

**GREATER THAMES ESTUARY
ESSEX ZONE**

MONITORING SURVEY

INTERIM REPORT No 1



Essex County Council



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**Report prepared by
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1.0 PROJECT BACKGROUND

1.1 INTRODUCTION

In summer 1999 proposals for further survey and monitoring of known sites along the Essex coast were submitted to the Greater Thames Estuary Regional Research Framework Steering Committee and English Heritage. The proposals were well received but some amendments were necessary, largely to the technical aspects of the monitoring survey. It was decided to separate the proposal into two parts. A project design for the new survey work was approved by English Heritage in December 1999, and fieldwork carried out in 2000 (Heppell and Brown 2001).

This report relates to the second set of proposals, the monitoring of known sites which had been located by the Hullbridge Survey in the 1980s (Wilkinson and Murphy 1995). The project design for this was submitted to English Heritage in November 2000, and after amendment approved in February 2001. The project is to run for three years, this is the first interim report and presents the initial results of the first year's work (2001). The project is funded by English Heritage and the first stage formed part of Planarch, an Intereg IIc project. A summary of the results of the 2001 survey has also been submitted for publication in *Essex Archaeology and History*.

1.2 STRUCTURE OF THE REPORT

This report is divided into three sections, the first deals with the background to the project, the second and third with the results of the fieldwork to date and the final section highlights some key points and provides a brief discussion. Figures and plates can be found to the rear of the report.

1.3 REASONS FOR THE PROJECT

The coastal zone of England contains an important legacy of historic assets, which includes a wide range of fragile and irreplaceable archaeological remains. These are vulnerable to a wide range of threats, including natural sea level fluctuation, changes in climate, natural processes, and increased amounts of development and dredging. The UK has the longest coastline of any EU member around 18,000 KM of which 8,500Km are in England, and 8% of this is in Essex. The Essex coast is of great importance for nature conservation, and consequently over 80% is designated as a series of Sites of Special Scientific Importance (SSSI).

The Greater Thames estuary has been identified as a national priority for archaeological investigation (Fulford et al 1997). The long history of archaeological research in the Greater Thames area is summarised in the Greater Thames Estuary Archaeological Research Framework (Williams and Brown 1999). The Hullbridge survey, which took place in the 1980s, covered much of the Essex coastline, clearly demonstrated the wide range of remains present in the intertidal zone.

Whilst extensive survey work has been carried out in Essex, primarily the Hullbridge survey, relatively little monitoring of known sites has taken place (Strachan 1996), and thus there is little data available to assess patterns of change and destruction. This presents a strong contrast with considerable efforts which are currently underway with regard to the impact of coastal erosion and change on nature conservation issues such as saltmarsh loss (eg CGP 2000; Cook et al 1994; Burd 1992). The present project represents a preliminary attempt at systematic monitoring of change and erosion of archaeological sites and deposits.

The monitoring project, which is to run over a three year period, comprises two elements. Firstly a number of different sites, identified during the Hullbridge Survey, were selected for revisits so that a rapid assessment could take place of the changes to these. The locations were chosen to give a range of site types, submerged land-surfaces, peat deposits, wooden structures, red hills and submerged forests, in a variety of estuarine conditions and tidal ranges. Secondly the area around Rolls Farm on the north shore of the river Blackwater was selected for a series of regular monitoring visits over a three year period. Rolls Farm comprises a complex at which a number of different site types, typical of intertidal archaeology, can be

found. As such it is ideal for gathering data on patterns of erosion and change by regular replanning and observation.

1.4 AIMS AND OBJECTIVES

These are set out in the project design (Brown, *et al.* 2001) and are summarised below.

The revisits to selected Hullbridge survey sites and the regular monitoring at Rolls Farm to assess the degree of survival and the processes of change, will contribute to four broad objectives

- A1: Provide an indication of the degree and nature of the threat to coastal historic assets
- A2: Assist in providing a sound basis for developing management and research priorities
- A3: Assist in the identification of areas or sites requiring positive management action
- A4: Provide an indication of how the rate of destruction of exposed wooden structures and other archaeological deposits, including old land surfaces, may be addressed

These objectives are being pursued through the following research aims

- RA1 Study of Chemical changes and moisture content in waterlogged wood
- RA2 Study the nature and extent of the physical erosion of wooden structures
- RA3 Study the nature and extent of physical erosion of archaeological sites and deposits (including peat deposits)
- RA4 Study the nature and extent of erosion/changes (including new exposures of structures and deposits) at selected Hullbridge survey sites

2.0 REVISITS TO SELECTED HULLBRIDGE SURVEY SITES

2.1 SCOPE OF WORK

Eight selected Hullbridge Survey sites were selected for revisit and rapid assessment of change/erosion, which could then be compared to the Hullbridge Survey data. It was also an opportunity to check for new exposures at known sites. The sites examined represent some of the most significant archaeological deposits along the Essex coast. The start of the project was delayed by several months due to foot and mouth restrictions.

As a result of practical access problems it was not possible to revisit sites C52 and C53 (see 2.3.1). Site C4 was chosen as a replacement as it has an essentially similar sequence of deposits as C52 and 53. At the time of survey the Canewdon paddle site C56, was still subject to Foot and Mouth restrictions consequently the revisit to this site will take place in 2002.

A site record was generated for each of the sites visited. These included a text record, plans and sections (as appropriate), digital plans and photographs. In addition notes were made as to the current land use, the condition of the foreshore, weather conditions which may have effected the reliability of the survey and areas of erosion. This data could then be compared with the records of the Hullbridge Survey.

Site No.	Easting	Northing	Site Name	Description
T1	58235	18322	Leigh Beck	Red hills, Roman and medieval fish processing site.
T2	55445	17871	Aveley (Purfleet)	Submerged forest, wood peat and old land surface.
C4	8026	9561	Retendon	Lower and upper peats and old land surface.
C56	59244	19591	Canewdon Paddle	The Canewdon paddle, later Bronze Age.
BL28	69014	20725	The Stumble	Neolithic settlement and later wooden structures
CO1	60582	21978	Alresford	Medieval wooden structures.
CL1	61563	21312	Jaywick (Lion Point)	Old land surfaces and features
CL2	62663	22475	Walton-on-the-Naze	Old land surface

Table 1: Hullbridge sites selected for revisits

The sites selected lie within five different areas, the Thames Estuary, along the river Crouch, the Blackwater estuary, the Colne Estuary and the Clacton area. The results of the survey which follow are described are by area. The site codes used eg. BL 18 are those initially assigned to the sites in the Hullbridge survey.

2.2 THE THAMES ESTUARY

The Thames is a micro tidal estuary, with the section from Tilbury to Shoeburyness notably ebb tide dominant. The salt marsh along this coast has been largely reclaimed during the medieval period converted to grazing marsh which over the last 50 years has largely been lost to arable conversion or development. The areas of salt marsh outside the wall are eroding at a rapid rate, a loss of 20% being recorded between 1973 and 1982 (Mouchel 1997). The main areas of salt marsh are located around the tidal creeks at Pitsea and to the north and south of Canvey Island, where there are also areas of enclosed grazing marsh. The pattern of sediment movement within the Thames estuary is complex, but within the twentieth century has kept pace with sea level rise, despite dredging activity and extensive reclamation.

The Thames estuary is subject to a number of anthropogenic pressures. The river is a main conduit to Tilbury and the rest of the Port of London. Tilbury concentrates primarily on container handling roll on/off traffic and bulk items such as forest products, this trade, which requires large vessels, is on the increase. On the coastal fringe and inland the Thames is also subject to industrial uses, these include quarrying, brickmaking and the large refineries at Shellhaven, currently subject to a development proposal for a major container port. The industrial landscape reflects the importance of the Thames as a trading conduit. The proximity of the area to London has also meant that the Thames is also the site of a great deal of housing development.

Two sites were identified during the Hullbridge survey, Thames site 1, at Leigh Beck, Canvey Island, and Thames site 2 at Purfleet. Both sites were selected for monitoring.

2.2.1 Thames Site 1: Leigh Beck

Thames site 1, Leigh Beck, comprised a range of deposits including Roman and medieval middens, the latter probably related to fish processing, along with Red hills. At the time of the Hullbridge Survey the probable medieval fish processing was considered to be unique in eastern England.

