

**Pegasus Boatyard
Oulton, Suffolk
OUL 036**

Archaeological Evaluation (and Palaeoenvironmental Survey) Report

SCCAS Report No. 2014/088

Client: Badger Building (East Anglia) Ltd.

Author: M. Sommers

February 2015

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Pegasus Boatyard Oulton, Suffolk OUL 036

Archaeological Evaluation (and Palaeoenvironmental Survey) Report

SCCAS Report No. 2014/088

Author: M. Sommers

Contributions By: K. Krawiec (ASE)

Editor: Dr R. Gardner

Report Date: February 2015

HER Information

Report Number: 2014/088
Site Name: Pegasus Boatyard, Oulton, Suffolk
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Date of Fieldwork: 10th and 11th July 2014
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Client Reference: n/a
Curatorial Officer: Dr Jess Tipper
Project Officer: M. Sommers
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Disclaimer

Any opinions expressed in this report about the need for further archaeological work are those of the Field Projects Team alone. Ultimately the need for further work will be determined by the Local Planning Authority and its Archaeological Advisors when a planning application is registered. Suffolk County Council's archaeological contracting services cannot accept responsibility for inconvenience caused to the clients should the Planning Authority take a different view to that expressed in the report.

Prepared By: M. Sommers
Date: 11th February 2015

Approved By: Dr R. Gardner
Position: Contracts Manager
Date:
Signed:

Contents

Summary

1. Introduction	1
2. Geology and topography	1
3. Archaeology and historical background	3
4. Methodology	6
5. Results	7
5.1 Trial Trenching	7
5.2 Palaeoenvironmental survey and assessment	10
6. Finds and environmental evidence	10
7. Discussion	10
8. Conclusions and recommendations for further work	12
9. Archive deposition	12
10. Acknowledgements	12
11. Plates	13

List of Figures

Figure 1. Location map	2
Figure 2. Sites recorded on the HER	4
Figure 3. 1st edition Ordnance Survey map, 1:2500 scale sheet of 1885	5
Figure 4. 2nd edition Ordnance Survey map, 1:2500 scale sheet of 1905	5
Figure 5. Trench locations	7

List of Plates

Plate 1. Trench 1, camera facing east (ref. HWZ 45)	13
Plate 2. Trench 1, camera facing northeast (ref. HWZ 46)	13
Plate 3. Trench 2, camera facing north (ref. HWZ 47)	14
Plate 4. Trench 2, camera facing east (ref. HWZ 48)	14
Plate 5. Trench 3, camera facing west (ref. HWZ 47)	15
Plate 6. Area of Trench 3 (prior to excavation), showing wall lines of former 19th century structures, camera facing south (ref. HWZ 73)	15 15
Plate 7. Trench 2, camera facing north (ref. HWZ 47)	16
Plate 8. Trench 2, camera facing east (ref. HWZ 48)	16
Plate 9. Trench 2, camera facing north (ref. HWZ 47)	17
Plate 10. Trench 2, camera facing east (ref. HWZ 48)	17
Plate 11. Trench 2, camera facing north (ref. HWZ 47)	18
Plate 12. Trench 2, camera facing east (ref. HWZ 48)	18
Plate 13. Trench 2, camera facing north (ref. HWZ 47)	19
Plate 14. Trench 2, camera facing east (ref. HWZ 48)	19
Plate 3. Trench 2, camera facing north (ref. HWZ 47)	20
Plate 4. Trench 2, camera facing east (ref. HWZ 48)	20

List of Appendices

Appendix 1.	Written Scheme of Investigation
Appendix 2.	OASIS data collection form
Appendix 3.	Palaeoenvironmental survey and assessment

Summary

An archaeological evaluation was carried out within an area of land formerly occupied by the Pegasus Boatyard in advance of a residential development. The site is situated on the northern bank of Oulton Broad in the parish of Oulton and is accessed from Caldecott Road. The broad is a large inland lake thought to be the result of medieval peat extraction. A series of ten trial trenches were excavated but no significant archaeological deposits, features or artefacts were identified. In the majority of the trenches natural deposits of sand and gravel were encountered although in two trenches, both of which were adjacent the broad, water borne silt deposits were revealed. A palaeoenvironmental borehole survey was also undertaken the results of which demonstrated that some areas of the site along the edge of the broad still retained a thin deposit of peat. A possible water channel was also recorded. Assessment and radiocarbon dating of a core sample indicated a freshwater peat sequence dating from the Late Neolithic that was incised by the small channel. In the later prehistoric period the environment changed to one of brackish mudflats with freshwater introduced from the dryland via creeks. (Suffolk Archaeology Community Interest Company/Suffolk County Council Archaeological Service Field Team for Badger Building [East Anglia] Ltd.)

1. Introduction

Planning permission has been granted for a residential development on land formerly occupied by the Pegasus Boatyard, situated on the northern bank of Oulton Broad, in the parish of Oulton, and accessed off Caldecott Road (application number BA/2012/0271). Conditions were attached to the planning consent, one which called for an agreed programme of archaeological work to be in place in advance of this development.

The first stage of the programme of work, as specified in a Brief produced by Dr. Jess Tipper of the Suffolk County Council Conservation Team, was the undertaking of a trenched evaluation in order to ascertain what levels of archaeological evidence may be present within the development area and to inform any mitigation strategies that may then be deemed necessary. A Written Scheme of Investigation (Appendix 1), detailing the methods to be used to fulfil the Brief, was produced and was subsequently approved by the County Conservation Team.

A palaeoenvironmental survey of the site was also stipulated by the Suffolk County Council Conservation Team and a separate Brief for this aspect of the work was issued by Sarah Poppy (Appendix 2).

The National Grid Reference for the approximate centre of the site is TM 5194 9302. Figure 1 shows a location plan of the development area.

The archaeological evaluation was undertaken on the 10th and 11th July 2014 by Suffolk County Council Archaeological Service's Field Team (now trading as Suffolk Archaeology Community Interest Company) who were commissioned and funded by Badger Building (East Anglia) Ltd. The palaeoenvironmental survey was undertaken by staff from Archaeology South-East, as sub-contractors for SCCAS/FT.

2. Geology and topography

The development area consists of an irregular shaped parcel of land with an area of just over 1.5ha. It lies on the northern bank of large body of water known as Oulton Broad, which forms the south and eastern boundary. To the north the site fronts onto, and is accessed from, Caldecott Road. The western boundary is formed by Pegasus Mews.

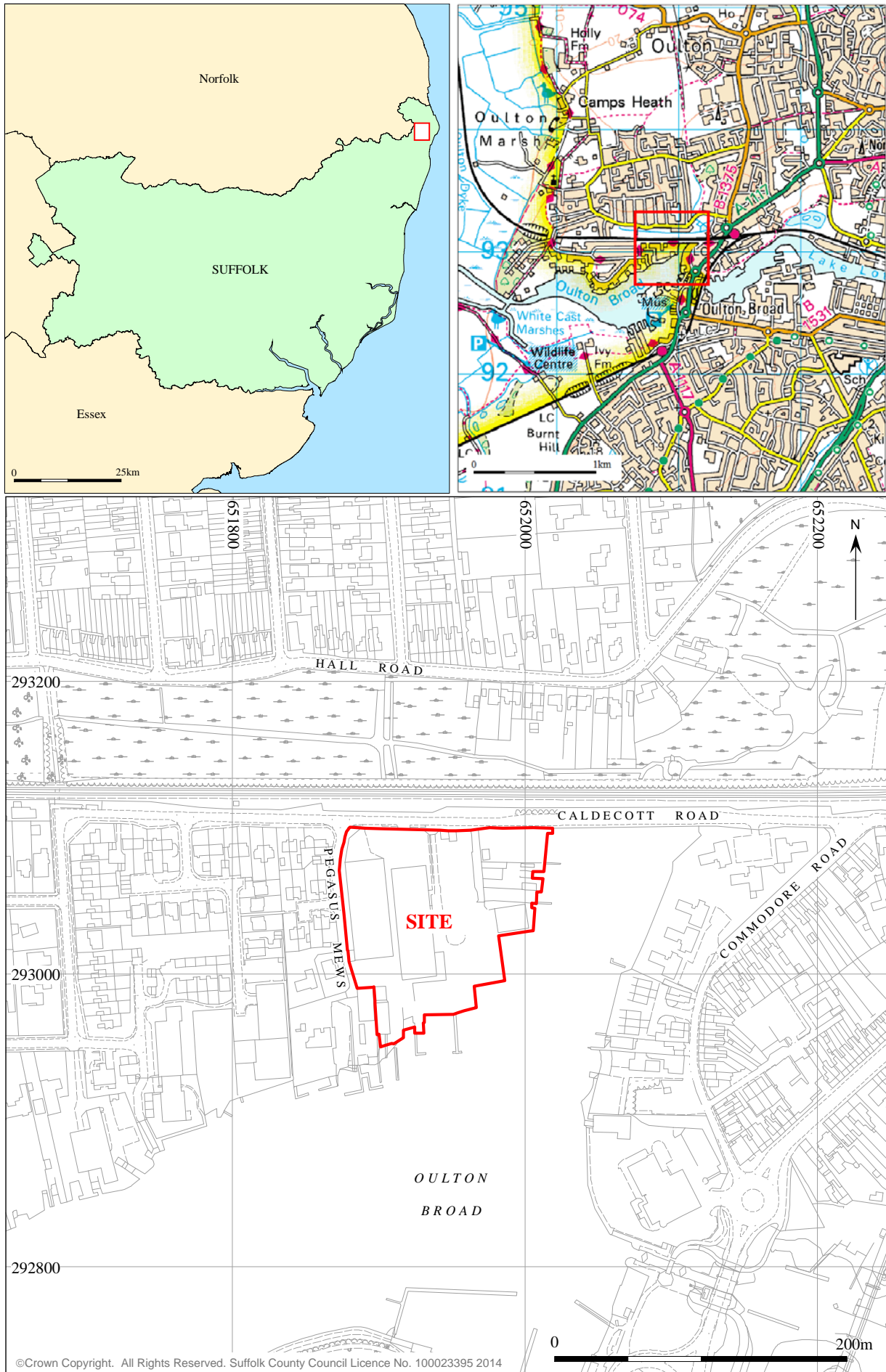


Figure 1. Location map

The site roughly consists of two terraces, one, which comprises the greater part of the site, at a height of 3m OD, and the other, the lower waterside areas, at a height of approximately 1.1m OD. The majority of the site is under concrete slab.

Oulton Broad is a large expanse of water with an area of marshland to the southwest. It is linked to the east to Lake Lothing, which is open to the North Sea, by Mutford Lock. It is also linked to the River Waveney to the west by the artificial channel, Oulton Dyke. Although Mutford Lock is normally kept closed the broad is permanently open to the sea via the River Waveney and is tidal. The broad forms part of the network of bodies of water collectively known as 'The Broads'. Originally thought to be natural lakes they are now recognised as the result of medieval peat digging. These bodies of water and their connecting waterways were constituted as a special area with a level of protection, similar to that of a National Park by The Norfolk and Suffolk Broads Act of 1988.

The underlying superficial geology of the site consists of sand and gravel, of uncertain age and origin, with deposits of peat along the southern eastern edges of the site. The bedrock geology consists of crag sand (British Geological Survey).

3. Archaeology and historical background

A number of archaeological sites or findspots are recorded on the Historic Environment Record (HER) within the vicinity of the development site. A summary of these entries is presented in Table 1; the recorded locations of are marked in Figure 2.

HER ref.	Summary
LWT 034	Probable decoy pond with five arms surviving and the stub of sixth. In valley N of Oulton Broad.
LWT 037	Mutford Bridge. A bridge is shown on the following maps: Saxton's 1575; Speede's 1610; Bowen's 1755; and Hodkinson's 1783. Named as 'Mutford Bridge' on all four maps. Construction date unknown. Modern OS map shows 'swing-bridge' in same location. HER location possibly erroneous - appears to outline the site of the modern bridge.
LWT 153	Oulton Broad, probably a remnant of a medieval turbary. 'Account-rolls for Flixton-by-Lowestoft (1355/7), from which Oulton was formed, show 31% of the manorial income at Flixton was derived from turbary'.

LWT 154	Lake Lothing, possible remnant of a medieval turbarry. Documentary evidence not examined.
LWT 194	Saxon silver Sceatta coin found 'Near Lowestoft'. Possibly found in the 1970's. Only rubbings of the coin seen (possibly erroneous map location).

Table 1. Summary of HER entries

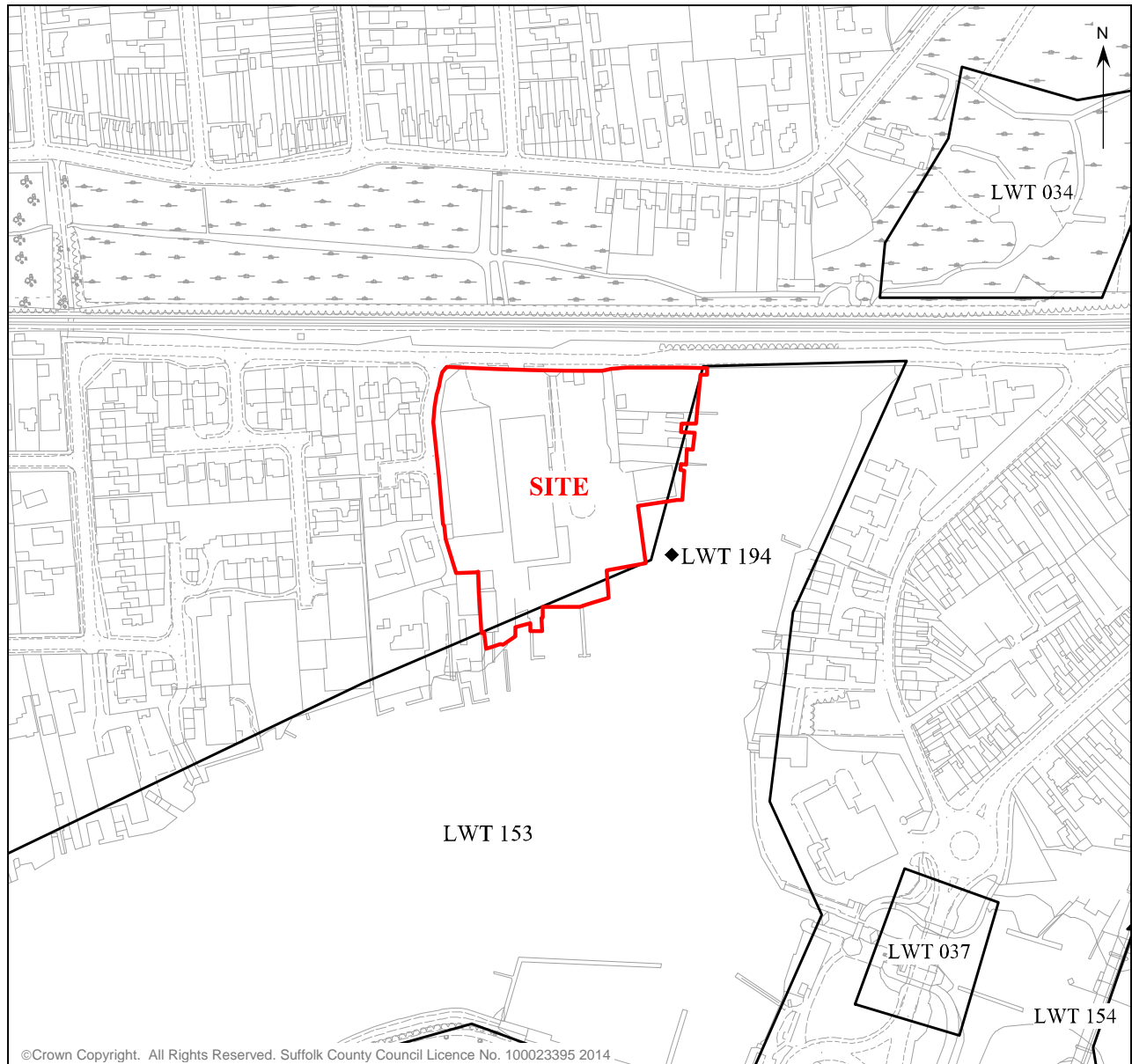


Figure 2. Sites recorded on the HER

There are few archaeological sites recorded on the HER in the vicinity of the development site (the Saxon coin location is probably incorrectly recorded). The development site's archaeological potential is based on its location on the edge of Oulton Broad and the fact that there was a potential for waterlogged archaeological remains (such as timbers) to be present.

