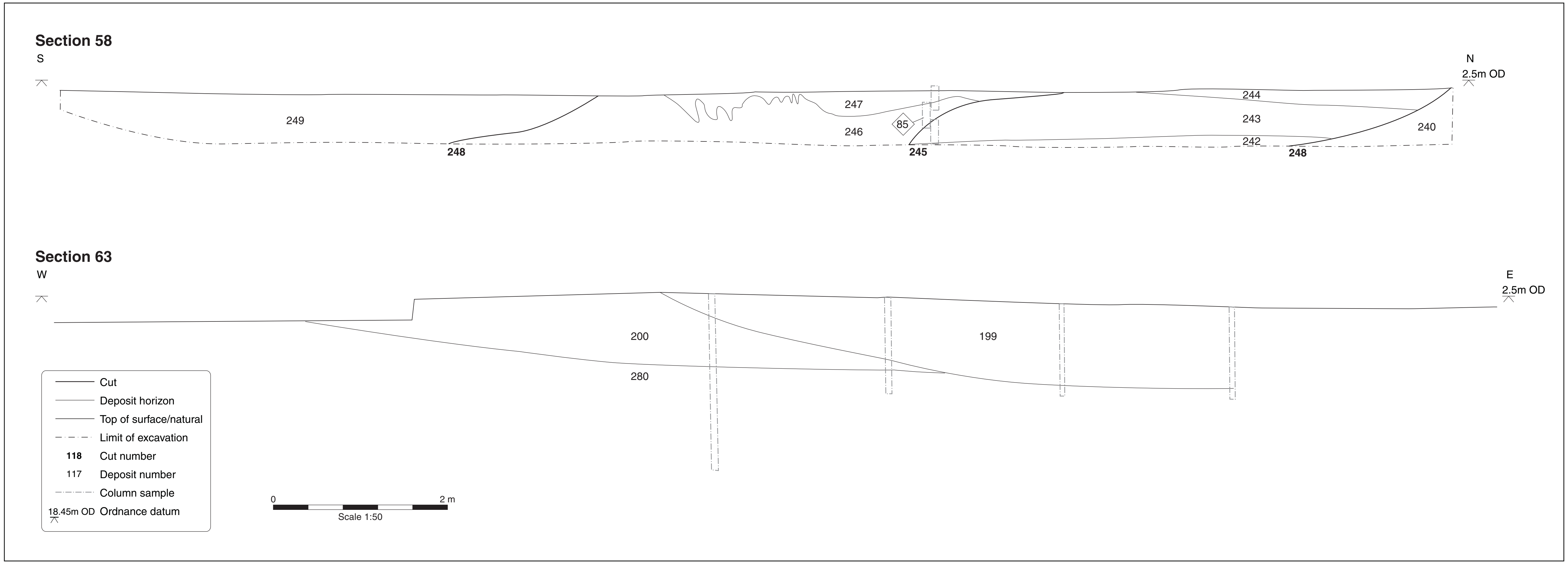


Figure 11c: Selected sections

Plate 1: Aerial view of evaluation and strip & map excavation (Excavation phase 1)

Plate 2: Marine deposits, group **240**, looking north-west

Plate 3: Period 1 silt filtration unit **253** with clay lining, looking south-west

Plate 4: Period 1 silt filtration unit **258** with clay lining and turves, looking south