2.2.1.1 Background

Canvey Island lies almost entirely below modern high water and is composed of Flandrian silts (Wilkinson and Murphy 1995, 183-194), it was a salt-marsh island, important for sheep grazing in the medieval period. The island was embanked and converted to grazing marsh in the 16th century, and the eastern part is now heavily built up. There are some 12-14 red hills located on the island. In general the range of finds of Roman, Saxon and Medieval date recovered from the south and east coasts of Canvey is remarkable, suggesting a major focus of coastal industry and transshipment site for transport of goods (eg Wymer and Brown 1995, Crowe 1996, Fulford *et al* 1997).

The red hill deposits at Leigh Beck, on the eastern end of the island have been known for many years and have yielded abundant artefacts. The site comprises a body of occupation, midden deposits some 2m deep. These contain pottery and briquetage.

The work at Leigh Beck in the 1980s suggested the following sequence of events

- 1st Century AD: Old ground surface (olive grey clay) thought to be slightly above sea level
- Aggregation of briquetage rich deposits, containing fish bones and cereal deposits of Roman date.
- There is a break in activity until the 12/13th centuries, possible occupation and abundant fish bone deposits, possibly the waste from a local fish processing industry
- Accumulation of a grey-brown clay with a blocky structure, relating to post-medieval drainage

In addition to the work of the Hullbridge Survey trenching has been carried out at Leigh Beck by the Rochford Hundred Group (Mackley and Faulkner 1994), the whole area has been subject to both systematic and casual collection by various groups and individuals for decades.

ECC FAU made a brief visit to the site in 2000. At this time it was noted that a number of timbers were visible to the south of the red hill complex, probably associated with post medieval drainage. Although no structures were visible in the area of the red hills there were traces of red deposits and briquetage to the south of the salt marsh cliff.

2.2.1.2 **Methodology**

A detailed walkover was carried out in the area in which deposits had been previously noted. Particular attention was paid to the edge of the marsh. The limits of deposits noted were planned using the GPS, as were the locations of timbers. The edge of the marsh itself were also planned so that should further visits take place accurate rates of erosion can be assessed.

2.2.1.3 **Results**

The area around Leigh Beck has altered greatly since the 1980s. A yacht club occupies an area of the marsh, with its own embankment. A great deal of erosion has also taken place over the last 50 years and considerable losses continue to occur. In 2000 it was possible to walk along the footpath to Canvey Point. There were some sections of the old sea wall visible against this. In 2001 the path has fallen away and more of the sea wall is visible.

Although a careful walkover was made of the area along the edge of the marsh, none of the midden deposits identified in the Hullbridge survey were relocated. Given the degree of erosion at this site it would seem reasonable to suggest that they have been destroyed. The red hill and briquetage deposits have also been eroded away. In 2000 some 'red' deposits were identifiable however the area has now eroded down to an uneven sandy clay. Although there is some briquetage and pottery still present on the surface it is by no means as dense as in previous years. Such material is also visible on the surface of the salt marsh, having been deposited by the tide.

In the area of marsh where the Hullbridge Survey sites were located comparison of survey data and vertical air photographs from the 1970s indicate that some 20m of marsh has been lost from this section. This would suggest an erosion rate of some 0.66m per annum.

2.2.2 **Thames Site 2: Purfleet Submerged Forest**

Thames site 2 is a substantial remnant of the extensive submerged forests and associated deposits along the Thames identified by Spurrell (1889) and earlier antiquarians. Similar deposits have been recorded buried at a variety of locations within deep alluvial sequences inland to the north east, including beneath the immediately adjacent Rainham Marsh nature reserve.

2.2.2.1 **Background**

The site was located during the 1986 season of the Hullbridge Survey. It comprises a single bed of wood peat, up to 1m thick, located on the Thames foreshore to the west of the confluence of the Mar Dyke (T2, TQ 5445 7871). The peat contains ash, alder, yew and other trees, both roots and trunks. Estuarine sediments underlie this deposit, containing some drifted tree trunks. Radiocarbon dates place the estuarine deposits within the Thames II transgression, c. 6500-5400BP and the peat at the end of the subsequent Tilbury III regression, c. 4930-3850BP (Wilkinson and Murphy, 1995, 90-8).



Plate 1; Purfleet Submerged Forest, T2. September 2001

The analysis of the evidence suggested the following sequence of events

- Initial sedimentation in an estuarine environment during the Thames II transgression (estuarine deposits)
- Tilbury III regression; a soil horizon forms, which later develops into woodland. Artefacts would suggest some activity.
- Conditions became wetter, wood peat formed above the sediments.

2.2.2.2 **Methodology**

The survey was carried out on 5 and 6 September 2001, around the spring tide. The weather conditions were good, and visibility in the site areas was clear.

A plan of the site was prepared using the GPS. The upper and lower edge of the peat bed were planned, as was the lower part of the sea wall as its position appeared to have altered from the position shown by the Ordnance Survey. The larger stools and tree trunks were also planned. Consequently, should further studies take place, ready comparison could be made of the deposits, and trees present.

2.2.2.3 Results

The wood and peat deposits at this site stretch for some 400m at the present time. For ease of description this has been split into three sections, west, east and central (see Fig. 5).

In the western section the peat deposit was still extant, and some 1m thick. The edge of this deposit lay close to the low water mark, and was marked by a small ridge. The eroded surface of this deposit runs back towards the sea wall for some 6m. The inland limit of the deposit is also marked by a ridge, c. 0.5m high. The top of this represents the highest level of the deposit. This upper shelf lies close to the modern sea wall. In places it is masked by the silts and concrete blocks associated with it. The western section of the site contains the vast majority of the tree stools and trunks in the survey area.

The comparison of this data with that of the Hullbridge survey clearly shows that erosion has taken place in this section, the peat being far closer to the sea wall and approximately 50m of the peat deposits lost from the western end of the site.

The central section of the site is the most altered. It has been almost completely covered with concrete blocks, presumably placed to re-enforce the sea wall. The remains of some of the trees from the earlier survey can be seen poking up from the blocks.

The eastern section of the wall has also been eroded. The initial survey located the peat deposits running for c. 220m in this section, almost to the Mar Dyke. Reference to the published photographs would also suggest that the deposit was much wider, extending some distance from the sea wall.

The exposure of peat in this section now runs for 80m, and extends for a maximum of 8m from the base of the sea wall. Much of the peat deposit has been eroded back to the sea wall. Exposures of the paleosol were located to the south of this peat bed. There are small roots and rootlets visible in this deposit.

No artefacts were recovered during the 2001 survey.

Coastal erosion is clearly a major threat in this area, the exposures of peat are certainly less expensive than they were in the 1980s. Comparison of photographs would also suggest that there are now more of the trees exposed. The erosion pattern appears to be lateral, with shelves being cut into the peat deposits, undermining them and leading to collapse

The large vessels using the navigation channel in this relatively narrow area of the Thames estuary add considerably to wave action in this area.

2.3 THE CROUCH

The rivers Crouch and Roach share an estuary, draining into the Greater Thames estuary between two large areas of reclaimed marsh, the Dengie peninsular and Wallasea, Potton and Foulness Islands. The two rivers form a single morpho-dynamic tidal system. This is characterised by relatively deep narrow channels, flanked by narrow tidal areas. The narrowness of the channels, which are restricted by sea walls results in an increase in tidal velocity, which limits sedimentary deposition and salt marsh development.

The Hullbridge survey located some 60 sites along the Crouch. The project design planned to examine sites, 52 and 53, to the west of Fenn Creek, and site 56. However sites 52 and 53 proved difficult to reach, as a sluice channel cut through the mudflats and proved to be too deep to cross. Given that it was only possible to cross the Fenn Creek c. 1.5hrs before and after low tide, thus allowing a window of 3hrs, it seemed that diverting around this sluice to access site 52 and 53 would be impractical. As such it was decided to survey the accessible section at site 4 which has a similar sequence of deposits. Site 56, where the Canewdon paddle was located, was inaccessible at the time of field survey due to Foot and Mouth restrictions, this will be surveyed as part of next years programme.