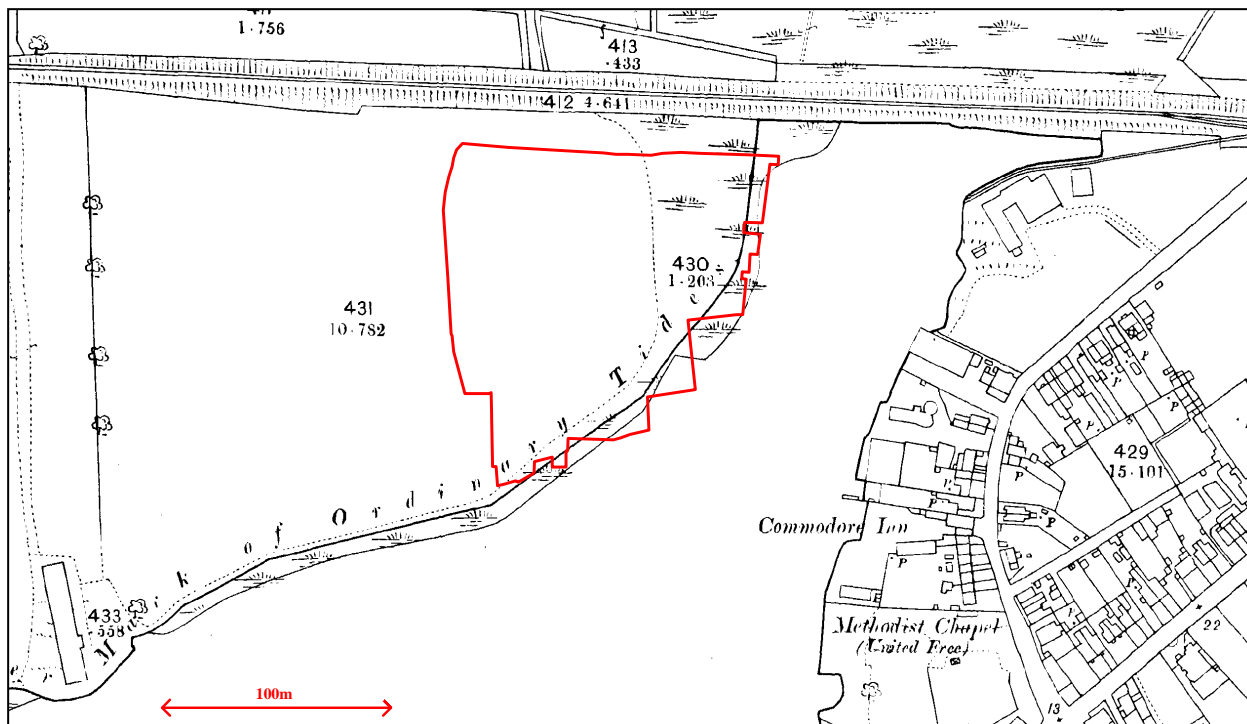


Figure 3. 1st edition Ordnance Survey map, 1:2500 scale sheet of 1885 (rescaled extract)

No structures are recorded within the development area on the 1st edition Ordnance Survey map, 1:2500 scale sheet, of 1885 (Fig. 3), but areas of marsh are indicated on its eastern and southern edges. By the 2nd edition of 1905 (Fig. 4) some structures are shown, including a pair of semi-detached houses, and the marsh along the southern waterside has disappeared and has been replaced by what appears to be gravel.

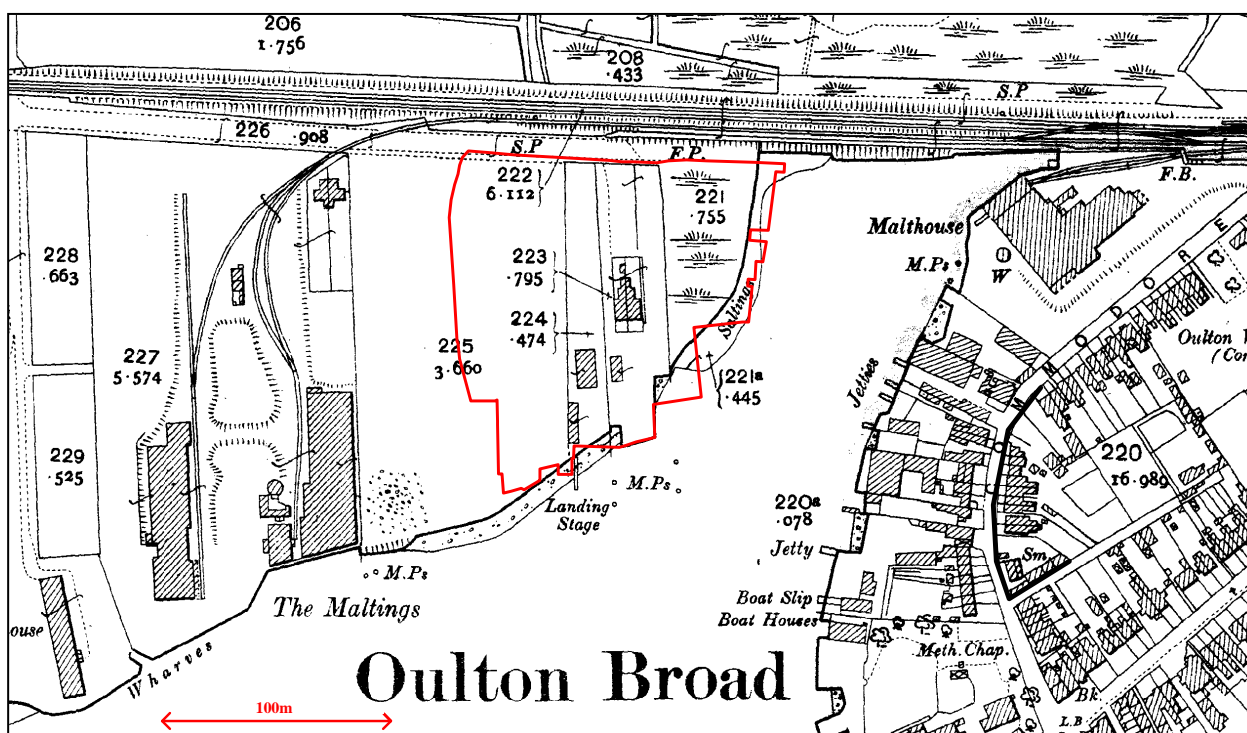


Figure 4. 2nd edition Ordnance Survey map, 1:2500 scale sheet of 1905 (rescaled extract)

4. Methodology

The trial trenches were machine excavated down to the level of the natural subsoil using a large tracked excavator fitted with a 2.2m wide toothless ditching bucket, after the concrete surface had been broken and removed (if applicable) from the footprint of the trench. The location of the trenches was broadly in accordance with the trench plan approved by the County Conservation Team.

The machining of the trenches was closely observed throughout in order to identify any archaeological features and deposits and to recover any artefacts that might be revealed. Excavation continued until undisturbed natural deposits were encountered, the exposed surface of which was then examined for cut features. Had any features or significant deposits been identified they would have been sampled through hand excavation in order to determine their depth and shape and to recover datable artefacts.

Following excavation of the trenches, the nature of the overburden was recorded and their locations plotted.

A photographic record of the work undertaken was also compiled using a 14 megapixel digital camera.

The palaeoenvironmental survey was undertaken at the same time as the trenching to take advantage of the breaking out of the concrete surface. See Appendix 3 for full details of the methodology used during the survey.

5. Results

5.1 Trial Trenching

A total of ten evaluation trenches were excavated, as depicted in Figure 5. This work revealed a natural subsoil consisting of yellow sand and gravel or, in the case of two of the trenches, a deposit of dense clayey silt. It lay at depths of between 0.25m to 1.0m. The following table (Table 2) details the depths of natural, as revealed in each trench, and the stratigraphy of the recorded overburden.

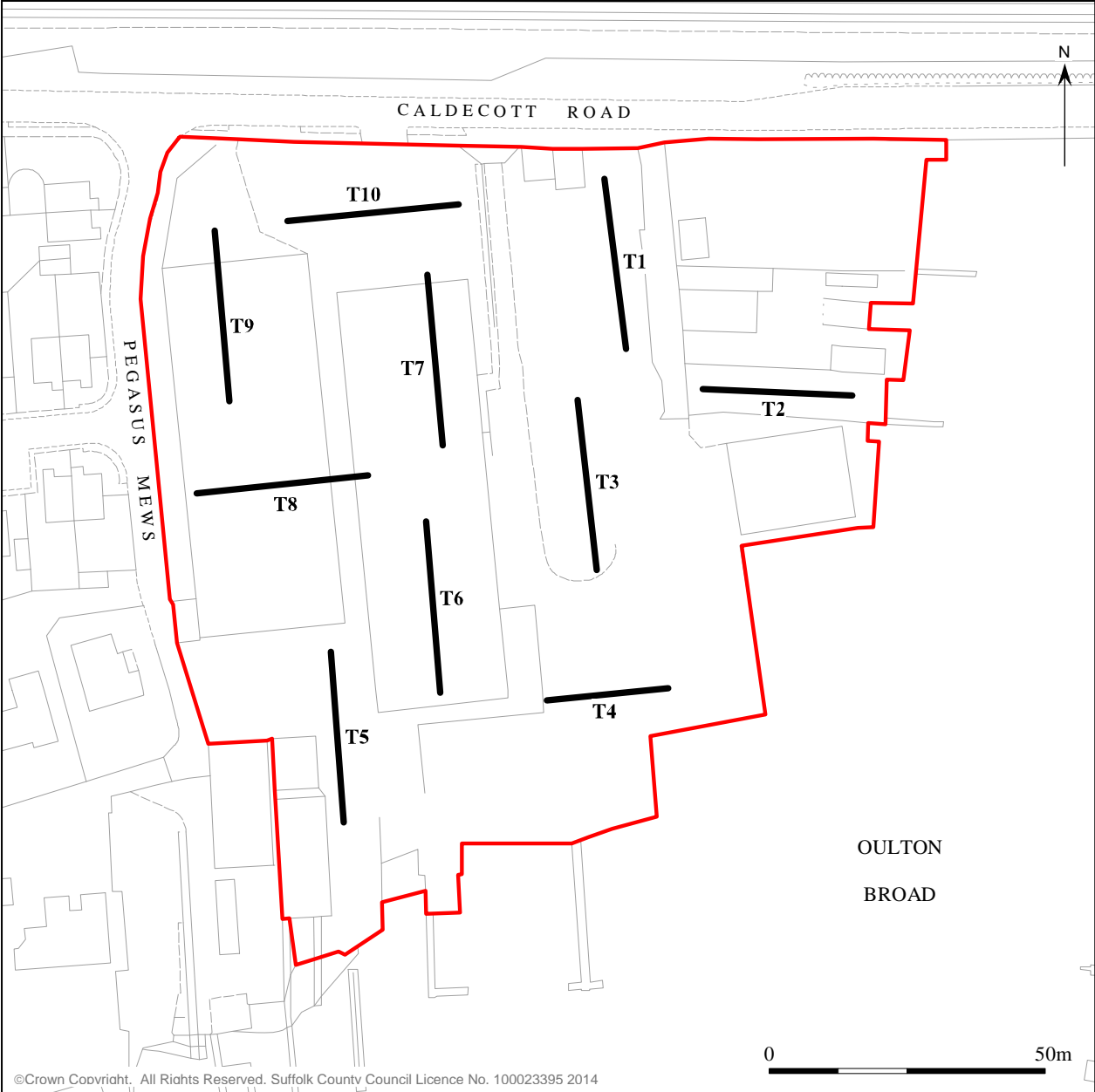


Figure 5. Trench locations

All trenches were 31m in length except for two which were slightly shorter due to the presence of on-site features. Trench 4 was reduced 28m to maintain an access route, and Trench 6 which was reduced to 22m due to an area of raised concrete. The total area exposed by the trial trenching was 650m², which equates to over 4% of the total development area of 15,000m².

No archaeological features were identified in any of the trenches and no significant artefacts were present within the excavated spoil.