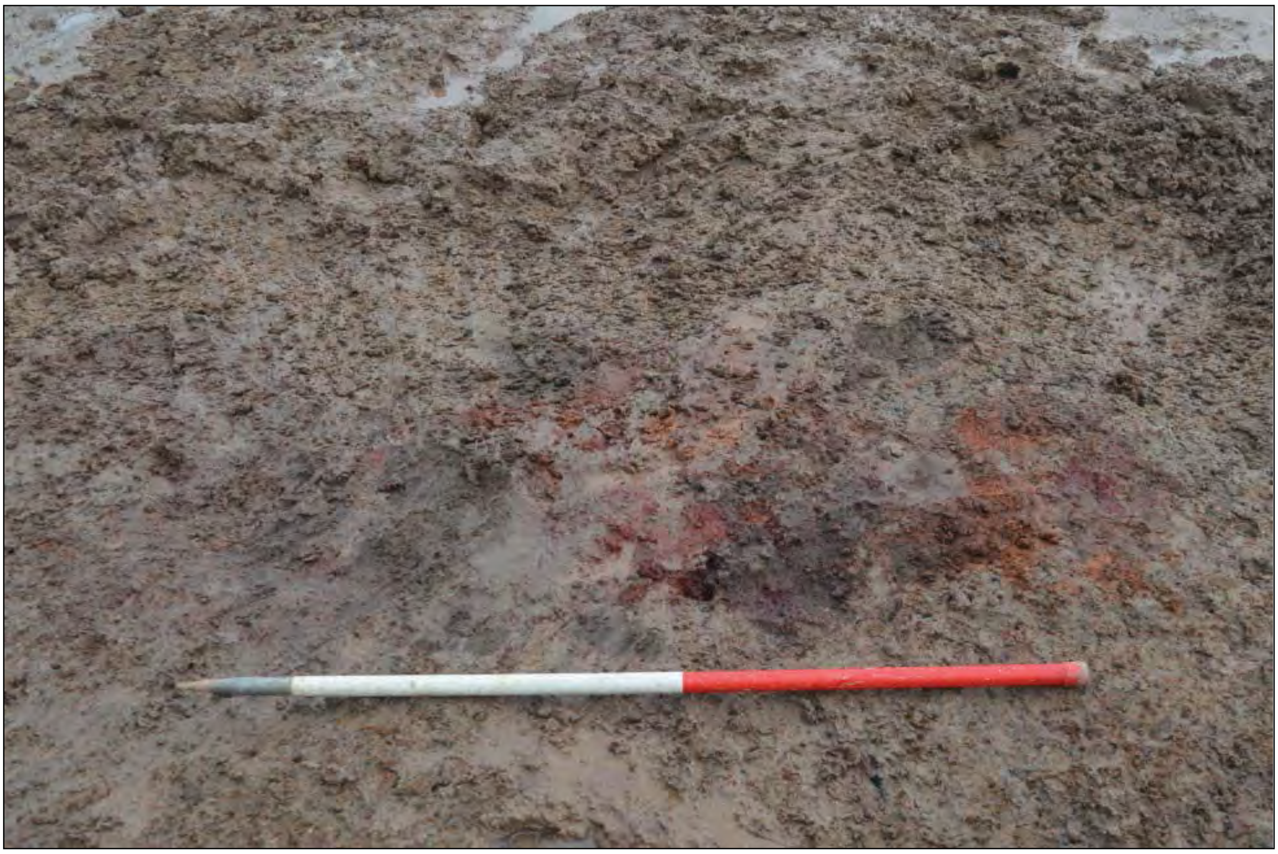

Plate 5: Period 1 hearth **277**, looking north-east

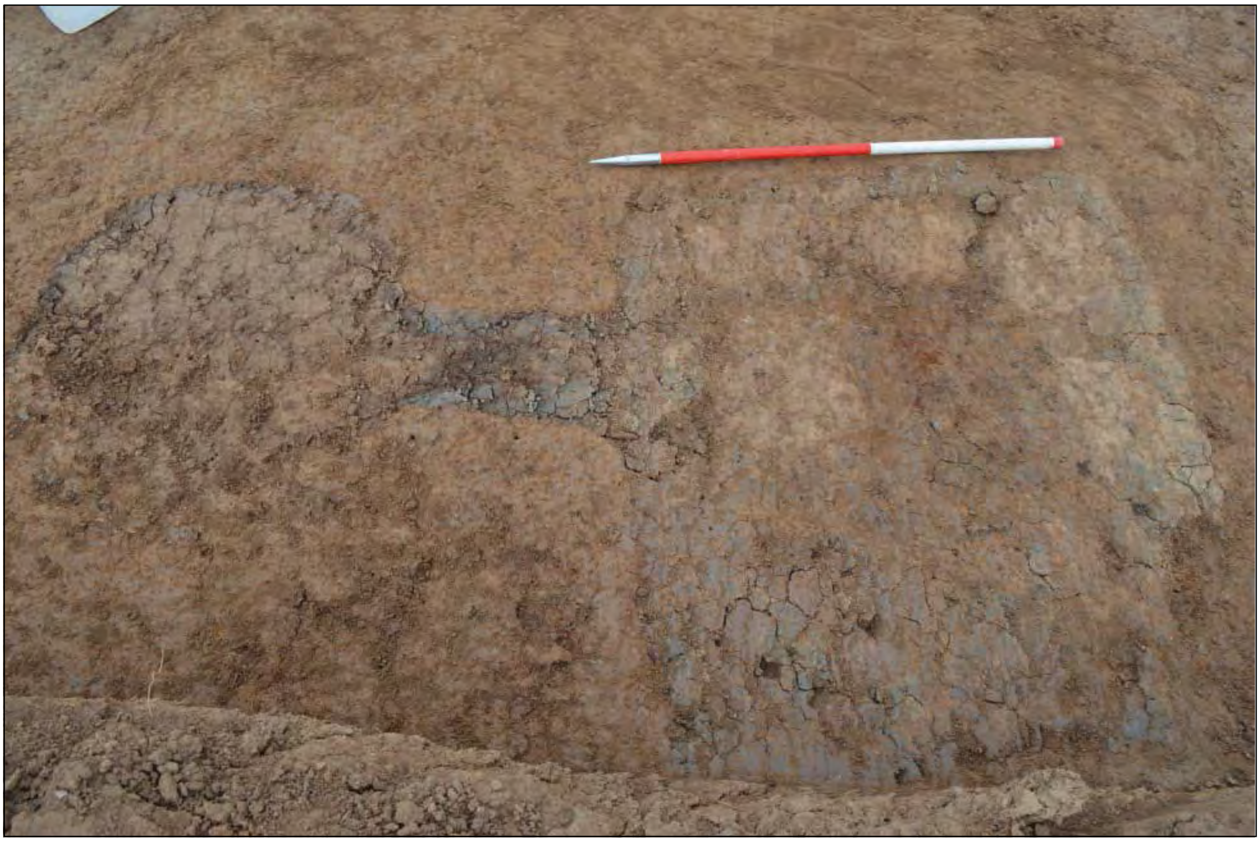

Plate 6: Period 1 silt filtration unit **203** pre-excavation, looking south-east

Plate 7: Period 2 hearth waste group **200** in plan, looking west

Plate 8: Period 2 hearth waste group **200** in section, looking west

Plate 9: Period 2 hearth **205** with superstructure 107 and hearth base 115, looking east

Plate 10: Period 2 hearth **205** with superstructure 107 and hearth base 115, looking north-east

Plate 11: Period 2 hearth **205** showing section of hearth base 115

Plate 12: Period 2 hearth **11**, looking east

Plate 13: Working shot of saltern Feature Group 1, looking east

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