2.3.1 C4: Fenn Creek

2.3.1.1 Background

Crouch site 4 is located immediately to the west of the junction with Fenn Creek (TL 8026 9561). It was first discovered in 1911 by Mr. William Henry Rand. The site comprises a stratigraphic sequence of peats and associated deposits, which is one of the type sequences in the Crouch estuary (Wilkinson and Murphy, 1995, 35-42, 62- 67).

A lower paleosol was located at the base of the sequence, and was a lithic yielding horizon. The artefacts recovered from this level were largely Mesolithic in date, but some Neolithic artefacts were also present. This old land surface was shown to extend for 290m, with varying concentrations of artefacts along this stretch.

A lower peat deposit overlies the land surface. Wood was generally sparse in this deposit, which formed a marked step or bench of material, and ran for a length of 440m. This lower peat bench was overlain by a series of estuarine deposits, which contained some plant material. This was overlain by an upper peat deposit, which was split into 3-4 layers and sealed by another inundation deposit. The present salt marsh comprised the top of the sequence.

The modern channels of the Crouch complicate the topographical analysis of the site. Sites 4, 5, 15 and 17 probably represent one greater site area. An examination of boreholes, geological survey cores and auguring would indicate that a buried channel, floored by gravel deposits, immediately to the north of Site 4. This was probably still a topographic feature when the lower peat was deposited (c. 4000 BP).

The Hullbridge survey suggested that the main threat to the site was progressive erosion, but that this was not proceeding rapidly. Comparison of photographs of the 1911 work suggested that little change had taken place.

2.3.1.2 Methodology

The monitoring survey of the site took place on the 10, 11 and 12 October 2001. The first two days of the survey were clear and sunny, and visibility was good. The final day of the survey was dull and overcast.

A sample section was prepared, to establish the erosion patterns of the layers present on site. A GPS plan was prepared of the lower peat shelf and the edge of the salt marsh, and the limits of the paleosol, to establish the rate of horizontal erosion on the site. This included locating areas of wood within the peat and on the adjacent paleosol. A careful walkover was carried out along this paleosol in order to assess artefact concentrations to compare with the earlier work.



Plate 2: Ellen Heppell planning Crouch Site 4 with the GPS. September 2001

It was noted that the gravel banks located in the channel were different to those shown on earlier maps, and the outline of the adjacent gravel bank was also planned.

2.3.1.3 Results

The deposits noted in the earlier studies were still present on site. The lower peat shelf was located an average of 15m from the low water mark. This is in contrast to the earlier survey (1982), when it was located c. 10m from this. This represents a retreat of c. 5m over a period of 19 years; indicating an average rate of erosion of c. 0.25 m per annum. The edge of the salt marsh itself has retreated by 2m between the two surveys.

The most vulnerable deposits appear to be the peats. The lower peat shelf is being undercut by wave action in the area, as is the upper peat. The majority of the collapsed 'lumps' were part of this layer. The undercutting of this deposit, by some 0.15m, leads to the collapse of the upper marsh surface.

The paleosoil runs down to beyond the level of low water. By touch it was possible to roughly identify what is thought to be the limit of this horizon as there was a shelf of material, beyond which the ground was much softer. This edge was between 0.5 and 2m from low water. The walkover of the visible area of the paleosoil uncovered no artefacts during the Hullbridge Survey this area had only yielded a few artefacts. There were a number of small tree stools, rootlets and some loose timbers located in this surface.

At the eastern end of the site, towards the junction with Fenn Creek, rather more lithic artefacts were recorded during the Hullbridge survey, this area is now under a substantial gravel bank.

The survey has clearly demonstrated that erosion is taking place on the Fenn Creek Site 4. It would seem reasonable to suggest that this would be a fairly general pattern in the upper Crouch estuary. However it should also be noted that the shifting gravel banks in the area may protect some portions of the sites.

The Crouch is an active area for yachting, and there are a number of vessels moored on or near the site. At low tide these vessels rest on the paleosoil. As the tides rises and falls the keels of these vessels are digging into the material. Thus more erosion is taking place. The backwash from vessels when travelling under motor is also possibly an added factor to erosion patterns.

2.4 THE BLACKWATER ESTUARY

The Blackwater estuary is a macro-tidal estuary, the geomorphology of which is determined by its geology and Quaternary history. There are two major London clay islands, Osea and Northey, and the mouth of the channel is over deepened, marking a former course of the Thames (Mouchel 1997). There are extensive areas of mud flats and salt marsh in the estuary, which are currently suffering from severe erosion. There are currently three managed retreat trials underway, in which the salt marsh is regenerating.

2.4.1 BL28: The Stumble

2.4.1.1 Background

'The Stumble' is an area of intertidal mudflats located between Osea Island and the mainland. The area is the site of a multi-period complex comprising a Neolithic habitation site and later wooden structures. The site was first located during the 1985 season of the Hullbridge survey, trial excavation commenced in 1986 (Wilkinson and Murphy, 1995, 76-81 and 150).

The area of the site lies 500m from Goldhanger Creek, which remains water filled at low tide, the main channel of the Blackwater runs to the south of Osea Island and is located some 1km to the south and 3km to the east of the site.

Saltmarsh lay to the north of the site, the deposits, which formed this were up to 2m deep. These deposits overlay thick layers of estuarine clays. These in turn overlay grey estuarine clay containing some organic remains and a lower peat deposit, of early Bronze Age date. This overlaid a leached silty sandy soil, an old land surface, formed on a silty or sandy clay head deposit.

The initial survey identified an earlier Neolithic site (areas A, B, C and E). This was initially recognised by a dense concentration of early Neolithic pottery and flint, eroding out of the side of a narrow channel cutting into the old land surface. Further survey showed that this scatter had clearly defined limits. Excavation in this area identified post holes and other shallow irregular features, remarkably well preserved charred plant remains were recovered from samples and pollen analysis of preserved soils here and at other sites in the Blackwater estuary has provided good evidence for the environmental setting and economy of the site. The Stumble represents one of the most significant Neolithic settlement sites in the Eastern Counties (eg Murphy 1996, Brown and Murphy 2000, Brown *et al* 2000). When occupied the site would have been on dryland, around 2-3m above high water as a rough indicator the early Neolithic High Water mark may be considered to be around the contemporary low water mark. Osea Island would have formed a low hill connected to the mainland.

The later Neolithic settlement (Area D and contexts 99,117, 118, and 124) was also identified by finds scatters, although noticeably less dense than the earlier site. Artefacts recovered comprised Grooved Ware, flintwork and concentrations of burnt flint. By this period sea level rise must have meant that the sites were very close indeed to the high tide mark. By the Early Bronze Age the lower peat was deposited, and Osea may have become an island.

A number of wooden structures were also located at 'The Stumble' by the Hullbridge survey work, largely located to the north-west of the Neolithic settlement areas, closer to the edge of the salt marsh. They were gradually eroding out of the estuarine clay layers, as they were largely eroded in plan and not in section they were without a good stratigraphic context. The structures are listed below with their Hullbridge Survey site number, and date based on radiocarbon dates which are listed in Wilkinson and Murphy (1995, Table 18)

- BL 28.96, Hurdle bridge across creek, oak and hazel, Iron Age
- BL 28.98, Post and brushwood structure, Saxon
- BL 28.121, Wood scatter with two posts, Iron Age
- BL 28.126, Post alignment, Iron Age
- BL 28.127, brushwood with posts, Post Medieval
- BL 28.128, Brushwood with posts, Post Medieval
- BL 28.129, Submerged complex of wood, Iron Age
- BL 28.195, small fragment of track, Iron Age
- BL 28.244, Hurdle, Iron Age/ Roman

2.4.1.2 Methodology

An initial visit to 'The Stumble' was carried out on the 24 July 2001, was carried out by Ellen Heppell (ECC), Peter Murphy (EH), Nigel Brown (ECC) and Ron Hall. At this visit the general location of the site was reestablished and methodologies for the survey were discussed.

The bulk of the survey work was carried out on 13, 14, 15 August 2001. The weather conditions were good for the duration of the survey, although the bright sunshine did make visibility difficult on occasions. The site was relatively dry with water pooling in only limited areas.