Trench	Recorded overburden/notes	Depth to natural
1	1. Concrete over sand and gravel with building rubble to a depth of 0.35m. 2. Grey sandy silt with occasional small pebbles, clean, possibly a natural deposit, 0.65m thick. 3. Natural subsoil of grey-yellow sand at a depth of 1m. Ground water pooled in base of trench. (Plates 1 and 2)	1m
2	1. Grey/brown sand and gravel over yellow sand and gravel to a depth of 0.25m. 2. Peaty/organic rich material with sand, 0.25m thick. 3. Dense grey silt at 0.45m with occasional slightly deeper channels filled with the above layer. Ground water present. (Plates 3 and 4)	0.45m
3	1. Brown silty sand, greyer towards base of layer, to a depth of 0.5m. 2. Natural subsoil of pinky/brown sand and gravel at a depth of 0.5m. Very wet. Trench excavated through the site of a pair of semi-detached houses, as marked on the 2nd edition Ordnance Survey map (fig.4), the wall bases and foundations of which were still extant. (Plates 5 and 6)	0.5m
4	1. Concrete slab over dirty brown/yellow sand and gravel to a depth of 0.2m. 2. Dense yellow brown silt, 0.2m thick. 3. Pale brown sand with some silt, 0.25m thick 4. Natural subsoil of dirty pinky/brown sand and gravel at a depth of 0.7m. Ground water pooled in base of trench. (Plates 7 and 8)	0.7m
5	1. Concrete slab over dense black silt with sand to a depth of 0.25m. 2. Yellow brown sandy silt, 0.4m thick. 3. Natural subsoil of yellow sand and gravel at a depth of 0.65m. (cont.)	0.65m

	<p>Area of trench sloped down gently from north to south towards Oulton Broad. Area of modern fill/made ground at the southern end of trench – presumably related to land reclamation in association with construction of the quayside.</p> <p>(Plates 9 and 10)</p>	
6	<p>North end of trench:</p> <ol style="list-style-type: none"> 1. Concrete slab over yellow sand and gravel to a depth of 0.25m. 2. A 0.35m thick deposit of made ground comprising angled bands and wedges of dark silty sand and yellow sand with building rubble (red brick etc.). 3. Pale brown silty sand, 0.2m thick 4. Natural subsoil of yellow sand and gravel at a depth of 0.8m. <p>South end of trench:</p> <ol style="list-style-type: none"> 1. Concrete slab over yellow sand and gravel to a depth of 0.25m. 2. Dark sand and silt with pebbles, some large, 0.3m thick (slowly becoming thicker to the south). 3. Grey silty sand, 0.25m thick (slowly becoming thicker to the south). 4. Pale grey with yellow sand, 0.2m thick. 5. Natural subsoil of yellow sand and gravel at a depth of 1.0m. Depth increases to a maximum of 1.2m at extreme southern end of trench. <p>(Plates 11 and 12)</p>	<p>0.8m (North end) 1.0m (South end)</p>
7	<ol style="list-style-type: none"> 1. Concrete slab over dark yellow sand to a depth of 0.25m. 2. Yellow brown silty sand with occasional pebbles, 0.55m thick. 3. Natural subsoil of yellow sand and gravel at a depth of 0.8m. <p>(Plates 13 and 14)</p>	0.8m
8	<ol style="list-style-type: none"> 1. Concrete slab over yellow sand & gravel to a depth of 0.3m. 2. Natural subsoil of yellow sand and gravel at a depth of 0.3m. Area of dense grey clay with chalk at extreme west end of trench. <p>(Plates 15 and 16)</p>	0.25m
9	<ol style="list-style-type: none"> 1. Concrete slab over banded pale grey and yellow sands to a depth of 0.35. 2. Natural subsoil of silty yellow sand and gravel at a depth of 0.35m. <p>(Plates 17 and 18)</p>	0.35m
10	<ol style="list-style-type: none"> 1. Concrete slab over yellow sand and gravel make-up to a depth of 0.3m. 2. Natural subsoil of yellow sand and gravel at a depth of 0.3m. <p>Large modern disturbance present in the western end of trench, not bottomed.</p> <p>(Plates 19 and 20)</p>	0.3m

Table 2. Summary of trench results

5.2 Palaeoenvironmental survey and assessment

See Appendix 3 for full survey report. A summary of the results follows below:

A borehole survey comprising 6 boreholes was undertaken with 2 cores recovered for assessment. The boreholes were located in relation to evaluation trenches that were being excavated at the same time. The survey demonstrated small areas of the site retained a thin deposit of peat as well as a possible channel. This channel, which was visible within the south facing section of evaluation Trench 2, was infilled by a combination of organic and coarser grained sandy shelly material.

The channel and thin blanket peat deposit were selected for assessment and radiocarbon dating. The borehole survey at Pegasus Boatyard has demonstrated that although preservation of deposits is variable across the site, the palaeoenvironmental potential of the site is high in the low-lying areas. The micro and macrofossil assemblages have demonstrated an initial freshwater peat sequence dating from the Late Neolithic which was incised by a small channel. This was minerogenic a clean, slow moving waterbody which became gradually infilled with organic and minerogenic sediment. At some point in the later prehistoric period the environment changed to one of brackish mudflats with freshwater introduced from the dryland via creeks. In some areas of the site freshwater peat persisted into the Anglo-Saxon period but this sequence has been truncated by peat cutting. The preservation within the deposit is good and full analysis is recommended.

6. Finds and environmental evidence

No artefacts of any period were recovered during the evaluation.

7. Discussion

The results of evaluation suggest that no significant archaeological features or deposits are present within the site. The surface of the exposed natural subsoil was cleanly cut and had any buried remains been present it is highly likely they would have been identified.

A natural subsoil of yellow sand and gravel was revealed immediately below the make-up deposits for the concrete slab in Trenches 7 to 10. The land to the west of the site was at a slightly higher level and it is highly likely that some truncation of the natural surface has occurred, particularly towards the western edge and the northwest corner of

the development site. The area of these trenches is significantly higher than the level of the broad and would not be liable to flooding.

Trenches 5 and 6 also revealed natural sand and gravel deposits although these were clearly sloping down towards the broad. In Trench 6 the ground levels had been built up through the deposition of imported material to extend the upper terrace. In the area of Trench 5 the concrete slab in general followed the natural slope down to the lower terrace adjacent to the waterside. The trench itself revealed probable former topsoil covered the natural sand and gravel over much of its length and consequently, in the area of these two trenches, the surface of the natural subsoil did not appear to have been truncated.

Trenches 1 and 3 revealed a darker yellow to brown natural subsoil of sand and gravel at a lower level, as demonstrated by pooling ground water in Trench 1. In Trench 3 the natural subsoil appeared to be under a probable former topsoil layer whilst in Trench 1 it was sealed by a layer of what was possibly natural sand and silt, which in turn had been buried beneath a deposit of made ground capped by the concrete slab.

The pair of 19th century semi-detached houses, the remains of which were exposed in the area of Trench 4, had clearly been extended since the 2nd edition Ordnance Survey map (Fig. 4) with additions to both houses to the south and an extensive extension to the north of the eastern property. It is possibly these had ceased to be private dwellings and had been converted to offices or stores for the boatyard.

Trenches 2 and 4 were located close to the high water mark as recorded on the 1st edition Ordnance Survey map (Fig. 3) and did indeed expose water logged silt deposits and a thin peat layer. An incised channel of unknown but probably natural origin was noted in Trench 2. Palaeoenvironmental coring analysis indicates the peat is a freshwater sequence that dates from the Late Neolithic period. This would indicate a low-lying inland waterlogged area away from the sea. In the later prehistoric period the environment changed to one of brackish mudflats, suggesting that the area was now open to the sea, although this is probably the result of fluctuating sea levels rather than evidence for early peat cutting. Freshwater creeks, formed by dry land drainage, are present and these have allowed the freshwater peat to persist into the Anglo-Saxon period in some areas of the site.

8. Conclusions and recommendations for further work

The evaluation did not identify any significant archaeological deposits or features that could be under threat from the proposed development. Based on these results, no further work is recommended, although the final decision is at the discretion of the County Conservation Team.

The palaeoenvironmental survey cores did contain well preserved sequences that may merit full analysis.

9. Archive deposition

Historic Environment Record reference under which the archive is held: OUL 036.

Digital archive can be found on the SCC servers at the following location:

R:\Environmental Protection\Conservation\Archaeology\Archive\Oulton\OUL036 evaluation (Pegasus Boatyard)

Digital photographs are held under the references HWZ 45 to HWZ 75

A summary has also been entered into OASIS, the online database, ref. suffolkc1-170086

10. Acknowledgements

The evaluation was carried out by Mark Sommers from the Suffolk County Council Archaeological Service Field Team (now Suffolk Archaeology Community Interest Company).

The palaeoenvironmental survey was conducted by Kristina Krawiec of Archaeology South-East

The project was directed by Mark Sommers and managed by Dr Rhodri Gardner, who also provided advice during the production of the report.

11. Plates



Plate 1. Trench 1, camera facing east (ref. HWZ 45)



Plate 2. Trench 1, camera facing northeast (ref. HWZ 46)



Plate 3. Trench 2, camera facing north (ref. HWZ 47)



Plate 4. Trench 2, camera facing east (ref. HWZ 48)



Plate 5. Trench 3, camera facing west (ref. HWZ 47)



Plate 6. Area of Trench 3 (prior to excavation), showing wall lines of former 19th century structures, camera facing south (ref. HWZ 73)



Plate 7. Trench 4, camera facing south (ref. HWZ 51)



Plate 8. Trench 4, camera facing southeast (ref. HWZ 53)



Plate 9. Trench 5, camera facing east (ref. HWZ 55)



Plate 10. Trench 5, camera facing south (ref. HWZ 56)



Plate 11. Trench 6, North end, camera facing west (ref. HWZ 57)



Plate 12. Trench 6, South end, camera facing west (ref. HWZ 58)



Plate 13. Trench 7, camera facing north (ref. HWZ 61)



Plate 14. Trench 7, camera facing north (ref. HWZ 62)



Plate 15. Trench 8, camera facing south (ref. HWZ 63)



Plate 16. Trench 8, camera facing east (ref. HWZ 64)



Plate 17. Trench 9, camera facing east (ref. HWZ 65)



Plate 18. Trench 9, camera facing north (ref. HWZ 66)



Plate 19. Trench 10, camera facing south (ref. HWZ 67)



Plate 20. Trench 10, camera facing east (ref. HWZ 68)

Appendix 1. Written Scheme of Investigation

OUL 036, Pegasus Boatyard, Oulton

Archaeological Evaluation by Trial Trench

**Written Scheme of Investigation
&
Safety Statement and Risk Assessment**

**Prepared by Suffolk County Council Archaeological Service
June 2014**

Document Control

Title: Pegasus Boatyard Archaeological Evaluation, Oulton
Date: 01/07/2014
Issued by: Suffolk County Council Archaeological Service Field Team
Author: Rob Brooks
Issued to: Dr Jess Tipper (SCCAS Conservation Team)

Contents

1. Background
2. Project Details
3. Archaeological Method Statement
4. Risk Assessment

Figures

1. Site location
2. Trench layout

Appendices

1. SCC Health and Safety Policy
2. Risk Assessments

1. Background

1.1 The Field Team of the Suffolk County Council Archaeological Service (SCCAS) have been asked by the agent Badger Building to prepare documentation for a programme of archaeological evaluation by trial trench at the above site (Fig 1). This Written Scheme of Investigation (WSI) covers the trenched evaluation only and not the palaeoenvironmental and geoarchaeological borehole works. Any further stages of archaeological work that might be required in relation to the proposed development would be subject to new documentation. This WSI covers only the archaeological aspects of works, whilst Archaeology South-East will provide a WSI and other related documentation regarding any palaeoenvironmental works.

1.2 The site covers c.1.6ha, located at NGR TM 519 930.

1.3 The work is to be undertaken as a condition of the planning permission. This is at the request of the local planning authority, following guidance set out in the National Planning Policy Framework as part of planning application number BA/2012/0271/FUL.

1.4 The archaeological investigation will be conducted in accordance with a Brief produced by Dr Jess Tipper of the SCCAS Conservation Team.

1.5 The site is of interest because of its palaeoenvironmental and archaeological potential – ‘the proposed lake has high potential for the discovery of important palaeoenvironmental and geoarchaeological deposits in the floodplain, and waterlogged archaeological remains (such as preserved timbers). The proposed redevelopment has the potential to cause damage and destruction to any underlying archaeological deposits’ (taken from Tipper, J., 2014 – Brief for a Trenched Archaeological Evaluation).

1.6 The proposed development involves the construction of housing and a lake on what was previously the Pegasus Yachts boatyard.

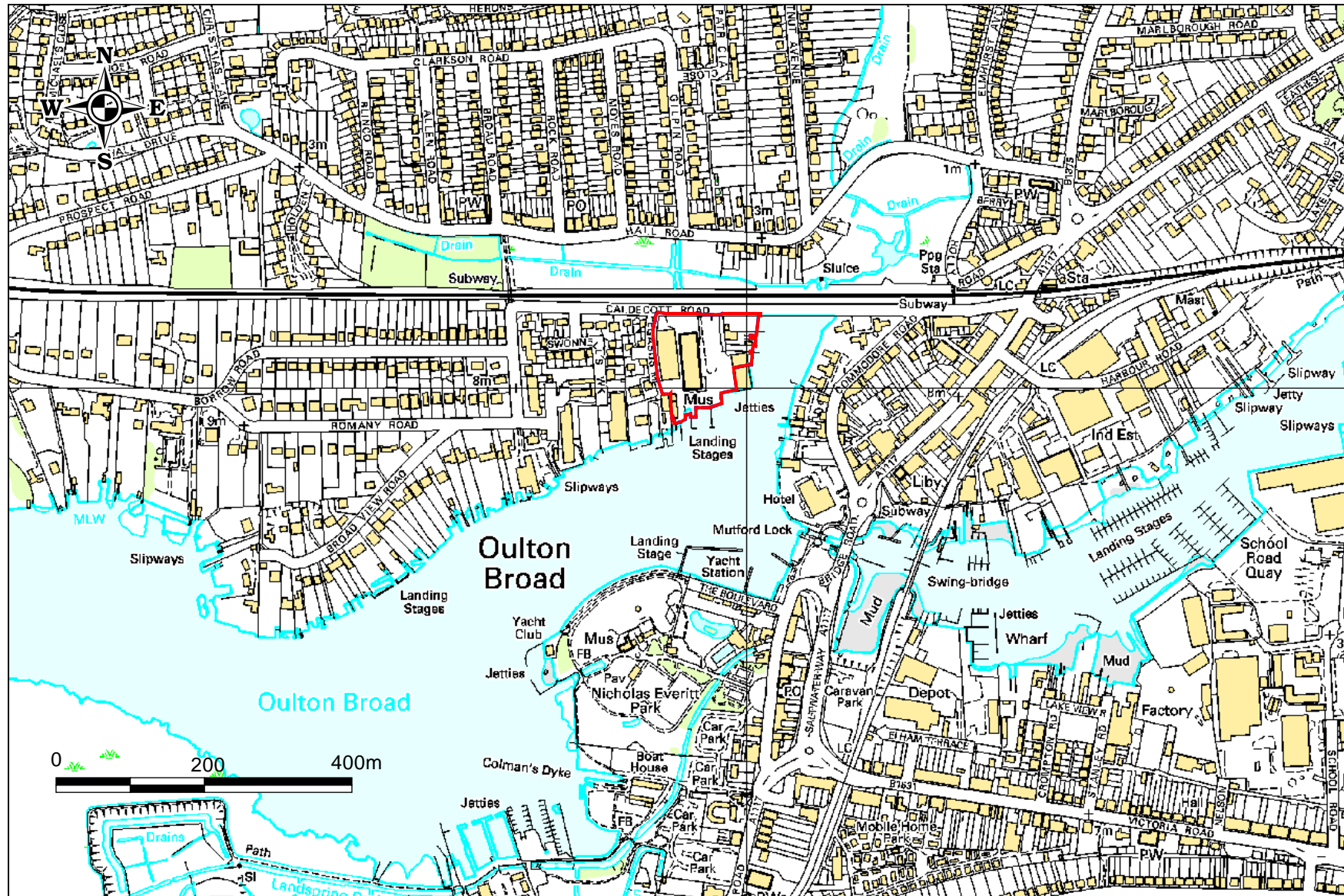
1.7 The site outline and trench pattern are shown on Figure 2. Deposits in this area will be directly affected by the foundations and other groundworks associated with the development.