The survey team was augmented by P. Connell, and A. Cooper of ECC, HAMP and Nicky Spurr (MDC Blackwater Project Officer).

Given that the Hullbridge survey had located the site through the density of finds in the area the initial task was to establish if such finds scatters were still present. The site area was easily identifiable as the paling track from the earlier excavations and some grid pegs were still present on site. This area was walked over. Note was also taken of any other finds concentrations along the mudflats. Particular attention was paid to areas in which the lower peat shelf was exposed.

A sample section showing the relative heights of the different deposits was prepared using a level and the GPS. Values for these heights are relative to the top of the salt marsh at c. 2.5m as time constraints meant that an OS related TBM could not be brought in.

The wooden structures associated with the site were located closer to the edge of the salt marsh, as such this area was also closely examined.

All locations were logged with the GPS.

2.4.1.3 Results

The Neolithic Sites

The earlier Neolithic site, located around trenches A/B and C, was initially identified in this year's survey by the presence of the trackway placed there to facilitate access during excavation in the 1980s. However the channel, which ran adjacent to the site, has completely silted up and is no longer identifiable on the ground. There were no traces of the excavated areas.



The finds scatter associated with this site was still present and relatively dense. A substantial amount of pottery was present, including rim and body sherds. The relative sherd size was also fairly large, up to 6cm. The sherds were also not noticeably abraded. The flintwork comprised a mix of tools and waste flakes, including a well preserved section of a blade.

As with the earlier study the limits of the site were clearly defined. The spread was some 80m east west and 60m north south. The southern limit of the spread was located roughly in the position of area C identified in the 1980s. The northern limit was roughly at the position of areas B and C. This scatter was located on the top of the old land surface which was obscured in places by mud and sand which had been deposited on the area, along with a considerable amount of shell.

There were few finds associated with area D, identified in the Hullbridge survey as an area of later Neolithic activity. This reflects the results of the earlier survey in which the finds density is described as occasional.

In addition to the areas located above, which were previously known sites, other areas of finds were located. These were further to the west of the main site, towards the causeway. These were located immediately below an exposure of the lower peat, which was c. 100m long. Although the density of finds was low their presence would suggest that new areas of archaeological activity area being exposed at the Stumble.

The old land surface extends intermittently for some 600m, 40m more than previously recorded. Where levels were taken to establish a sample section of the paleogeology in the area this surface was shown to be almost flat, with a drop of only 0.19m over a distance of 180m, the width of the old land surface at the eastern end of the site. There are patches of a peat deposit overlying this land surface. This is a thin deposit, an average of 0.1-0.2m thick.

Wooden Structures

A total of nine sets of wooden structure were located during the 2001 survey. With the exception of 500 all were eroding out of the mud flats immediately to the south of the edge of the salt marsh.

Structure 500 was located immediately to the north west of the area of Neolithic finds. This was initially identified as two partial rows of posts, c. 2m apart and running for 2.5m. On the later survey days some roundwood, probably part of a hurdle trackway was exposed. Some cut ends were visible. It is notable that no wooden structures located close to the Neolithic areas were recorded by the Hullbridge survey.

Structure 501 was located at the point of the salt marsh, eroding out of estuarine deposits. This structure consisted of two parallel rows of round posts. It is thought that this may be another trackway. However no roundwood was located. There were also no associated finds in this area.

Structure 502 also consisted of parallel groups of posts. In this case there were some pieces of roundwood exposed but not in a great enough density to definitively state that this was another hurdle trackway. This structure has only recently been exposed. When located on a modern Ordnance Survey base map it is under an area of salt marsh.

Structures 503 and 504 were located at the base of slumped material from the eroding salt marsh. Both consisted of isolated posts.

Structures 505 and 506 are the only ones, which could possibly be associated with structures located in the earlier survey. 505 was an alignment of five posts. It lies close to the location of 98, a post and brushwood structure. It is possible that the posts may have survived whereas the brushwood has washed away. The same is true of 506, which may be associated with 128.

The remaining wooden features were isolated posts, 507 and 508. These were located at the northern limit of one of the peat exposures.

Threats

The monitoring of the Stumble has identified a number of areas in which active erosion is taking place. The results clearly show that there has been vertical erosion across the flats. A greater area of old land surface has been exposed in comparison to the previous studies. The dense area of finds would suggest that the Neolithic site is being actively eroded. The identification of finds scatters further to the west of the Hullbridge site would suggest that new sites are being revealed and subsequently eroded at the present time.

The vertical erosion is probably greatest at the more forceful spring tides, especially in bad weather when the wind could whip up waves and drag them across the flats. The length of 'trails' of material behind posts and the scouring around the base, even during a calm period, clearly show the amount of material shifted by tidal forces.

There is some deposition taking place, which masks the old land surface in places. This material is coarse slightly silty sand, containing a high proportion of shells. However this deposit is unconsolidated and regularly shifts with the tide, thus providing little protection for the underlying deposits.

The erosion of the salt marsh is clear to see. The point has retreated at least 10m since the Ordnance Survey was last updated. The whole length of the marsh is eroding, and this is likely to expose more of the wooden structures located during both phases of the survey.

2.5 THE COLNE ESTUARY

The Colne estuary is macro-tidal, it is characterised by ebb dominant tidal currents. Both the Colne and the Blackwater join the sea at Mersea Island. In comparison to the other rivers in the survey the Colne has undergone little modification to its morphology in the last 100years. This failure to adapt to sea level rise through morphological change may lead to the Colne progressively 'drowning', with associated loss of mud flats and salt marsh (Mouchel 1997).

2.5.1 CO1: Alresford

2.5.1.1 Background

Colne site 1 (Wilkinson and Murphy, 1995, 203-5) is located at the junction of the River Colne and Alresford Creek, on the northern bank of Alresford creek. The saltmarsh in this area was eroding and slumped sediment overlaid the lower sequence, but this slumped material covered a firm clay bench, on which a number of wooden structures were located.

The main structure (Context 2) comprised eight vertical timbers, with associated horizontal timbers, one held in place by a small wedge. Carpentry was visible on the timbers, some of the vertical timbers had mortice holes cut into them and one of the horizontals was trough shaped. The surface pottery in this area was fifteenth century in date and the timbers dated to the thirteenth century (Wilkinson and Murphy, 1995, 203-5 and table 18). This structure defies explanation. A number of other wooden structures occur on the site, all associated with the firm clay bench. Contexts 3, 4, 5 and 6 could possibly be part of a sea wall revetment, with brushwood bundle 7 representing the remains of bundles used to face the sea wall or seal a breach. All these features are shown located at 30-50m from the marsh edge as was.

2.5.1.2 Methodology

Field survey of the Alresford sites was carried out on the 25 and 26 September 2001. Both days were still and clear and the visibility was good.

A great deal of erosion of the salt marsh has taken place in the intervening period between the two surveys, the plants on the marsh surface are not present in many areas and this has meant that the salt marsh deposits are breaking down and slumping. These very fine deposits are very unstable and difficult to cross. As such it was not possible to either hand plan or GPS plan those features visible on the site. Therefore an extensive photographic record was taken. The positions of the timbers were sketched onto a copy of the modern OS map.

The comparison of the data from the two surveys also proved problematical. The Hullbridge site drawings show the edge of the salt marsh, and few other reference points. Given that the degree of marsh erosion in this area is great it is not possible to overlay the edges of the marsh to compare locations of structures. Thus comparison of the two sets of data with any reliability at the present time is difficult. It is possible that archive drawings from the original survey may show more detail and more of the surroundings, which could eliminate this problem.

2.5.1.3 Results

A total of five groups of timbers and a number of what appeared to be isolated posts were located during the 2001 survey.

The first group, 100, was located immediately to the west of the channel which runs alongside the railway embankment. This group comprised two distinct elements. To the north, within a patch of salt marsh deposits, there were a number of roundwood stems. These are possibly the remains of a trackway or platform. To the south of these there was a row of three upright posts, the central post being slightly offset. To the south of this row, and on line with it, was an upright board.