1.8 This WSI complies with the requirements of SCC’s standard Requirements for a Trenched Archaeological Evaluation (2012 Ver 1.1), as well as the following national and regional guidance ‘Standards and Guidance for Archaeological Excavation’ (IFA, 1995, revised 2001) and ‘Standards for Field Archaeology in the East of England (EAA Occasional Papers 14, 2003).

1.1 Research aims

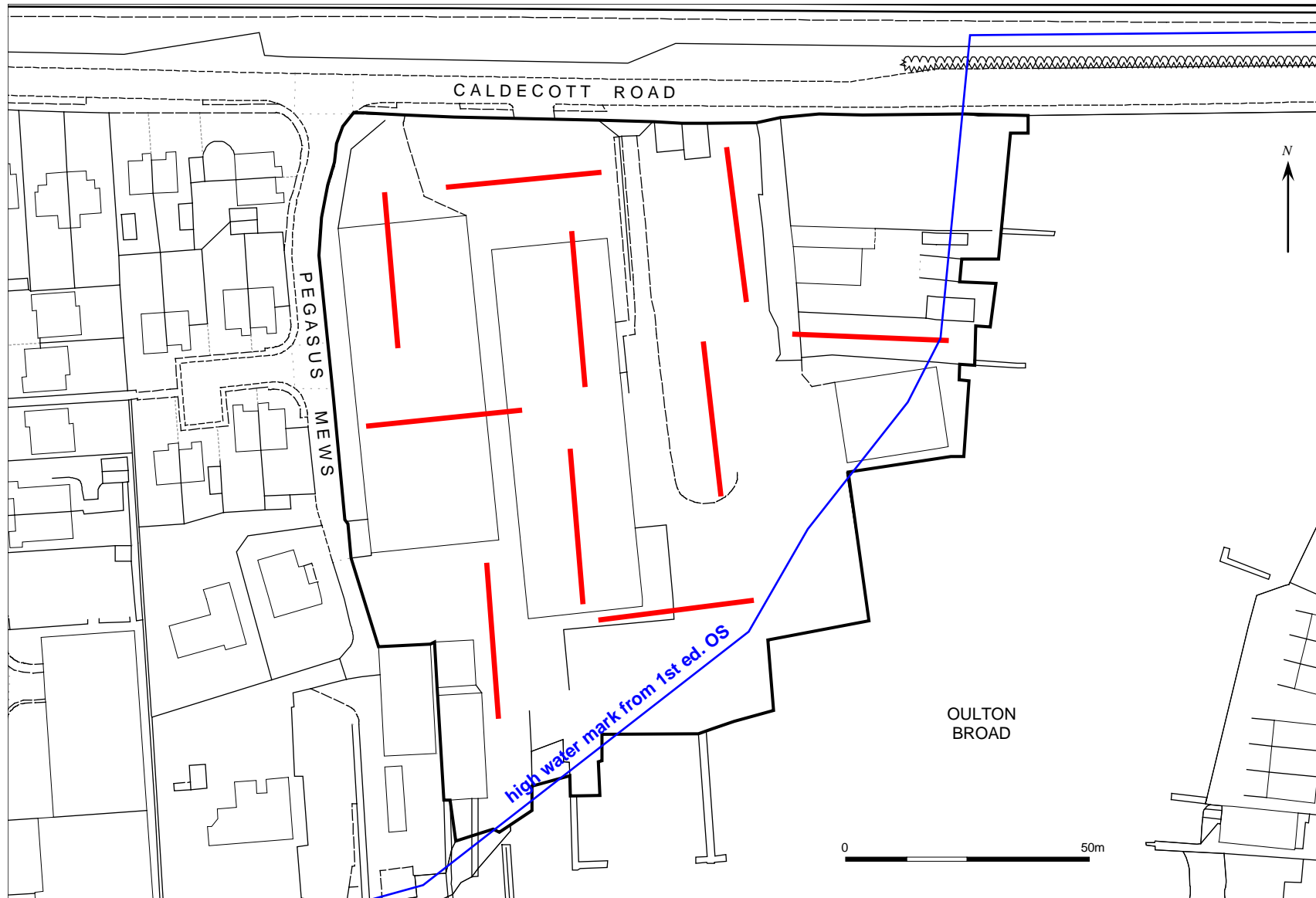
The research aims of this trial trench evaluations are as follows, as typically described by an LPA brief:

- RA1: Establish whether any archaeological deposit exists within the application area, with particular regard to any which are of sufficient importance to merit preservation in situ.*
- RA2: Identify the date, approximate form and purpose of any archaeological deposit within the application area, together with its likely extent, localised depth and quality of preservation.*
- RA3: Evaluate the likely impact of past land uses, and the possible presence of masking colluvial/alluvial deposits.*
- RA4: Establish the potential for the survival of environmental evidence.*
- RA5: Provide sufficient information to construct an archaeological conservation strategy, dealing with preservation, the recording of archaeological deposits, working practices, timetables and orders of cost.*



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Figure 1. Site Location (red)



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Figure 2. Trench layout

2 Project details

Site Name	Pegasus Boatyard Evaluation
Site Location/Parish	Oulton
Grid Reference	TM 519 930
Access	Caldecott Road
Planning Application No	BA/2012/0271/FUL
HER code	OUL 036
OASIS Ref	suffolkc1-170086
SCCAS Job Code	TBC
Type:	Trial trench evaluation
Area	1.6ha
Project start date	TBC
Fieldwork duration	5 days (estimated)
Number of personnel on site	Up to 5 (including palaeoenvironmental subcontractors)

Personnel and contact numbers

Contracts Manager	Rhodri Gardner	01473 581743
Project Officer (first point of on-site contact)	TBA	-
Finds Dept	Richenda Goffin	01284 352447
Sub-contractors	Archaeology South East (Palaeoenvironment)	
Curatorial Officer	Dr Jess Tipper	01284 741225
Consultant	N/A	
Developer	Badger Building (E Anglia) Ltd	01502 583026

Emergency contacts

Local Police	Old Nelson Street, Lowestoft, NR32 1PE	101
Location of nearest A&E	Lowestoft Road, Gorleston, Great Yarmouth, Norfolk NR31 6LA	01493 452452
Qualified First Aiders	SCC Project Officer attending	

Hire details

Plant:	N/A	
Toilet Hire	N/A	
Tool hire:	N/A	

Other Contacts

Suffolk Fleet Maintenance		01359 270777
Suffolk Press Office		01473 264395
SCC EMS (Jezz Meredith)		01473 583288
SCC H&S (Stuart Boulter)		01473 583290

3 Archaeological method statement

3.1 Evaluation by trial trench

- 3.1.1 The archaeological fieldwork will be carried out by members of the SCCAS field team led in the field by an experienced member of staff of Project Officer Grade. The excavation team will comprise up to 5 experienced excavators and surveyors (including the Project Officer) from a pool of suitable staff at SCCAS and Archaeology South-East (geoarchaeological subcontractors).
- 3.1.2 Evaluation of the development area will employ ten trial trenches to sample the proposed development area (PDA).
- 3.1.3 The PDA covers an area of approximately 1.6ha (Figs. 1 and 2).
- 3.1.4 The trenches will measure 30m long x 1.8m wide will be excavated to sample the PDA (Fig. 2).
- 3.1.5 No information has been provided about the presence or otherwise of services by the developer currently (as of 01/07/2014). If previously unknown services or similar restrictions are encountered during work on site then trench layout will be amended accordingly. A CAT scan of the trenching will be carried out prior to excavation.
- 3.1.6 *General trial trench methodology*
- 3.1.7 The trench will be cut using a tracked mechanical excavator equipped with a toothless ditching bucket, under the constant supervision of an archaeologist. All overburden (topsoil and subsoil) will be removed stratigraphically until either the first archaeological horizon or natural deposits are encountered. Spoil will be stored adjacent to each trench and topsoil, subsoil and concrete/overburden will be kept separate for sequential backfilling if requested by the client prior to excavation.
- 3.1.8 Archaeological deposits and features will be sampled by hand excavation and the trench bases and sections cleaned as necessary in order to satisfy the project aims and in compliance with the SCCAS Requirements for Archaeological Evaluation, 2012.
- 3.1.9 Trenches requiring access by staff for hand excavation and recording will not exceed a depth of 1.2m. Any trench in which this depth is not sufficient to meet the archaeological requirements of the Brief and Specification will be brought to the attention of the client or their agent and the Archaeological Advisor to the LPA so that further requirements can be discussed (and costed).
- 3.1.10 Deeper excavation can be undertaken provided suitable trench support is used or, where practicable, the trench sides are stepped or battered.
- 3.1.11 A site plan, which will show all trench locations, feature positions and levels AOD will be recorded using an RTK GPS or TST, depending on the specific requirements of the project. A minimum of one to two sections per trench will be recorded at 1:20. Feature sections and plans will be recorded at 1:20 and trench

and feature plans at 1:20 or 1:50 as appropriate. Normal Field Team conventions, compatible with the County HER, will be used during the site recording.

- 3.1.12 The site will be recorded under HER site code OUL 036, acquired from the Suffolk HER Office and archaeological contexts will be recorded using standard SCCAS Context Recording sheets and associated database.
- 3.1.13 A digital photographic record will be made throughout the evaluation.
- 3.1.14 All pre-modern finds will be kept and no discard policy will be considered until all the finds have been processed and assessed.
- 3.1.15 All finds will be brought back to the SCCAS Bury St Edmunds office for processing, preliminary conservation and packing. Much of the archive and assessment preparation work will be done in house, but in some circumstances it may be necessary to send some categories of finds to specialists working in other parts of the country.
- 3.1.16 Bulk environmental soil samples (40 litres each) will be taken from suitable archaeological features and retained until an appropriate specialist has assessed their potential for palaeo-environmental remains. Decisions will be made on the need for further analysis following this assessment. If necessary advice will be sought from English Heritage's Regional Advisor in Archaeological Science on the need for specialist environmental sampling (see below).
- 3.1.17 The site has the potential for preserved palaeo-environmental and waterlogged remains, particularly in the area of the proposed lake. As such it may be necessary to take, and subsequently assess and date column samples in agreement with SCCAS/CT. Such samples would be assessed by an appropriate specialist (such as Dr Steve Boreham, University of Cambridge), to potentially date the material as well to evaluate the survival rate of pollen, spores, diatoms and foraminifera.
- 3.1.18 In the event of human remains being encountered on the site, guidelines from the Ministry of Justice will be followed. The evaluation will attempt to establish the extent, depth and date of burials whilst leaving remains *in situ*. During the evaluation any exposed human remains will be securely covered and hidden from the public view at all times when they are not attended by staff. At the conclusion of the work backfilling will be carried out in a manner sensitive to the preservation of such remains.
- 3.1.19 If circumstances dictate that the lifting of human remains is unavoidable then a Ministry of Justice Licence for their removal will be obtained prior to their removal from site.

3.2 Reporting, archive and OASIS record

- 3.2.1 A unique HER number has been acquired from the Suffolk HER – OUL 036. This will be clearly marked on all documentation relating to the project.
- 3.2.2 All artefactual material recovered will be held by the SCC Contracting Team until their analysis of the material is complete. Ownership of all such archaeological finds will then be given over to the relevant authority. There is a presumption that this will be SCCAS/CT, who will hold the material in suitable storage to facilitate future study and ensure its proper preservation.
- 3.2.2 In the event that artefacts of significant monetary value are discovered separate ownership arrangements may be negotiated, provided they are not subject to Treasure Act legislation.
- 3.2.3 The project archive shall be compiled in accordance with the guidelines issued by the SCCAS/CT (2010). The client is aware of the costs of archiving and provision has been made to cover these costs in our agreement with them. The archive will be deposited with the County Archaeology Store unless another suitable repository is agreed with SCCAS/CT.
- 3.2.4 Specialist finds staff will be used, who are experienced in local and regional types and periods for their field.
- 3.2.5 All site data will be entered on a computerised database compatible with the County HER. All site plans and sections will be copied to form a permanent archive on archivally stable material. Ordnance Datum levels will be on the section sheets. The photographic archive will be fully catalogued within the County HER photographic index.
- 3.2.6 All finds will be processed, marked and bagged/boxed to County HER requirements. Where appropriate finds will be marked with a site code and a context number.
- 3.2.7 Bulk finds will be fully quantified on a computerised database compatible with the County HER. Quantification will fully cover weights and numbers of finds by context with a clear statement for specialists on the degree of apparent residuality observed.
- 3.2.8 Metal finds on site will be stored in accordance with ICON guidelines, initially recorded assessed for significance before dispatch to a conservation laboratory within 4 weeks of the end of the excavation. All pre-modern silver, copper alloy and ferrous metal artefacts will be x-rayed and coins will be x-rayed if necessary for identification. Sensitive finds will be conserved if necessary and deposited in bags/boxes suitable for long term storage to ICON standards. All coins will be identified to a standard acceptable to normal numismatic research.
- 3.2.9 The site archive will meet the standards of SCCAS/CT.
- 3.2.10 The pottery will be recorded and archived to a standard consistent with the Draft Guidelines of the Medieval Pottery Research Group and Guidelines for the archiving of Roman Pottery, SGRP (ed. M.G. Darling, 1994) and to The Study of

Later Prehistoric Pottery: General Policies and Guidelines for analysis and Publications, Occasional Papers No.1 and No. 2, 3rd Edition (Revised 2010, Prehistoric Ceramic Research Group).

- 3.2.11 Environmental samples will be processed and assessed to standards set by the Regional Environmental Archaeologist with a clear statement of potential for further analysis and significance.
- 3.2.12 Animal and human bone will be quantified and assessed to a standard acceptable to national and regional English Heritage specialists.
- 3.2.13 An industrial waste assessment will cover all relevant material (i.e. fired clay finds as well as slag).
- 3.2.14 A report on the results of the evaluation will be completed c. 6 weeks after the completion of the fieldwork. A draft of the report will be submitted to SCCAS/CT for approval.
- 3.2.15 On receipt of approval of the report from SCCAS/CT hard and digital copies will be sent to the Suffolk HER.
- 3.2.16 The Suffolk HER is registered with the Online Access to Index of Archaeological Investigations (OASIS) project. The SCCAS Contracting Team will provide appropriate details relating to this project by completing the OASIS form at <http://ads.ahds.ac.uk/project/oasis>. The completed form (reference suffolkc1-170086) will be included as an appendix to the final report.

4 Risk assessment

4.1 General

4.1.1 The project will be carried out in accordance with the Suffolk County Council statement on Health and Safety at all times. Particular hazards to SCCAS staff and subcontractors identified with this project are as follows:

Outdoor working – hazards to staff from weather conditions and uneven ground.

Manual excavation – the main hazards are to staff from the use of tools, shallow holes and the resultant trip hazards, live services and ground contamination.

Mechanised excavation, site stripping etc. – the most significant hazard from this activity is working in close proximity with plant machinery.

4.1.2 Specific risk assessments for each are provided in Appendix 2.

4.1.3 All SCCAS staff are experienced in working under similar conditions and on similar sites to the present site and are aware of all SCCAS H&S policies. All staff will be issued with a copy of the project's risk assessment and will receive a safety induction from the Project Officer. All permanent SCCAS excavation staff are holders of CSCS cards.

4.1.4 It may be necessary for site visits by external specialists, SCCAS Conservation Team members and other SCC staff. All such staff and visitors will be issued with the appropriate PPE and will undergo the required inductions. PPE is not restricted to the list below – additional items will be provided if circumstances require it.

4.1.5 PPE required in this case includes:

- Hard Hat (to EN397)
- High Visibility Clothing (EN471 Class 2 or greater)
- Safety Footwear (EN345/EN ISO 20346 or greater – to include additional penetration-resistant midsole)

4.1.6 Other PPE that may be deployed as necessary includes:

- Gloves (to EN388)
- Eye Protection (safety glasses to at least EN 166 1F)

4.1.7 Site staff, official visitors and volunteers are all covered by Suffolk County Council insurance policies (available upon request).

4.1.8 A van will be available with fresh water and a first aid kit, as will toilet facilities.

4.2 Environmental controls

- 4.2.1 Suffolk County Council is firmly dedicated to following an EMS policy. All our preferred providers and subcontractors have been issued with environmental guidelines.
- 4.2.2 On site the SCCAS Project Officer will police environmental concerns. In the event of spillage or contamination EMS reporting and procedures will be carried out in consultation with Jez Meredith (SCCAS EMS Officer). All rubbish will be bagged and removed either to areas designated by the client or returned to SCC property for disposal.

4.3 Plant and equipment details

- 4.3.1 A 360° tracked mechanical excavator equipped with a full suite of buckets will be required for the trial trenching. The sub-contracted plant machinery will be accompanied by a fully qualified operator who will hold an up-to-date Construction Plant Competence Scheme (CPCS) card (approved by the Construction Industry Training Board).
- 4.3.2 The plant machinery will be well serviced and be as quiet a model as is practicable. It will come equipped with appropriate spill kit and drip trays. It will only refuel in a single designated area, as defined by the SCCAS. If required all refuelling, will be carried out using electrically operated pumps and will only be done when drip trays are deployed.
- 4.3.3 Other plant details and appropriate certification can be supplied by the machine provider.

4.4 Hazardous substances

- 4.4.1 No hazardous substances are specifically required in order to undertake the archaeological works.

4.5 Services

- 4.5.1 A full services survey had not been provided at the time of writing this document. Appropriate measures will be taken to avoid previously unidentified services.

4.6 Lighting

- 4.6.1 No trenches are to be excavated indoors and no special requirements are necessary.

4.7 Access/Egress

- 4.7.1 All movements to and from site will respect any existing perimeter fencing/hoarding with all points of entry returned to their locked condition (if applicable), with the site kept secure via any existing means at all times.

Appendix 2. Risk Assessments



Specific Risk Assessments for Archaeological Evaluation: OUL 036, Pegasus Boatyard, Oulton, Suffolk

- 1 Working with plant machinery
- 2 Physical work in an outdoor setting
- 3 Deep excavations
- 4 Use of hand tools
- 5 Damage to services

1-5 = Low risk

6-12 = Medium risk

20-25 = High risk

Risk Assessment 1 Working with plant machinery

Activity	Location	Hazard	Risks	Persons affected	Initial risk	Control measures	Residual risk	Name	Date	Rescue procedures
Direction and supervision of tracked 360 ^o excavator.	Various.	Staff in close proximity to excavation (operation of bucket & manoeuvre of boom).	Accidental contact with boom or bucket or unexpected movement of machine.	Principally SPO/PO, but at times may involve others.	10	Only PO to supervise machinery. No personnel to be within radius of boom. All staff to wear high visibility clothing, hard hats and safety footwear at all times.	5	R Brooks	01/07/2014	Call emergency services. First Aid if required.

Severity	Likelihood				
	1	2	3	4	5
1	1	2	3	4	5
2	2	4	6	8	10
3	3	6	9	12	15
4	4	8	12	16	20
5	5	10	15	20	25

Initial Risk
Residual Risk

Likelihood	Severity	Risk (likelihood x severity)
1. Highly unlikely	1. Slight inconvenience	1-5 Low
2. May occur but very rarely	2. Minor injury requiring first aid	
3. Does occur but only rarely	3. Medical attention required	6-12 Medium
4. Occurs from time to time	4. Major injury leading to hospitalisation	
5. Likely to occur often	5. Fatality or serious injury leading to disablement	13-25 High

Risk Assessment 2 Physical work in an outdoor setting

Activity	Location	Hazard	Risks	Persons affected	Initial risk	Control measures	Residual risk	Name	Date	Rescue procedures
Hand excavations of archaeological features.	Various.	Extremes of heat, cold and wet weather. Trip hazards.	Hypothermia, heat stroke, sunburn. Minor injuries.	All field staff.	9	All staff provided with appropriate clothing for weather conditions. No staff to work alone in extreme conditions. Regular sweep for trip hazards.	2	R Brooks	01/07/2014	First Aid if required. Call emergency services if necessary.

	Likelihood				
Severity	1	2	3	4	5
1	1	2	3	4	5
2	2	4	6	8	10
3	3	6	9	12	15
4	4	8	12	16	20
5	5	10	15	20	25

Initial Risk
Residual Risk

Likelihood	Severity	Risk (likelihood x severity)
1. Highly unlikely	1. Slight inconvenience	1-5 Low
2. May occur but very rarely	2. Minor injury requiring first aid	
3. Does occur but only rarely	3. Medical attention required	6-12 Medium
4. Occurs from time to time	4. Major injury leading to hospitalisation	
5. Likely to occur often	5. Fatality or serious injury leading to disablement	13-25 High

Risk Assessment 3 Deep excavations

Activity	Location	Hazard	Risks	Persons affected	Initial risk	Control measures	Residual risk	Name	Date	Rescue procedures
Excavation of trial trenches and archaeological features within.	Various.	Trench collapse, falls, and work in confined spaces.	Physical injury (minor to rare major examples), suffocation.	All field staff.	12	No excavation beyond safe depth in any circumstances (not necessary for evaluation stage of works). No excavation of trenches beyond depth of 1.2m (or shallower where there is risk of collapse in the judgement of the PO if deposits are unconsolidated).	2	R Brooks	01/07/2014	Call emergency services. First Aid if required.

	Likelihood				
Severity	1	2	3	4	5
1	1	2	3	4	5
2	2	4	6	8	10
3	3	6	9	12	15
4	4	8	12	16	20
5	5	10	15	20	25

Initial Risk
Residual Risk

Likelihood	Severity	Risk (likelihood x severity)
1. Highly unlikely	1. Slight inconvenience	1-5 Low
2. May occur but very rarely	2. Minor injury requiring first aid	
3. Does occur but only rarely	3. Medical attention required	6-12 Medium
4. Occurs from time to time	4. Major injury leading to hospitalisation	
5. Likely to occur often	5. Fatality or serious injury leading to disablement	13-25 High

Risk Assessment 4 Use of hand tools

Activity	Location	Hazard	Risks	Persons affected	Initial risk	Control measures	Residual risk	Name	Date	Rescue procedures
Excavation of archaeological features using shovels, mattocks, forks, wheelbarrows and small tools	Various.	Splinters from poorly maintained equipment, trip hazards from unused equipment, accidental striking of personnel in close proximity, some heavy lifting.	Minor injuries.	All field staff.	8	<p>Ensure all tools in serviceable condition.</p> <p>Careful policing of temporarily unused equipment (e.g. no discarded hand tools near trench edges).</p> <p>Ensure all tools carried appropriately.</p>	4	R Brooks	01/07/2014	First Aid if required.

	Likelihood				
Severity	1	2	3	4	5
1	1	2	3	4	5
2	2	4	6	8	10
3	3	6	9	12	15
4	4	8	12	16	20
5	5	10	15	20	25

Initial Risk
Residual Risk

Likelihood	Severity	Risk (likelihood x severity)
1. Highly unlikely	1. Slight inconvenience	1-5 Low
2. May occur but very rarely	2. Minor injury requiring first aid	
3. Does occur but only rarely	3. Medical attention required	6-12 Medium
4. Occurs from time to time	4. Major injury leading to hospitalisation	
5. Likely to occur often	5. Fatality or serious injury leading to disablement	13-25 High

Risk Assessment 5 Damage to services

Activity	Location	Hazard	Risks	Persons affected	Initial risk	Control measures	Residual risk	Name	Date	Rescue procedures
Machine cutting of trial trenches.	Various.	Accidental damage to cables or services (water, electrical etc.).	Electrocution, environmental damage/pollution, cost implications.	Machine operator and PO.	6	Client to provide survey of any known services. Carefully observed machine excavation under full supervision. Use of CAT scanner.	2	R Brooks	01/07/2014	Call emergency services. First Aid if required. Any pollution to be reported to Environmental Manager immediately.

Severity	Likelihood				
	1	2	3	4	5
1	1	2	3	4	5
2	2	4	6	8	10
3	3	6	9	12	15
4	4	8	12	16	20
5	5	10	15	20	25

Initial Risk
Residual Risk

Likelihood	Severity	Risk (likelihood x severity)
1. Highly unlikely	1. Slight inconvenience	1-5 Low
2. May occur but very rarely	2. Minor injury requiring first aid	
3. Does occur but only rarely	3. Medical attention required	6-12 Medium
4. Occurs from time to time	4. Major injury leading to hospitalisation	
5. Likely to occur often	5. Fatality or serious injury leading to disablement	13-25 High

Appendix 3. SCC Liability Insurance Certification



To Whom It May Concern

Our ref: Our Ref: QLA-19A004-0013 17 July, 2012

Zurich Municipal Customer: Suffolk County Council

This is to confirm that Suffolk County Council have in force with this Company until the policy expiry on 31/07/2013 Insurance incorporating the following essential features:

Policy Number: QLA-19A004-0013

Limit of Indemnity:
Public Liability: £ 50,000,000 any one event
Products Liability: £ 50,000,000 for all claims in the
Pollution:) aggregate during any one period of insurance
Employers' Liability: £ 50,000,000 any one event inclusive of costs

Zurich Municipal
Zurich House
2 Gladiator Way
Farnborough
Hampshire
GU14 6GB

Telephone 0870 2418050
Direct Phone 01252 384594
Direct Fax 01252 0
E-mail
sally.rose@uk.zurich.com@zurich.com

Communications will be monitored regularly to improve our service and for security and regulatory purposes

Zurich Municipal is a trading name of Zurich Insurance plc

A public limited company incorporated in Ireland. Registration No. 13460
Registered Office: Zurich House, Ballsbridge Park, Dublin 4, Ireland.

UK branch registered in England and Wales
Registration No. BR7985.
UK Branch Head Office: The Zurich Centre, 3000 Parkway, Whiteley, Fareham, Hampshire PO15 7JZ

Authorised by the Irish Financial Regulator and subject to limited regulation by the Financial Services Authority. Details about the extent of our regulation by the Financial Services Authority are available from us on request.

Excess :

Public Liability/Products Liability/Pollution: £ £311,000 any one event
Employers' Liability: £ £311,000 any one claim

Indemnity to Principals :

Covers include a standard Indemnity to Principals Clause in respect of contractual obligations.

Full Policy :

The policy documents should be referred to for details of full cover.

Yours faithfully

A handwritten signature in blue ink, appearing to read 'Sally Rose'.

Sally Rose
Underwriting Services
Zurich Municipal
Farnborough



To Whom It May Concern

Our ref: SS/PS/B'HAM

14 August, 2012

Zurich Municipal Customer: Suffolk County Council

This is to confirm that Suffolk County Council have in force with this Company until the policy expiry on 31st July 2013 Professional Negligence Insurance incorporating the following essential features:

Policy Number: QLA-19A004-0013

Services covered: Service C - Archeology

Limit of Indemnity: £ 5,000,000 any one claim and *in the aggregate for all claims* first made against the Insured and notified to Zurich Municipal during the period of insurance

Excess : £ 311,507 any one claim

Retroactive Date: 01/08/2006

Exclusions

Standard insurance market exclusions apply, notably exclusion of Pollution other than sudden and accidental; punitive or exemplary damages; express warranties or guarantees; claims the cause of which occurred prior to the Retroactive Date.

This is a brief summary and the full policy should always be referred to for exact details of cover.

Yours faithfully

Sally Rose
Underwriting Services
Zurich Municipal

Zurich Municipal
Zurich House
2 Gladiator Way
Farnborough
Hampshire
GU14 6GB

Telephone 0870 2418050
Direct Phone 0121 6978594
Direct Fax 0121 978585
E-mail sally.rose@zurich.com

Communications will be monitored regularly to improve our service and for security and regulatory purposes

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UK Branch Head Office: The Zurich Centre,
3000 Parkway, Whiteley, Fareham,
Hampshire PO15 7JZ

Authorised by the Irish Financial Regulator and subject to limited regulation by the Financial Services Authority. Details about the extent of our regulation by the Financial Services Authority are available from us on request.