A similar feature, 101, was located to the west of the previously described structure, c.5m from the current edge of the salt marsh. This structure comprised a round post, with a board c.1m to the south. This upright board had a round mortice hole cut onto the top of it, similar to those noted in context 2 in the 1980s survey.

Group 103 was a group of six posts, 2-10m from the edge of the marsh. There was no readily apparent pattern or alignment to these posts.

Group 104 was located close to the edge of the surviving edge of the marsh, and comprised two rows of timbers, perpendicular to each other. The west east row consisted of four timbers, one of which was slightly offset. This ran for c. 3m. The north south row had three timbers, running for c. 2m.

Group 105 was located close to the edge of the marsh in an area where a new channel had eroded. There were at least ten upright posts in this area, but again there was no real discernible pattern to their layout.

The isolated posts noted were concentrated in the channel, which runs alongside the railway embankment. These were more substantial than the others noted, and some were square cut. Presumably these would be tying up posts for small boats. The other isolated timbers were located along the edge of the marsh. These may be associated with other timbers, which have either been eroded away or are not yet exposed.

Despite the problems comparing data it would seem likely that the timbers located are different to those found in the 1980s. Firstly the 1980s sites lay some 20-30m from the edge of the salt marsh whereas the structures located in 2001 lay far closer, 10m being the greatest distance. The retreat of the marsh also needs to be taken into account.

The threats to the archaeology in this area are clear. Erosion is considerable and its effects very apparent, the edge of the railway embankment is being actively eroded, as is the salt marsh. Much of the marsh area has lost its consolidating vegetation and is gradually being washed away.

2.6 CLACTON

The Clacton area for the purposes of this study comprises the stretch of coast from Jaywick to Walton-on-the-Naze. This stretch of open coastline is almost covered in beach sand and shingle, which cover the exposures of Flandrian material. This stretch of coast is however the classic area of the 'Lyonesse surfaces' which were first studied in the early twentieth century.

2.6.1 CL1: Jaywick

2.6.1.1 Background

The exposure at Jaywick corresponds to Clacton area 2 (Wilkinson and Murphy, 1995, 100-104), which was first recorded by Hazeldine Warren in the early twentieth century (eg Warren et al 1936). This work identified a later Neolithic land surface which outcropped between Jaywick and Dovercourt. This surface termed the 'Lyonesse surface', was associated with a range of settlement features.

The 1984 season of the Hullbridge survey examined sections along this exposure, but noted that at the time the length of the Lyonese deposits was 'sadly depleted'. The survey concentrated on an area off Lion Point, sub-divided into three areas by wooden groynes. The best exposures of the old land surface were located on top of head deposits towards the top of the beach. Further towards the low water mark such surfaces had eroded down onto the London Clay. Such exposures were visible through 'windows' in the beach sand.

Archaeological deposits were reported in the late 1990s. A team from FAU visited the site to record these exposures but the Environment Agency was recharging the beach at this time as part of a major programme of works in the area and any exposures had been covered up.

2.6.1.2 Methodology

The re-visit to the Lion Point site took place on 08 October 2001. The previous night had been very windy, as was the day of the survey.

A walkover was carried out across the areas where deposits and features had been noted in the previous survey.

2.6.1.3 Results

No archaeological deposits were visible at Jaywick. The whole area was the site of a major scheme by the Environment Agency in the late 1990s. New, very substantial, breakwaters have been constructed using large granite blocks and the beach area has been recharged. In the area towards the top of the beach, where the majority of the archaeological deposits were noted, the sand is almost up to the top of the sea wall. Any surviving archaeological deposits will lie beneath this sand, in effect preserved, for the time being, from further erosion.

2.6.2 CL2: Walton-on-the-Naze

2.6.2.1 Background

The site (Wilkinson and Murphy, Interim Report 5 1984, 9-13) was situated at the north end of the Naze, in an area where the London clay deposits, which lies below the old land surface, dips below the later marine clays.

The site comprised exposures of old land surface, a silt loam or pale blue clay depending on location. These exposures contained occasional to common heat-shattered flints, occasional struck flints and small sherds of pottery (rare).

The old land surface was truncated by a recent trench and was relatively uneroded to the south west of this (inland). To the north east the surface was patchy, most of the area had eroded down to London clay. Contexts on the old land surface included shallow cut features, artefact scatters, and some areas of peat.

2.6.2.2 Methodology

An initial site visit was carried out on 08/10/01, the weather at this time was very overcast and windy. A second visit took place on 06/11/01, the weather at this time was clear and sunny and visibility was good.

On both visits the site was walked over in detail and examined for artefacts, and other surfaces. Notes were made as to the current condition of the site.

2.6.2.3 Results

The revisit to the Walton site showed that a number of changes had occurred in the area. The area is now littered with boulders, which have been displaced from the sea defences. The area between these was covered by a loose sand deposit. What is thought to be route of the trench observed in 1984 is now also filled by boulders.

There were exposures of the London clay to the north of the barrier beach, but only limited patches of a lighter grey clay (the old land surface) were visible on this. No artefact scatters were visible. There were occasional patches of peaty material, however these contained modern (19-20th century) material, such as brick and ceramic pipes. As such they are not thought to be a prehistoric context.

The shifting sands and boulders in the area make it impossible to assess the level of survival at the present time. However it would seem likely that these are masking the surviving archaeological deposits.

3.0 MONITORING OF A RANGE OF SITES AT ROLLS FARM

3.1 Scope Of Work

The Rolls Farm sites are located on the north shore of the Blackwater, and are to be subject to regular monitoring visits over the three years of the survey. The Rolls Farm complex was chosen for this more detailed study as it contains a representative sample of the range of site types which are located within the intertidal zone, such as a buried land surface with associated artefact scatters, Bronze age wooden structures, Late Iron Age and Roman Red Hills, and relict sea walls. The regular examination of these will help to establish the processes involved in the degradation and destruction of such sites.

The degradation and destruction of the wooden structures is certainly or possibly the result of the following processes

- Oxidation of iron sulphide impregnating wood tissue. Although this has the effect of hardening and cementing wood together, thus protecting it from erosion, the effect on wood microscopically means that establishing stem age and species may prove impossible.
- Intermittent desiccation. Exposure twice daily may result in the drying and distortion of the top surfaces of wooden components, and possibly microbial degradation.
- Physical erosion of components by tidal erosion.

The degradation and destruction of archaeological deposits, such as the peat horizons, old land surface and exposed Red Hill are also likely to be the result of a number of processes

- Intermittent desiccation. Exposure twice daily may result in the drying of upper surfaces, accelerating disaggregation and consequently erosion
- Physical removal of deposits by tidal erosion
- Animal and plant damage.

The effects of these processes will be examined by laboratory analysis of wood samples, repeat planning of the sites using fixed points, measurement of tidal flow, and measurement of the length of exposure.

3.2 Background

Rolls Farm is a multi-period complex, located on the north shore of the Blackwater, overlooking Thirslet Creek (Wilkinson and Murphy, 1995, 71-76; 143-149; 169-173), first located during survey in 1985.

3.2.1 The Neolithic Site

An earlier Neolithic habitation site was located at approximately -1.5mOD , this comprised an 'abundance' of flint and pottery eroding out from a lower peat deposit. The site was first located during survey in 1985.

An earlier Neolithic habitation site was located at approximately -1.5mOD , this comprised an 'abundance' of flint and pottery eroding out from under the edge of the lower peat shelf close to the level of mean low water.

The stratigraphy of the site is as follows

- Salt marsh and estuarine clays
- Firmer clay with some rootlets
- Lower peat (estuarine detritus)
- Buried soil on firm clayey slightly sandy silt

The scatter was examined by the means of a transect, in which finds density was logged. Trial pits were also excavated through the peat in order to ascertain at which level the artefacts occurred. These studies identified a mean density of struck flint at 10 per m^2 , greater than any other site studied with the exception of the Stumble. It was not possible to conclude whether this dense find scatter represented *in situ* occupation or simply dumping of material on the edge of an occupation site.

3.2.2 **Wooden Structures**

A number of wooden structures were located 80m to the north of this occupation scatter, some 30m from the edge of the salt marsh. These were located within the area of estuarine clays and were being gradually exposed by coastal erosion. Four structures were identified in 1985 and a further five in 1987. These structures were either situated in depressions representing a relict creek system, or on a firmer bench overlooking this.