Appendix 2. OASIS data collection form

OASIS ID: [suffolkc1-170086](#)

Project details

Project name	OUL 036 Pegasus Boatyard Evaluation, Oulton
Short description of the project	trial trenching did not reveal any significant archaeological features or deposits within this waterside site. The low lying waterside areas did reveal water logged silt and peat deposits. Palaeoenvironmental assessment suggests the peat is a freshwater sequence of Late Neolithic date, becoming brackish in the later prehistoric period but with some freshwater areas surviving until the Anglo-Saxon period
Project dates	Start: 10-07-2014 End: 05-01-2015
Previous/future work	No / Not known
Any associated project reference codes	BA/2012/0271/FUL - Planning Application No.
Any associated project reference codes	OUL 036 - HER event no.
Any associated project reference codes	OUL 036 - Sitecode
Type of project	Field evaluation
Current Land use	Vacant Land 1 - Vacant land previously developed
Monument type	NONE None
Significant Finds	NONE None
Methods & techniques	""Sample Trenches""
Development type	Housing estate
Position in the planning process	After outline determination (eg. As a reserved matter)

Project location

Country England

Site location	SUFFOLK WAVENEY OULTON OUL 036 Pegasus Boatyard Evaluation
Postcode	IP9 1JB
Study area	15000.00 Square metres
Site coordinates	TM 519 930 52.4760827625 1.70982885463 52 28 33 N 001 42 35 E Point

Project creators

Name of Organisation	Suffolk County Council Archaeological Service/Suffolk Archaeology Community Interest Company
Project brief originator	Local Authority Archaeologist and/or Planning Authority/advisory body
Project design originator	Dr Jess Tipper
Project director/manager	Rhodri Gardner
Project supervisor	M. Sommers
Type of sponsor/funding body	Developer

Project archives

Physical Archive Exists?	No
Digital Archive recipient	Suffolk County SMR
Digital Archive ID	OUL036
Digital Contents	"other"
Digital Media available	"Images raster / digital photography","Text"
Paper Archive recipient	Suffolk County SMR
Paper Archive ID	OUL036
Paper Contents	"other"
Paper Media available	"Notebook - Excavation',' Research',' General Notes","Report","Correspondence"

Project
bibliography

Publication type	Grey literature (unpublished document/manuscript)
Title	Archaeological Evaluation Report: Pegasus Boatyard Oulton, Suffolk OUL 036
Author(s)/Editor(s)	Sommers, M.
Other bibliographic details	SCCAS Report No. 2014/088
Date	2015
Issuer or publisher	SCCAS
Place of issue or publication	Ipswich
Description	Printed sheets of A4 paper with card covers and a plastic comb binding

Entered by	MS (mark.sommers@suffolk.gov.uk)
Entered on	5 January 2015

Appendix 3. Palaeoenvironmental survey and assessment

**A BOREHOLE SURVEY AND PALAEOENVIRONMENTAL
ASSESSMENT AT PEGASUS BOATYARD, OULTON
BROAD, SUFFOLK.**

**NGR: 651953 293000
(TM 5195 9300)**

**ASE Project No: 6560
Site Code: OUL036**

ASE Report No: 6560

**Kristina Krawiec
With contributions by
QUEST and John Whittaker**

September 2014

**Archaeology South-East
Units 1 & 2
2 Chapel Place
Portslade
East Sussex
BN41 1DR**

**Tel: 01273 426830
Fax: 01273 420866
Email: fau@ucl.ac.uk**

Abstract

In July 2014 Archaeology South-East were commissioned to undertake a borehole survey and palaeoenvironmental assessment at the site of Pegasus Boatyard Oulton Broad, Suffolk by Suffolk County Council Archaeology Service. The survey comprised 6 boreholes with 2 cores recovered for assessment. The boreholes were located in relation to evaluation trenches that were being excavated at the same time. The site is located along the southern edge of Oulton Lake which is thought to have been formed by medieval peat cutting. The survey demonstrated small areas of the site still retained a thin deposit of peat as well as possible channel. This channel was visible within the south facing section of evaluation Trench 2. The channel was infilled by a combination of organic and coarser grained sandy shelly material.

The channel and thin blanket peat deposit were selected for assessment and radiocarbon dating. The borehole survey at Pegasus Boatyard has demonstrated that although preservation of deposits is variable across the site, the palaeoenvironmental potential of the site is high. The micro and macrofossil assemblages have demonstrated an initial freshwater peat sequence dating from the Late Neolithic which was incised by a small channel. This was minerogenic a clean, slow moving waterbody which became gradually infilled with organic and minerogenic sediment. At some point in the later prehistoric period the environment changed to one of brackish mudflats with freshwater introduced from the dryland via creeks. In some areas of the site freshwater peat persisted into the Anglo-Saxon period but this sequence has been truncated by later medieval peat cutting. The preservation within the deposit is good and full analysis is recommended.

CONTENTS

- 1.0 Introduction
- 2.0 Archaeological Background
- 3.0 Archaeological Methodology
- 4.0 Results
- 5.0 Discussion and Conclusions

Bibliography
Acknowledgements

HER Summary Sheet
OASIS Form

Appendix I: Borehole logs
Appendix II: Troels-Smith classification table

FIGURES

Figure 1: Borehole locations

TABLES

Table 1: Quantification of site archive
Table 2: Results of the pollen assessment
Table 3 Ostracod and forams assessment BH 6
Table 4: Results of the waterlogged plant macrofossil (seeds) assessment
Table 5: Results of the Mollusca assessment
Table 6: Radiocarbon dating results

1.0 INTRODUCTION

1.1 Site Background

1.1.1 Archaeology South-East (ASE), the contracting division of the Centre for Applied Archaeology (CAA), Institute of Archaeology (IoA), University College London (UCL) was commissioned by Suffolk County Council Archaeological Service (SCAAS) to undertake a borehole survey and palaeoenvironmental assessment at Pegasus boatyard, Oulton Broad, Suffolk (NGR 651953 293000). The boreholes were carried out concurrently with an archaeological evaluation and some of the observations from the trenches are included in this report.

1.2 Geology and Topography

1.2.1 The site is bounded to the south by Oulton Broad and Caldicott Road to the north. The site was once occupied by warehouse buildings which were partially demolished at the time of the survey with the concrete foundation slabs still in place.

1.2.2 The underlying solid geology is sand and gravel of the Crag formation which in places is overlain by tidal river or creek deposits comprising silt and clay. In areas peat is also recorded as well as sands and gravels of unknown age and provenance.

1.3 Planning Background

1.3.1 The survey was carried out on behalf of SCAAS as prior to the redevelopment of the site.

1.4 Scope of Report

1.4.1 This report presents the results of the borehole survey as well as the assessment of palaeoenvironmental proxies.

2.0 ARCHAEOLOGICAL BACKGROUND

2.1 Introduction

2.1.1 The full archaeological background can be found within the main evaluation report produced by SCAAS. The site is located on Oulton Broad which is a freshwater broad separated from Lake Lothing and the open sea by Mutford Lock. The site was mainly agricultural land prior to the 20th century when the area was opened to development as a boatyard and mooring. The Broad itself was the site of a medieval peat cutting.

2.2 Project Research Aims and Objectives

2.2.1 The project aimed to establish the potential for the survival and significance of geoarchaeological and palaeoenvironmental evidence (SCAAS 2014).

2.2.2 The main objectives were:

- The characterisation of the sequence across the development area
- Identify variations in the sequence in relation to potential features such as palaeochannels
- Retrieve suitable samples to assess the potential for the preservation of environmental remains and material for scientific dating

3.0 ARCHAEOLOGICAL METHODOLOGY

3.1 Fieldwork Methodology

3.1.1 The boreholes were carried out under supervision using a windowless sampling terrier rig. The locations of the boreholes were decided on site in relation to open evaluation trenches being carried out at the same time. The lithology of the cores was recorded on site using the Troels-Smith classification system (1955). The scheme breaks down a sediment sample into four main components and allows the inclusion of extra components that are also present, but that are not dominant. Key physical properties of the sediment layers are also identified according to darkness (Da), stratification (St), elasticity (El), dryness of the sediment (Dr) and the sharpness of the upper sediment boundary (UB). The core logs are located in Appendix I and were supplemented by digital photography.

3.2 Pollen by QUEST

3.2.1 Eight sub-samples were extracted as follows: (1) sampling a standard volume of sediment (4gms); (2) adding two tablets of the exotic clubmoss *Lycopodium clavatum* to provide a measure of pollen concentration in each sample; (3) deflocculation of the sample in 1% Sodium pyrophosphate; (4) sieving of the sample to remove coarse mineral and organic fractions ($>125\mu$); (5) acetolysis; (6) removal of finer minerogenic fraction using Sodium polytungstate (specific gravity of 2.0g/cm^3); (7) mounting of the sample in glycerol jelly. Each stage of the procedure was preceded and followed by thorough sample cleaning in filtered distilled water. Quality control is maintained by periodic checking of residues, and assembling sample batches from various depths to test for systematic laboratory effects. The assessment consisted of recording the concentration, preservation and main taxa of pollen and spores recorded on 10% of the slide. Pollen grains and spores were identified using the University of Reading pollen type collection and the following sources of keys and photographs: Moore *et al* (1991); Reille (1992). The concentration of microscopic charred particles is also recorded. The results are displayed in Table 2.

3.3 Ostracods and Forams by John Whittaker

3.3.1 A total of three samples were submitted for assessment from Borehole 2 (interval 0.84-1.09mbgl, 0.17 to -0.08mOD), the fourth from BH 6 (from 2.20mbgl, -0.59mOD).

3.3.2 The sediment samples, in each case, were broken up by hand or with a knife into small pieces and placed in ceramic bowls. They were then dried thoroughly in an oven. A little sodium carbonate was added (to help remove the clay fraction) and boiling water was poured over the sample. After a long soaking each sample was then washed through a 75 micron sieve with hand-hot water and the resulting residue decanted back into the bowl for drying in the oven. In all cases a single washing produced a satisfactory breakdown. After final drying the samples were placed in labelled plastic bags. Picking was undertaken by first dry-sieving each sample into >500 , >250 , >150 and >75 micron fractions, then sprinkling a little of each fraction at a time onto a picking tray. A representative fauna of foraminifera and ostracods, where present, was then picked out into a 3"x1" faunal slide and a semi-quantitative estimate of each species made by experience and by eye (on a several specimens/common/abundant basis). Notes were also made of other important organic remains in each of the sample. The data for BH 2 and 6 were then logged on two sheets (Table 3) of an EXCEL file.

3.4 Plant Macrofossils by QUEST

3.4.1 Two samples (BH2, 1.36-1.52mbgl, -0.35 to -0.51mOD and 1.52-1.66mbgl -0.51-0.65mOD) were extracted for the recovery of macrofossil remains from BH 2 including waterlogged plant macrofossils, waterlogged wood, Mollusca and insects. The extraction process involved the following procedures: (1) measuring the sample volume by water displacement, and (2) processing the sample by wet sieving using 300µm and 1mm mesh sizes. Each sample was scanned under a stereozoom microscope at x7-45 magnifications, and the main types of macrofossil remain recorded (Table 4). A sub-sample of the extracted waterlogged seeds were identified from each sample. Identifications of the palaeobotanical remains (waterlogged plant macrofossils), have been made using modern comparative material and reference atlases (e.g. Cappers *et al.* 2006). Nomenclature used follows Stace (2005) (Table 4).

3.5 Molluscs by QUEST

3.5.1 A semi-quantitative assessment of the molluscs from each sample (as detailed above) was carried out and the main taxa identified with reference to guidebooks and the modern reference collection at the University of Reading. The results are displayed in (Table 5).

3.6 Radiocarbon Dating

3.6.1 A total of two samples were submitted for radiocarbon dating to BETA Analytic Inc, Florida. A bulk sample of sediment was submitted from BH2 1.96-2.00m bgl (-0.95 to -0.97mOD) and BH6 1.57-1.60m bgl (0.04-0.01mOD). After processing by the lab the plant material from BH2 was dated and the organic sediment from BH6 was dated.

3.7 Archive

3.7.1 The site archive is currently held at the offices of ASE. The contents of the archive are tabulated below (Table 1).

Number of Contexts	0
No. of files/paper record	Core logs
Plan and sections sheets	survey
Bulk Samples	3
Photographs	20 digital photographs
Bulk finds	0
Registered finds	0
Environmental flots/residue	

Table 1: Quantification of site archive

4.0 RESULTS

4.1 Lithology

- 4.1.1 A total of 6 boreholes were undertaken at the site which were located in relation to evaluation trenches that were being carried out at the same time. The boreholes were placed to target the best possible deposits in order to recover samples for assessment. The full borehole logs can be found in Appendix I.
- 4.1.2 The underlying Crag sand deposits were encountered directly underlying the made ground in boreholes 3-5. This area of the site was higher than the eastern side and corresponds to the mapped deposits in the BGS records.
- 4.1.3 The presence of a channel was recorded in evaluation Trench 2 and therefore a borehole, BH2, was placed to target these sediments. The underlying Crag sands were rooted though with woody remains, probably the base of reeds, and were overlain by a coarser grey sand and gravel. This was overlain by a silty peat deposit with frequent reed remains which returned an age determination dating the sediment to the late Neolithic (Beta-388599; 4030 +/- 30BP, 2620 to 2475 Cal BC). This in turn was overlain by a yellow brown reedy silt sand with frequent mollusc fragments and was weakly laminated. This was overlain by a sharp transition to a grey white laminated sand and coarse gravel which also had reed and molluscan remains throughout. This sand was then overlain by a reedy mat before a sharp transition to silt clay alluvial deposition.
- 4.1.4 A second borehole, BH6, was located to the east of Trench 2 and encountered a peat layer overlying the Crag deposits. This deposit returned an age determination dating the onset of sediment accumulation to the Anglo-Saxon period (Beta-388600; 1100 +/-30BP, 885 to 1015 Cal AD). This is likely a floodplain edge peat deposit that has survived the truncation seen across the rest of the site. Both BH2 and 6 were retained for palaeoenvironmental assessment and dating, the results of which are given below.

4.2 Pollen by QUEST

- 4.2.1 The results of the assessment indicate a low to very high concentration of pollen in a moderate to good state of preservation in the samples from BH2 and BH6 (Table 2).
- 4.2.2 *BH2*
The results of the assessment of basal sample 1.82mbgl (-0.81mOD) indicate that during the accumulation of the late Neolithic peat (Beta-388599; 4030 +/- 30BP, 2620 to 2475 Cal BC) in BH2, the floodplain and dryland environments were dominated by woodland taxa. *Alnus* (alder) dominated with *Salix* (willow), most likely forming carr woodland on the floodplain, whilst *Quercus* (oak), *Tilia* (lime) and *Betula* (birch) dominated the dryland with an understorey of *Corylus* (hazel). Grasses (Poaceae), dandelions (Lactuceae) and plantain (*Plantago* type) herbaceous taxa are also indicated, perhaps suggesting the presence of woodland glades. No definitive evidence of human activity or saline conditions was recorded.
- 4.2.3 Within the overlying four samples (1.66-1.06mbgl,-0.65 to -0.05mOD), a mixed assemblage of woodland and herbaceous taxa is recorded. Dryland woodland remains present, but its spatial extent is diminished as indicated by a reduction in *Tilia* values. This is potentially representative of the Late Neolithic/Bronze Age lime

decline. A greater concentration and diversity of herbaceous taxa including grasses, dandelions, sedges, daisies (Asteraceae) and possibly nettle (cf *Urtica* type) is suggestive of a more open conditions, most likely consequent of woodland clearance. Alder continues to occupy at least part of the floodplain environment. The presence of a single cereal grain at 1.22mbgl (-0.21mOD) is suggestive of nearby cultivation.

4.2.4 BH6

The results of the assessment of basal sample 1.57mbgl (0.04mOD), indicate a similar assemblage of pollen to that recorded at 1.82mbgl (-0.81mOD) in BH2. The dominance of alder carr woodland is indicated on the floodplain with a ground flora of sedges (Cyperaceae), and grasses (possibly reeds – *Phragmites australis*), whilst the dryland is dominated by oak, lime, birch and hazel. No definitive evidence of human activity or saline conditions was recorded.

- 4.2.5 Within the overlying two samples (1.45 & 1.33mbgl, 0.16mOD & 0.28m OD), which date from the Anglo-Saxon period onwards (Beta-388600; 1100 +/-30BP, 885 to 1015 Cal AD), a mixed assemblage of woodland and herbaceous taxa us recorded. Woodland remains present on both the dryland, but its spatial extent is diminished. A greater concentration and diversity of herbaceous taxa including grasses, dandelions, sedges, daisies (Asteraceae) and plantain is suggestive of a more open conditions as would be expected. Alder continues to occupy at least part of the floodplain environment.

4.3 Ostracods and Forams by John Whittaker

BH 2

- 4.3.1 The results from the 3 samples in BH2, covering a 25cm interval, are shown in Table 3. All the samples contained a diverse content of “organic remains”, and in particular foraminifera and ostracods. These latter are divided into several components: marine/outer estuarine foraminifera and ostracods; brackish forminifera and ostracods; and freshwater ostracods. All are variously colour-coded and their preferred ecology is also summarised in Table 3. This information is taken from Murray, 2006 (foraminifera), Athersuch, Horne & Whittaker, 1989 (brackish and marine ostracods) and Meisch, 2000 (freshwater ostracods).
- 4.3.2 The site of BH2, therefore, seems to have been a brackish creek with mudflats, surrounded by saltmarsh (and probably protected by reed stands. There are also freshwater and marine components in the assemblages, which decrease and increase, respectively, up-sequence with time. This would suggest that the freshwater component, through a stream which fed into the creek, was more marked initially, but with increased salinity (through changes in the hydrography in the area and/or dredging) this became more restricted as the outer-estuarine component increased. Some indication of the initial salinity can be gauged from the nodding of the valves of the abundant *Cyprideis torosa* in 1.05-1.09mbgl, -0.04m to -0.08mOD, nodding in this brackish ostracod being usually indicative of salinities of <6‰.

BH 6

- 4.3.2 The sediment from 2.20mbgl (-0.59mOD) is a silt sand, with some plant remains. Unfortunately, it contains nothing of a calcareous nature. It would seem to represent alluvium, perhaps in a different depositional environment.

4.4 Plant remains and molluscs by QUEST

- 4.4.1 Two small bulk samples were extracted from BH2 for the recovery of macrofossil remains including waterlogged plant macrofossils, waterlogged wood, insects and Mollusca (Table 4). The results of a rapid assessment indicate an absence of charcoal and charred plant macrofossils; bone fragments were also not recorded. Waterlogged seeds and Mollusca were present in high concentrations and waterlogged wood was present in low to moderate concentrations. Insects were present in low quantities sample 1.52-1.66mbgl (-0.51m to -0.65mOD).
- 4.4.2 The results of the macrofossil rapid assessment indicated that waterlogged seeds were present in both samples; these samples thus underwent a more detailed assessment (Table 4). The combined seed assemblage comprised *Sambucus nigra/racemosa* (elder), *Rubus* (bramble), *Rumex/Polygonum* sp. (dock/sorrel/knotweed), *Scirpus* sp./*Eleocharis* sp. (rushes), *Ranunculus repens* (creeping buttercup), Poaceae (grasses) and *Potamogeton* sp. (pondweed). This assemblage is largely indicative of an open, semi-aquatic environment.

4.5 Mollusca by QUEST

- 4.5.1 Two samples were assessed for molluscs from BH2. The samples contain purely freshwater molluscs, with no terrestrial species being found. There were relatively few molluscs in Sample 1 (1.36-1.52mbgl, -0.35 to -0.51mOD) compared with Sample 2 (1.52-1.66mbgl, -0.51m to -0.65mOD), which contained large numbers of shells. The majority of species in both samples prefer clean moving water as their favored environment; the water needs to be well-oxygenated with good vegetation but more generally the water was slow-moving.
- 4.5.2 The assemblages are entirely consistent with the location of the boatyard in Oulton Broad, situated between the River Waveney, about 3km inland from the river's outlet to the sea. In this flat landscape it is probable that water flow has always been slow and the molluscs indicate that at the time of deposition the water was clean and well-vegetated. There is no indication of the timing of deposition; all the species are native to Britain, with no recent introductions.

4.6 Radiocarbon Dating

- 4.6.1 The radiocarbon dating results are given below. The floodplain peat recovered in BH6 (-1.58m OD) has dated the inception of peat formation to the Anglo-Saxon period between the late 9th to early 11th century. The date range here is large as bulk organic sediment was used.
- 4.6.2 The plant material recovered from the lower organic unit in the channel in BH2 (-2.94m OD) has returned a much earlier date of the Late Neolithic. This may be due to differential preservation of deposits across the site with the in-channel deposits being more deeply buried and less likely to be eroded or removed by peat cutting. The other alternative is that the deposit represents a reworked clast of peat eroded out of older deposits when the channel was incised through the softer underlying sands.

Lab number	Sample number	Material	13c/12C ratio	2 Sigma Calibration	Conventional Radiocarbon Age
BETA-388599	AES_DS_00273_BH2	Plant material	-28.8 o/oo	2620 to 2475 Cal BC (4570-4425 Cal BP)	4030 +/- 30BP
BETA-388600	ASE_DS_00274_BH6	Organic sediment	-28.6 o/oo	885 to 1015 Cal AD (1065-935 Cal BP)	1100 +/-30BP

Table 6: Radiocarbon dating results

7.0 DISCUSSION

7.1 Survey results

7.1.1 The borehole survey has demonstrated a variable preservation of deposits across the site due in part to extensive exploitation of the peat resource in the medieval period. The two locations examined have demonstrated that floodplain freshwater peat still survives in pockets at the site and has provided sufficient material to allow some comment to be made about the nature of landscape change over time. The onset of peat accumulation in BH2 has been dated to the Late Neolithic and the pollen signal indicates a typical wetland carr environment at the site with oak-lime-hazel woodland on the dryland. A similar, although demonstrably later peat deposit (Anglo-Saxon) was also identified at the BH6 location suggesting that freshwater deposits still existed at the site as the saline influence increased.

7.2.3 The thin peat deposit in BH2 was incised by a small channel infilled with a mixture of organic and minerogenic sediment. The molluscan assemblage suggests a slow-moving freshwater environment with clean oxygenated water throughout the life of the channel. This was overlain by a more homogenous silt clay deposit which produced an ostracod/foram assemblage indicating a change in depositional environment to a brackish creek with surrounding saltmarsh. This suggests that the freshwater channel was incised sometime during the late Neolithic/Early Bronze Age, with the pollen indicating the lime decline typical for this period. The rising sea levels that characterise the late Neolithic would have led to a rise in base water levels leading to organic accumulation. It is likely that later sea level rise overtook organic accumulation leading to an increase in local salinity and a change from organic to minerogenic deposition.

7.2.3 This transition to a more saline environment, characterised by homogenous silts clays typical of mudflat environments, is at present undated. The presence of a cereal grain at this transition suggests a date from at least the later prehistoric period is most likely. The surrounding dryland, initially dominated by a mixed deciduous woodland, also demonstrates a degree of woodland clearance supports this hypothesis.

7.1.2 The results of the assessment demonstrate that the sequences from Pegasus Boatyard have a high potential to provide a detailed reconstruction of the vegetation history and elucidate evidence for human activity.

7.2 Deposit survival

7.2.1 The preservation of these deposits across the site is highly variable and for the most part the organic material has been heavily truncated. This is most likely due to medieval peat cutting as well as subsequent post-medieval and modern development of the site. The boreholes did not encounter archaeological remains and the peat deposit, although conducive to the preservation of wooden archaeological material, is unlikely to contain significant archaeological features.

7.3 Consideration of research aims

7.3.1 The aims of the project have been met in that the deposits present at the site have been recorded and shown to contain a good degree of preservation of palaeoenvironmental remains. The subsequent assessment has allowed the nature

of the depositional environment to be characterised and placed within a chronological framework. The pollen and macrofossil preservation is sufficient at the site should full analysis be required. There are also further samples available for radiocarbon dating.

7.4 Conclusions

- 7.4.1 The borehole survey and palaeoenvironmental assessment at Pegasus Boatyard have demonstrated that, despite variable preservation of deposits across the site, useful and meaningful environmental data have been gathered. The material is suitable for full analysis and given the lack of well dated sequences from the area, and the lack of suitable deposits due to extensive peat cutting, this is recommended.

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HER Summary Form

Site Code	OUL036					
Identification Name and Address	Pegasus Boatyard, Oulton Broad, Suffolk					
County, District &/or Borough	Suffolk					
OS Grid Refs.	651953 293000					
Geology	Peat; Alluvium;					
Arch. South-East Project Number	6560					
Type of Fieldwork	Eval.	Excav.	Watching Brief	Standing Structure	Survey	Other
Type of Site	Green Field	Shallow Urban	Deep Urban	Other		
Dates of Fieldwork	Eval.	Excav.	WB.	Other July 2014		
Sponsor/Client	Suffolk County Council Archaeological service					
Project Manager	Diccon Hart					
Project Supervisor	Kristina Krawiec					
Period Summary	Palaeo.	Meso.	Neo.	BA	IA	RB
	AS	MED	PM	Other Modern		
<p>Summary</p> <p><i>The borehole survey at Pegasus Boatyard has demonstrated that although preservation of deposits is variable across the site, the palaeoenvironmental potential of the site is high. The micro and macrofossil assemblages have demonstrated an initial freshwater peat sequence dating from the Late Neolithic which are incised by a small channel. This was a clean, slow moving channel which became gradually infilled with organic and minerogenic sediment. At some point in the later prehistoric the environment changed to one of brackish mudflats with freshwater introduced from the dryland via creeks. In some areas of the site freshwater peat persists into the Anglo-Saxon period but this sequence has been truncated by later medieval peat cutting. The preservation within the deposit is good and full analysis is recommended.</i></p>						

Table 2: Results of the pollen assessment

	Depth (m BGL)	BH2 1.06	BH2 1.22	BH2 1.66	BH2 1.82	BH2 1.96	BH6 1.33	BH6 1.45	BH6 1.57
Latin name	Common name								
Trees									
<i>Alnus</i>	alder	2		3	12	20	1	9	8
<i>Quercus</i>	oak	1	3	2	4	9	1	4	2
<i>Pinus</i>	pine		2		2				
<i>Tilia</i>	lime				2	1		2	
<i>Betula</i>	birch		3		11	7	1	2	1
Shrubs									
<i>Corylus</i> type	e.g. hazel	2		2	3	5		3	2
<i>Salix</i>	willow				2				
Herbs									
Cyperaceae	sedge family					4	2	2	3
Poaceae	grass family	6	5		2	3		3	4
Cereale type	cereal		1						
Lactuceae	dandelion family			2	2		3	3	15
Asteraceae	daisy family						1	3	3
<i>Rumex acetosa/acetosella</i>	sorrel							1	
Caryophyllaceae	pink family								1
<i>Chenopodium</i> type	goosefoot family	1			1				
<i>Plantago</i> type	plantain				1			1	
<i>Plantago lanceolata</i>	ribwort plantain			1					
cf <i>Urtica</i> type	nettle	2	1	1				1	
<i>Ranunculus</i> type	buttercup		2						
cf <i>Potentilla</i> type				1					
cf <i>Vicia/Trifolium</i>	vetch/clover							1	
Aquatics									
<i>Typha latifolia</i>	bulrush								3
Spores									
<i>Sphagnum</i>	moss							1	
<i>Filicales</i>	ferns		1		2	4		4	1
<i>Pteridium aquilinum</i>	bracken							2	
<i>Polypodium vulgare</i>	polypody					1		4	1
Total Land Pollen (grains counted)		14	17	12	42	50	9	37	39
Concentration*		2	3	2	5	5	2	5	5
Preservation**		4	3-4	2	4	4	3	4	3
Microcharcoal Concentration***		2	1	0	1	0	1	1	1
Suitable for analysis		?	YES	?	YES	YES	NO	YES	YES

Key:

*Concentration: 0 = 0 grains; 1 = 1-75 grains, 2 = 76-150 grains, 3 = 151-225 grains, 4 = 226-300, 5 = 300+ grains per slide