These structures were brushwood structures, comprising sections of trackways and platforms. Some of these were poorly exposed and could not be located in subsequent survey. This was interpreted as being because of erosion over the winter months. Those structures which were dated proved to be Bronze Age. At this date the environment in the area was probably salt marsh, developed in the early Bronze Age. The sections of trackway appear to cross the relict creeks associated with this marsh, bridging soft points. The absence of associated finds scatter would suggest that this site, although obviously the focus of a great deal of activity, was not the site of settlement.

3.2.3 **Red Hills**

To the west of the main exposures of the Neolithic and Bronze age site there is a substantial red hill (BL 11), part of a line of such features spaced around 300-350m apart. The site barely rises above the salt marsh but is clearly visible from the seaward side as the southern side is being steadily eroded. The main site area is 60m E-W and 20m N-S, but some areas of briquetage in salt marsh creeks to the north would suggest that it either extends this far or that there is a further feature inland. Within the main site area a possible hearth and a possible evaporating trough were identified.

To the south of this red hill a line of posts were identified, part of a relict breached sea wall.

3.3 **Methodology**

As a number of different site types were present methodologies were adapted to suit each site. As Rolls Farm is to be monitored regularly over the next three years it was important that the data collected could be easily replicated in following visits.

The Neolithic site lay close to the low water mark and as such the time available on this section of the site is limited. An area of the lower peat surface and old land surface was chosen for study, as close as possible to that examined in the earlier survey. A transect was placed north south across this, using metal grid pegs. The present surface level was marked by a hacksaw mark on the pegs so that the amount of vertical erosion could be measured. The edge of the peat in relation to this grid line was planned, this should allow the degree of horizontal erosion to be measured. The old land surface was divided into 1m wide collection units, again so that relative find densities could be compared.

The Bronze Age wooden structures and associated creek systems were located close to the marsh edge. Two areas in which wooden structures were present were planned in detail. Again the present surface level was marked by hacksaw marks on the grid pegs. A plan of the relict creek system in the immediate vicinity was prepared using the GPS equipment and the current edge of the salt marsh was also marked. As the trackways were noted to cross the relict creeks a careful examination was made of the edges of these and any possible timbers/roundwood stems located so that these areas could be re-examined to establish if trackways show up in these locations.



Plate 4; Archaeologist Andrew Lewsey planning one of the wood trackways at Rolls Farm. The water filled dips to the rear are the relict creek system. August 2001

The general area of the red hill was planned using the GPS. The main area of briquetage, the extent of associated deposits, grey clay layers associated with settling tanks and the edge of the salt marsh were all located. Detailed hand drawn plans and sections were made of selected areas. Again the grid pegs were marked with hacksaw lines.

The line of posts associated with a relict sea wall was planned using the GPS. It should be noted however that the western extent of the line is postulated, as the ground was too unstable in this area for safe access.

A full record of colour prints was made of all notable features and contexts.

In addition to the field survey detailed above measurement of the tidal flow at the site took place, using a suspension type tidal flow meter.

Tidal monitoring took place on 16 and 23 July 2001. The initial field survey took place on 22-24 August 2001, with a second visit on 22-24 November 2001.

3.4 RESULTS

3.4.1 The Neolithic Site

The Neolithic site was examined carefully as described above. The density of the finds in the area examined, below the lower peat, close to that of the original survey, was low. The occasional flint was recovered, along with the occasional piece of very small abraded pottery. In the majority of the collection units no finds were recovered.

This absence of material is a great contrast to the results of the earlier work, in which the abundance of material made this area one of the richest found in the survey. This spread was located 250m from the sea wall to the north. Comparison between the two sets of survey plans would suggest that the edge of the lower peat lies at roughly the same distance from the sea wall. It was noted in the initial survey that the scatter was concentrated in a stretch along the edge of the lower peat of 50m (E-W), with concentrations diminishing at each end. The low density could be the result of masking by the loose sand, shelly, gravel layer which has been deposited over the old land surface, in which finds are difficult to discern. This deposit was not present when the site was revisited in 1996 as part of the Blackwater Management Plan. Indeed at that time it was possible to make out the location of one of the Hullbridge Survey trenches, and the range and concentration of artefacts noted, was similar to that recorded by the Hullbridge Survey (Strachan 1996).

It was also thought possible that the concentrations of material located during the Hullbridge work, had been missed. As such on the second visit the area examined was increased. The results however did not change, the finds density remained low.

The vertical erosion between the two visits proved to be minimal, an average of 0.05m across the top of the peat shelf. The most noticeable difference was the greater degree of undercutting of the peat deposit.

3.4.2 Wooden Structures

3.4.2.1 Initial Visit

A number of wooden structures were noted during the initial visit of this years survey some of which were associated with the relict creek system, which was clearly visible. A total of six sections of trackways were noted, and four areas, which could, potentially be trackways.

The sections of trackway can be divided into two main types, those located on a platform at a higher level on the edge of the eroding marsh, and those at a lower level crossing the relict creeks.

Sections of trackway 200, 215, 202 and 203 were located on the edge of the marsh and were not obviously located with the creek system. These sections of track were constructed of long lengths of roundwood, running NE SW weaving across shorter more substantial timbers. There was the occasional vertical post, presumably used to anchor the track. Although on roughly the same alignment it would seem unlikely that these represent a single feature. This is especially the case with structures 202 and 203. These two sections of trackway lie close to each other, and on the same alignment but 202 lies some 0.3m lower than 203. Unfortunately a gully has cut through the mud between these two structures, making the stratigraphic relationship difficult to discern.

Structure 204 was the best example of a trackway located. It was some 5m long and c. 1m wide. A further possible section of trackway, 205, ran perpendicular to this feature. This section was very eroded, with only an occasional timber remaining in situ. These two sections of trackway were planned in detail to enable monitoring to take place.

The final four sections located, 206, 207, 208, and 209, were situated on the edges of the relict creek system. These were small areas in which roundwood stems were visible. These either represent the remains of eroded trackways or the top of sections, which are not yet fully exposed. These sections lie in the same area as those found during the Hullbridge Survey.

The further re-visits in this area will examine the structures detailed above to assess erosion. Samples will also be taken from selected elements for scientific study, as described in the project design.

3.4.2.2 Repeat Visit 1

The wooden structures were re-examined and compared with initial plans during the repeat visit. There appears to be general erosion of the saltmarsh edge.

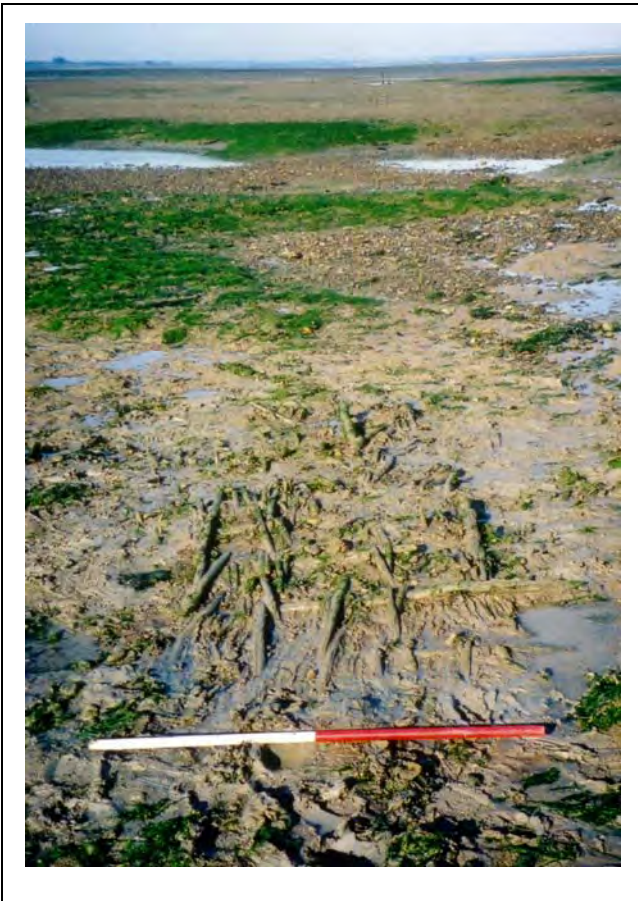


Plate 5; Trackway 204 (1m scale). August 2001

Structures 202, 203, 204 and 204 were selected for detailed comparison, as they were the best preserved examples. On the repeat visit elements which had been removed and new elements were noted.