**Preservation: 0 = absent; 1 = very poor; 2 = poor; 3 = moderate; 4 = good; 5 = excellent

***Microcharcoal Concentration: 0 = none, 1 = negligible, 2 = occasional, 3 = moderate, 4 = frequent, 5 = abundant

Table 3: Ostracod and Forams
assessment BH6

ORGANIC REMAINS			
Depth in borehole	0.84-0.88m	0.92-0.96m	1.05-1.09m
plant remains + seeds	x	x	x
charcoal/coal/slag	x	x	x
insect remains	x		
charophyte oogonia	x	x	x
marine/outer estuarine foraminifera	x	x	x
marine/outer estuarine ostracods	x	x	x
brackish foraminifera	x	x	x
brackish saltmarsh foraminifera	x	x	x
brackish ostracods	x	x	x
freshwater ostracods	x	x	x
<i>Bithynia opercula</i>			x
molluscs			f
<i>Ecology</i>	<i>Brackish mudflats and saltmarsh; also with freshwater and marine components, decreasing and increasing, respectively, with time</i>		
MARINE/OUTER ESTUARINE FORAMINIFERA			
Depth in borehole	0.84-0.88m	0.92-0.96m	1.05-1.09m
<i>Elphidium excavatum</i>	xx	xx	x
<i>Elphidium margaritaceum</i>	o	x	
lagenids	o	x	

BRACKISH FORAMINIFERA			
Depth in borehole	0.84-0.88m	0.92-0.96m	1.05-1.09m
<i>Haynesina germanica</i>	xxx	xxx	xx
<i>Ammonia</i> sp. (brackish)	xxx	xx	x
<i>Elkphidium williamsoni</i>	x	o	
<i>Jadammina macrescens</i>	xx	xx	xx
MARINE/OUTER ESTUARINE OSTRACODS			
Depth in borehole	0.84-0.88m	0.92-0.96m	1.05-1.09m
<i>Semicytherura nigrescens</i>	x	x	o
<i>Loxoconcha rhomboidea</i>		x	
BRACKISH OSTRACODS			
Depth in borehole	0.84-0.88m	0.92-0.96m	1.05-1.09m
<i>Cyprideis torosa</i>	x	o	xxx
<i>Loxoconcha elliptica</i>	x	x	
<i>Leptocythere lacertosa</i>	o		
<i>Leptocythere castanea</i>	o	o	
FRESHWATER OSTRACODS			
Depth in borehole	0.84-0.88m	0.92-0.96m	1.05-1.09m
<i>Candona candida</i>	x	x	x
<i>Pseudocandona</i> sp.	o	o	x
<i>Candona neglecta</i>			x
<i>Limnocythere inopinata</i>			x
<i>Ilyocypris bradyi</i>			x
<i>Sarscypridopsis aculeata</i>			o
<i>Cyclocypris</i> sp.			o

Organic remains are recorded on a presence (x)/absence basis; f – fragments only

Foraminifera and ostracods are recorded: o - one specimen; x - several specimens; xx - common; xxx – abundant

Calcareous foraminifera of low-mid saltmarsh and tidal flats

Agglutinating foraminifer of mid-high saltmarsh

Brackish ostracods of tidal flats and creeks

Non-marine ostracods, but able to tolerate low salinities

Table 3: Results of the macrofossil assessment, BH2,

Depth (m BGL)	Volume sampled (l)	Volume processed (l)	Fraction	Charred					Waterlogged		Mollusca		Bone			
				Charcoal (>4mm)	Charcoal (2-4mm)	Charcoal (<2mm)	Seeds	Chaff	Wood	Seeds	Whole	Fragments	Large	Small	Fragments	Insects
1.36 to 1.52	0.3	0.3	>1mm & >300µm	-	-	-	-	-	1	4	4	-	-	-	-	-
1.52 to 1.66	0.4	0.4	>1mm & >300µm	-	-	-	-	-	2	4	4	-	-	-	-	2

Key: 0 = Estimated Minimum Number of Specimens (MNS) = 0; 1 = 1 to 25; 2 = 26 to 50; 3 = 51 to 75; 4 = 76 to 100; 5 = 101+

Table 4: Results of the waterlogged plant macrofossil (seeds) assessment, BH2

Depth (m OD)	Waterlogged seeds		
	Latin name	Common name	Number
1.36 to 1.52	<i>Sambucas nigra/racemosa</i>	elder	1
	Poaceae	grass family	2
	<i>Persicaria</i> sp.	smartweed	2
	<i>Rumex/Polygonum</i> sp.	sorrel/ knotweed	4
	<i>Ranunculus repens</i>	creeping buttercup	1
	<i>Scirpus</i> sp.	clubrush	2
	<i>Eleocharis</i> sp.	spikerush	2
	<i>Chenopodium</i> sp.	goosefoot family	1
	<i>Potamogeton</i> sp.	pondweed	3
	Unknown		5
1.52 to 1.66	<i>Rubus</i> sp.	bramble	2
	<i>Scirpus</i> sp.	clubrush	2
	<i>Ranunculus repens</i>	creeping buttercup	2
	<i>Eleocharis</i> sp.	spikerush	1
	Unknown		3

Table 5: Results of the Mollusca assessment

	Depth (m BGL)		Typical habitat
	1.36 to 1.52	1.52 to 1.66	
<i>Theodoxus fluviatilis</i>		S	flowing water in rivers, and canals
<i>Valvata cristata</i>	C	R	still or slow-flowing water, well vegetated
<i>Valvata piscinalis</i>	C	C	slow-moving water in rivers, lakes, canals, ditches
<i>Bithynia leachii</i>	R		moving well-oxygenated water
<i>Bithynia tentaculata</i>	A	C	well-oxygenated large water bodies, rivers, canals
<i>Radix balthica</i>	C	C	ubiquitous in all types of water
<i>Bathyomphalus contortus</i>	R		clean flowing water to stagnant drains R
<i>Gyraulus albus</i>	R	R	catholic, tolerant of stagnant and flowing water
<i>Gyraulus laevis</i>		S	clean, quiet water
<i>Planorbis carinatus</i>	R	R	slow rivers, canals, ditches, lakes, ponds
<i>Acroloxus lacustris</i>	S		quiet clean rivers, lakes, canals, ditches
<i>Pisidium henslowanum</i>	R	R	moving water in canals, lakes, drains
<i>Pisidium pulchellum</i>		R	smaller slower-flowing rivers, lakes, ponds
<i>Pisidium subtruncatum</i>	R	R	ubiquitous in streams, lakes, canals, ditches

Key: S = single shell, R = rare, C = common, A = abundant : these are relative quantities, no attempt was made to count numbers of specimens present

Appendix I Borehole Logs

6560 Pegasus Boatyard, Oulton Broad, Lowestoft OUL036

BH1

0-0.15m	Sandy made ground				
0.15-0.40m	Da	St	El	Sicc	Ub
	3	0	0	4	4
	Ag2 As2 Sh++ ptm				
	Blue grey mottled stiff silt clay, black organic mottled and occasional shell fragments				
0.40-0.56m	Da	St	El	Sicc	Ub
	3	0	0	4	4
	Gmin4 Gmaj++				
	Brown white mottled sand occasional gravel oxidised root channels				
trends into					
0.56-0.74m	Da	St	El	Sicc	Ub
	4	0	0	3	2
	Ag2 Dh1 sh1				
	Dark black brown slightly silty sand, occasional black organics				
0.74-1.10m	Da	St	El	Sicc	Ub
	3	0	0	4	4
	Gmin4 Ptm				
	Brown sand occasional shell and roots				
1.10-2.00m	Da	St	El	Sicc	Ub
	3	0	0	2	4
	Gmin4 Th				
	Wet grey brown sand, rooty, occasional <i>phragmites</i> at base				
2.00-3.00m	Da	St	El	Sicc	Ub
	3	2	0	1	4

Gmin4 Ag+ Ptm

Yellow grey fine sand occasional shell, silt laminations at 2.10m

BH2

0-0.26m Yellow orange sand gravel made ground

0.26-0.40m Brown sand made ground

0.40-0.52m Buried topsoil, leaf litter

0.52-0.74m	Da	St	El	Sicc	Ub
	3	0	0	4	4

As1Ag1Gmin4 Gmaj1

Grey orange mottled sandy gravelly silt clay

0.74-1.26m	Da	St	El	Sicc	Ub
	3	0	0	4	4

As2Ag2 ptm Sh++

Grey orange sticky silt clay, occasional shell, dark organic band at top

1.26-1.32m	Da	St	El	Sicc	Ub
	2	0	3	3	4

Sh1Dh3

Reedy rooty mat

1.32-1.50m	Da	St	El	Sicc	Ub
	3	3	0	2	4

Dh1 Gmin2 Gmaj1 ptm++

Grey white laminated sand and coarse gravel, finer with depth, reed remains and shell

1.50-1.82m	Da	St	El	Sicc	Ub
	3	1	2	3	4

Ag1 Dh2 Gmin1 Sh++ ptm++

Yellow brown reedy silt sand, very shelly , weakly laminated

1.82-2.00m	Da	St	El	Sicc	Ub
	4	0	2	3	4
	Sh2 Dh1 Ag1				
	Black brown reedy occasionally silt peat				
2.00-2.50m	Da	St	El	Sicc	Ub
	3	0	0	2	4
	Gmin3 Gmaj1				
	Grey gravelly wet sand				
2.50-2.90m	Da	St	El	Sicc	Ub
	2	0	0	4	4
	Gmin3 Gmaj1 Tl+				
	Fine-coarse grey yellow sand, occasional wood fragments				
2.90-4.00m	Da	St	El	Sicc	Ub
	3	0	0	2	4
	Gmin3 Ag1				
	Yellow-grey orange occasionally silty sand, very wet occasional silt clasts				
BH3					
0-0.20m	Sandy gravelly made ground				
0.20-0.30m	Dark brown sand with brick and metal made ground				
0.30-0.60m	Da	St	El	Sicc	Ub
	3	0	0	4	4
	Gmin4 Gmaj++				
	Mid brown sand occasional gravel and chalk fragments trends into				
0.60-1.56m	Da	St	El	Sicc	Ub
	2	1	0	3	2
	Gmin4 Gmaj++				
	Yellow fine sand occasional brown sand lenses, occasional gravel				

1.56-1.62m	Grey sand lense				
1.62-2.00m	Da	St	El	Sicc	Ub
	2	0	0	3	4
	Gmin3 Gmaj1				
	Coarse sand occasional fine gravel				

BH4

0-0.30m	Gravelly orange sand trends into				
0.30-1.50m	Coarse sand, occasional gravel, core refused due to coarse gravel				

BH5

0-0.67m	Made ground				
0.67-0.84m	Da	St	El	Sicc	Ub
	3	0	0	3	4
	Gmin3 Gmaj1				
	Brown orange mottled sand occasional gravel				
0.84-1.20m	Da	St	El	Sicc	Ub
	4	2	0	3	2
	Gmin3 Ag1 Gmaj++				
	Grey black occasional silty sand, hydrocarbon smell				
1.20-1.69m	Da	St	El	Sicc	Ub
	3	1	0	3	2
	Gmin42 Ag2				
	Yellow-grey silty sand , occasional laminations				
1.69-1.76m	Da	St	El	Sicc	Ub
	3	2	0	3	4
	Gmin1 Ag3 TI+ Sh+				
	Pale grey silt sand lense of organics, woody material at top				
1.76-2.80m	Da	St	El	Sicc	Ub

	2	2	0	2	4
	Gmin4				
	Grey yellow mottled sand, oily water, contaminated				
2.80-3.00m	Coarse sand occasional shell				
BH6					
0-1.30m	Made ground, brick rubble				
1.30-1.62m	Da	St	El	Sicc	Ub
	4	0	1	3	4
	Dh2Sh1 Ag1 Gmin++				
	Dark brown sandy silt peat, abundant rootlets and reed remains				
1.62-2.20m	Da	St	El	Sicc	Ub
	3	0	0	2	4
	Gmin4				
	Grey brown sand				
2.20-2.42m	Da	St	El	Sicc	Ub
	3	3	0	3	3
	Gmin4 Gmaj++				
	Pale grey orange laminated silt sand, reed remains				
2.42-2.74m	Da	St	El	Sicc	Ub
	2	3	0	3	4
	Gmin3 Ag1				
	Laminated buff sand occasional silt				
2.74-3.00m	Da	St	El	Sicc	Ub
	2	0	0	3	4
	Gmin3 Gmaj1				
	Coarse yellow sand and gravel				

Appendix II: Troels-Smith

Darkness	Degree of Stratification	Degree of Elasticity	Degree of Dryness
nig.4 black	strf.4 well stratified	elas.4 very elastic	sicc.4 very dry
nig.3	strf.3	elas.3	sicc.3
nig.2	strf.2	elas.2	sicc.2
nig.1	strf.1	elas.1	sicc.1
nig.0 white	strf.0 no stratification	elas.0 no elasticity	sicc.0 water

Sharpness of Upper Boundary	
lim.4	< 0.5mm
lim.3	< 1.0 & > 0.5mm
lim.2	< 2.0 & > 1.0mm
lim.1	< 10.0 & > 2.0mm
lim.0	> 10.0mm

	<i>Sh</i>	<i>Substantia humosa</i>	Humous substance, homogeneous microscopic structure
<i>I Turfa</i>	<i>Tb</i>	<i>T. bryophytica</i>	Mosses +/- humous substance
	<i>Tl</i>	<i>T. lignosa</i>	Stumps, roots, intertwined rootlets, of ligneous plants
	<i>Th</i>	<i>T. herbacea</i>	Roots, intertwined rootlets, rhizomes of herbaceous plants
<i>II Detritus</i>	<i>DI</i>	<i>D. lignosus</i>	Fragments of ligneous plants >2mm
	<i>Dh</i>	<i>D. herbosus</i>	Fragments of herbaceous plants >2mm
	<i>Dg</i>	<i>D. granosus</i>	Fragments of ligneous and herbaceous plants <2mm >0.1mm
<i>III Limus</i>	<i>Lf</i>	<i>L. ferrugineus</i>	Rust, non-hardened. Particles <0.1mm
<i>IV Argilla</i>	<i>As</i>	<i>A. steatodes</i>	Particles of clay
	<i>Ag</i>	<i>A. granosa</i>	Particles of silt
<i>V Grana</i>	<i>Ga</i>	<i>G. arenosa</i>	Mineral particles 0.6 to 0.2mm
	<i>Gs</i>	<i>G. saburralia</i>	Mineral particles 2.0 to 0.6mm
	<i>Gg(min)</i>	<i>G. glareosa minora</i>	Mineral particles 6.0 to 2.0mm
	<i>Gg(maj)</i>	<i>G. glareosa majora</i>	Mineral particles 20.0 to 6.0mm
	<i>Ptm</i>	<i>Particulae testae molloscorum</i>	Fragments of calcareous shells

Physical and sedimentary properties of deposits according to Troels-Smith (1955)

Suffolk Archaeology CIC
Unit 5 | Plot 11 | Maitland Road | Lion Barn Industrial Estate
Needham Market | Suffolk | IP6 8NZ
Rhodri.Gardner@suffolkarchaeology.co.uk

01449 900120
www.suffolkarchaeology.co.uk