Some of the larger, more exposed elements of trackway 202 had been removed between the two visits. Some extra timbers had been exposed at the southern end of the gully, which separated this feature from 203.

Examination of trackway 203 showed again that some of the higher elements of the structure had been removed by tidal forces. Some wood had been exposed in the intervening period, largely on the edge of the slope, which had shallowed off, probably as a result of wave action.

The main section of trackway, 204, had also suffered from erosion. Some of the larger structural elements had gone, especially on the northern side of the track. In the main area some of the roundwood stems had been removed. It was noticeable that on the second visit there were areas of twigs/ brushwood, which underlaid the wattling.

Trackway 205, which was fragmentary on the first visit, was not visible. This would suggest that it has been totally removed. There were no additional structural elements visible at the sites of 206, 207 and 208.

The second phase of survey also identified a number of wooden trackways in areas where they had not been noted previously. A total of six sections of trackway were noted between ** and **. These trackways were located on a grey clay deposit, possibly estuarine clays.

It would appear that this is the area subject to the greatest degree of erosion. The edge of the marsh deposits is clearly visible as a ridge running along, roughly where MHW is marked on the OS maps. Above this ridge, to the north, there are salt marsh deposits, upon which occasional islands of vegetation survive.

Comparison with the photographs taken as part of the Hullbridge survey would suggest that in the 1980s the estuarine clays, in which the trackways are located, were not exposed.

Two of the wooden structures are worthy of individual mention. Structure 212 was a bundle of brushwood, positioned centrally in what is possibly a relict creek. There were no visible uprights associated with this structure. The second is structure 213. This comprised a fragmentary trackway some 5m in length and 2m wide. This comprised roundwood stems laid flat with some vertical or angled poles. It was notable that some of the elements of this structure were cut boards or planks. A loose board with a round mortice hole

cut thought the top was found in the vicinity of this structure. However as this timber was not *in situ* it is not possible to say if it was part of trackway 213.

3.4.3 Red Hills

The red hill was clearly visible, it is clear that a great deal of erosion has taken place in this area. The general stratigraphy of the site, described in the Hullbridge Survey was noted during the recent survey, but internal features had been exposed, which were not visible during the Hullbridge Survey.

The red hill has been divided in two by an inlet. Three clay lined tanks were noted in this area, 0.5m deep. These were in areas which had been eroded back since the initial survey. One of these appears to coincide with an area of briquetage noted in the 1980s. There are also traces of what could be clay lined tanks on the west of the inlet. The exposure of such internal features clearly indicates that erosion is taking place.

The second visit showed that further erosion had taken place, primarily along the south west facing sections of the feature. Some of the internal features were not visible. Loose material collapsed from the main mound had masked these. It was notable that more briquetage was present on site than during the previous visit.

3.4.4 Relict Sea Wall

In addition to the sites recorded during the Hullbridge survey there were sections of relict sea wall present in the area, these were noted but not planned.

This relict feature comprises a row of substantial posts, driven in at an angle of c. 45°. In some areas two rows of such posts were visible. These survive up to a height of 1m. In contrast to the relict sea wall at Thames site 1 (Leigh Beck), there is no rubble core to this earthwork, suggesting that it was a simple embankment. In places traces of the internal fleet ditch survive. Of particular interest is a raised area of rubble, located at a gap in the posts. This is likely to be the position of an attempt to fill a breach in the wall.

There appear to be three distinct elements to these features, suggesting piecemeal reclamation in the area. Although undated at the present time reference to cartographic sources would suggest that this relict feature pre dates the first Edition Ordnance Survey dating to 1876.

3.5 TIDAL FLOW

Measurement of the tidal flow off the site was carried out on a spring tide and a neap tide. This measured the speed of the current in meters per second, with an average reading being recorded every ten minutes.

The neap tide was monitored on 16 July 2001, the weather was calm and clear. The readings were found to be largely consistent. One hour after high water, on the ebb, when the depth of water was >2.25m the flow was on average 0.4m/s, this gradually decreased to a total of 0.04m/s. The same pattern was noted with the flow tide.

The spring tide was monitored on 23 July 2001 by Ron Hall, again the weather was relatively calm. One hour after high tide, on the ebb, with a water depth of 2.2m, the flow was an average of 0.5m/s. This gradually diminished to 0.17m/s. The same pattern was noted with the flow tide, with speed increasing to 0.6 at around high water.

Provisional analysis of these results would suggest that tidal flow is greater at the spring tide than neap tides and on the flow. This would mean that

the greater erosion threat would occur at this time when the flow is from the south west. Thus the most vulnerable area is that of the red hill, borne out by the pattern of erosion in this area.

3.6 CONTEXT 215 WOOD PRESERVATION Peter Murphy

3.6.1 Introduction

This roundwood structure was exposed on the upper shore at a level equivalent to other structures which have given radiocarbon dates of 2850 ± 70 BP (HAR-8879: 1125-920 cal BC, 2 sigma) and 2790 ± 80 BP (HAR-7055: 1036-842 cal BC), (Wilkinson and Murphy 1995, 58 and 143-150). The project will monitor erosion (primarily the rate of loss of components) of several structures in the vicinity, (including a hurdle

panel), by re-planning every three months. Recording of tidal flow rates at Spring and Neap Tides had previously been done during summer 2001 by Ron Hall, Ellen Heppell and the writer (3.5 above).

Plainly, it was not possible to remove wood samples from the monitored structures to examine wood preservation in detail, for that would have disrupted monitoring of erosion. Instead, 215 was selected for sampling, since it was a simple structure - probably the eroded remnant of a brushwood bundle (cf. context 191) - in a terminal stage of destruction, and within a few metres of the monitored structures. This structure had first been seen in August 2001, so it must have been partly exposed for at least 4 months.

3.6.2 Methods

Sampling was carried out on 23.11.01. Samples were taken from 25 roundwood components - virtually the entire structure. Two samples per component were collected; 'A', from part of the stem exposed; and 'B' from a part still embedded in intertidal mud.

Examination of this sample collection was seen primarily as a pilot study to determine whether significant differences could be seen between exposed and buried wood, and whether these might be quantifiable. Two of these samples - 3A and B - were sent to Ian Panter (EH) for fixing and scanning electron microscopy. The remaining samples were stored in plastic bags, and chilled to minimise chemical changes before examination. 30 stems were examined macroscopically, then by transmitted light microscopy, at magnifications of x 250-400.

Species identification was not attempted systematically. Roundwood samples from intertidal contexts, as here, are very soft and spongy, and to provide sections suitable for identification, it is normally necessary to soak samples in methanol to harden them. However, it was thought that this might modify some of the variables being recorded. Although clear radial longitudinal sections (RLS) can be obtained from samples not pre-treated with methanol, and these clearly show presence/absence of framboids and fine cell structures, cutting TS and TLS was very difficult. From characteristics of rays and perforation plates seen in RLS, it appeared that that *Corylus* (hazel) predominated. Roundwood structures nearby were of *Acer*, *Corylus*, *Fraxinus*, *Quercus* and *Salix/Populus* (Wilkinson and Murphy, *ibid.*). Other variables that had been thought to be potentially informative when writing the Project Design were as follows (Brown *et al* 2001, 8).

- % water content. In fact, macroscopic examination of samples indicated that both exposed and buried wood samples were saturated. There is, no doubt, surface evaporation from exposed wood, but it appears that water is rapidly replaced by capillary action. In view of this % water content was not determined.
- Physical erosion, especially presence/absence of bark. Typical diameters of exposed and buried portions of each stem were recorded. Plainly, there is natural variation along the length of a stem, but surviving stem diameters give an idea of the degree of surface erosion.
- Degree of induration by iron sulphide minerals. Macroscopically, this was perceptible by hardening of bark and wood tissue, making sectioning difficult. Where iron sulphide replacement has occurred, a slight 'crunching' sound is audible during sectioning, and there is resistance to the blade. Microscopically, the presence of pyritic framboids in pith, medullary ray cells and vessels was noted.
- Colour of replaced tissue. In anoxic sediments, this should be black. After exposure, oxidation of iron minerals would be expected to give a reddish colour. This might be an indication of duration of exposure.
- Boring organisms, and other associated plants and animals.
- Gross distortion and fissuring, and degree of preservation of fine structures, particularly vessel perforation plates. A 'scoring' system of 1-3 for both was adopted, '1' indicating good preservation (i.e. potentially identifiable) to '3' badly fissured/distorted and fine structures lacking.

3.6.3 Results

1. Gross physical erosion. None of the stems examined had bark, which must have been lost in prehistory, prior to burial. The mean stem diameter for exposed stems was 12.4mm; for stems still embedded in sediment 13.1mm. Recent erosion since exposure had resulted in about a 4.5% mean loss in diameter.
2. Fissuring. There was very little sign of this. Only one exposed stem showed radial fissures.

3. Boring. Only 4 stems showed boring, by some unknown organism. Both buried and exposed stems were affected. This took the form of narrow tubular boring, of about the same diameter as the nematodes associated with stems.
4. Associated biota. The majority of exposed stems had formed a substrate for filamentous green algae, and on one there was a rooted seedling, with a leaf form similar to *Halimione portulacoides*. Nematodes, hydrobiids and an amphipod were also associated.
5. Framboids in wood tissue. It seems likely that replacement of wood by iron compounds - probably principally pyrite - is initiated by microbially-induced iron sulphide framboid formation in waterlogged sediments with adequate levels of organic material and sulphur (Wiltshire *et al* 1994). In intertidal sediments sulphate ions from sea-water would ensure that sulphur was not a limiting factor for framboid formation. The most stable iron sulphide found under these conditions is pyrite, which is the ultimate product of a chemical pathway beginning with the formation of intermediate ferrimagnetic sulphides. The results from the intertidal timber circle at Holme-next-the-Sea, Norfolk suggest an arrested phase of diagenesis surrounding the timber where the metastable ferrimagnetic iron sulphides survived and the ultimate formation of pyrite had not yet occurred (Linford, in press). There was very rapid oxidation of iron sulphide minerals at Holme, but at Rolls Farm virtually none - just superficial reddening on three stems. Deeper in the wood tissue, there were abundant unoxidised framboids.
6. Cell structure. This was uniformly good. In most samples there were well-preserved hazel-type perforation plates.

3.6.4 Conclusions

It is not possible to specify exactly how long the wood components visible on the mudflat surface had been exposed, but the structure as a whole was visible in August, 2001, and must have been exposed for at least 4 months. Some superficial erosion had occurred (mean loss in diameter about 4.5%), and this probably resulted partly from physical abrasion by sediment suspended in the water column, partly from biological activity (e.g. the radulas of hydrobiids). Boring was uncommon. The wood appeared never to have dried out fully, so there was little splitting. There was also little oxidation of pyrite framboids or larger pyrite masses impregnating the wood. Fine cell structures had survived well.

Although this study indicates some of the destructive processes in operation, in isolation the relative significance of these variables is unclear. Further studies in contrasting intertidal environments are required.

4.0 DISCUSSION

4.1 METHODOLOGIES

There are five main points which are crucial to the success of this project and widely applicable to work in the intertidal zone.

- **Safety:** there are a number of risks associated with working in the intertidal zone and on salt marshes, these include becoming lost, cut off by the tide, exposure, and getting trapped in the mud. As such safety concerns need to be paramount within the project. To this end a full and detailed Risk Assessment was prepared and all staff briefed as to issues and procedures they needed to be aware of. The Health and Safety protocols have been successful, there have been no reportable accidents in the project to date.
- **Rapid recording:** working within the tides means that limited windows are available for safe working, as such recording has to take place rapidly. Modern survey techniques such as the use of GPS have proved advantageous in this regard
- **Accuracy:** site locations and plans also need to be accurate to allow clear comparison of data, and location
- **Consistent:** data and recording techniques also need to be consistent to allow for comparison of 'like with like'. Comparison can be greatly aided by the use of digital planning/mapping and the use of GIS
- **Adaptable;** the intertidal environment presents practical difficulties, for example the transfer of equipment, access and the tides, as such, within the considerations outlined above, all techniques need to be adaptable

4.2 The Hullbridge Survey Revisits and Rolls Farm Monitoring

The revisits to the selected Hullbridge survey sites have shown that the majority of the sites are eroding to varying degrees. This has resulted in the almost complete destruction of some sites, for example the midden and associated deposits at Leigh Beck, T1. The survey has also demonstrated that there are new exposures of archaeological material at some of the sites. This is clearly demonstrated at the Stumble, where new finds scatters were located outside the limits of the earlier sites. Further timber structures were also located along the eroding edge of the salt marsh. The only exception to this was site CL 1 (Jaywick) which now lies below beach recharge deposits.



Plate 6; Container traffic on the Thames, just off site T2. The wash from such vessels is contributing to the erosion of the peat deposits at this site.

The most eroded sites appear to be those along the north bank of the Thames, T1 and T2. Erosion on these sites appears to be primarily lateral. In contrast the lateral erosion at the sites on the Blackwater Estuary appears to be more gradual, The sites are more effected by vertical erosion. This would suggest that rates and types of erosion are closely associated with the type of tidal environment, and topography.

Given that the survey has clearly demonstrated that erosion is taking place, both destroying existing deposits and exposing new sites, it may be appropriate to consider further revisits and additional recording at some key sites, for example Thames site 2 (Purfleet), Crouch Site 4 and The Stumble. Revisits to selected sites is also important as, due to the rapidly changing nature of the intertidal environment, a single revisit provides only a 'snapshot' into what is happening. Further visits would allow a more rounded evaluation of such sites to be made. The possibilities for further work at Purfleet, T2, may usefully be discussed at a meeting between the Environment Agency, English Heritage, and Essex County Council, provisionally arranged for February 2002, at which co-ordinated research in the Thames Estuary will be discussed. Similarly further work at the Stumble can be considered as the publication report of the 1980s excavations is finalised during the course of 2002.

The first two visits to Rolls Farm have taken place to date. The data gathered, although only at the preliminary analysis stage, suggests that it should be possible to achieve the aims set out in the project design. Data relating to rates and patterns of erosion, to the prehistoric landsurface, wooden structures and Red Hill, is emerging. As with the revisits erosive processes are destroying existing deposits and structures whilst uncovering new features. These included wooden trackways close to the site of the red hill, where no features had been noted previously. The construction of these trackways appears different to those noted previously.

4.3 Suggested further work

4.3.1 Radiocarbon Dates

The project design contained no provision for radiocarbon dating, and given the range and complexity of the wooden structures at Rolls Farm, this seems to be an unfortunate omission. At present the wooden structures which have been located on the site are undated. Given the position and nature of the trackways associated with the relict creek system it has been *assumed* that they are Bronze Age date. Similarly the rather different wooden structures closer to the Red Hill have been *assumed* to of a different date, possibly Roman. Given the nature of this project it would seem appropriate to obtain radiocarbon dates for these structures. In the longer term since the group of supposed Bronze Age structures is intimately connected with the relict saltmarsh it may be possible to, through a combination of radiocarbon dating and stratigraphic relationships to arrive at a dated sequence of prehistoric saltmarsh development. In the first instance it is suggested that up to five radiocarbon dates are obtained, this should provide a basic date range for the wooden structures and enable a decision to be made as to whether a more detailed dating programme would be worth while.

4.3.2 Additional visits to selected Hullbridge survey Sites

Given the importance of the sites and the extent of change/erosion which is occurring at The Stumble, Crouch Site 4, and Thames site 2, it is suggested that one annual visit is made to each of these sites during 2002 and 2003. A meeting has been arranged between the Environment Agency, English Heritage and Essex and Kent County Councils to discuss co-ordination of Research in the Thames estuary, and options for further study of Thames site 2 will be considered at that meeting.

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E. Heppell 08/01/02

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