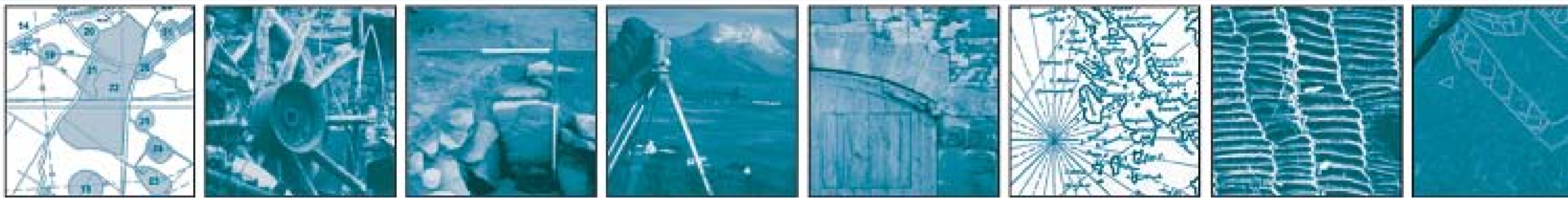

BUTLINS, BOGNOR REGIS

Palaeoenvironmental investigations at the Butlins Ocean Hotel site, Bognor, West Sussex

for

Butlins

July 2010

HEADLAND ARCHAEOLOGY Ltd

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Client: Butlins

HA Job No: BUBR10/003

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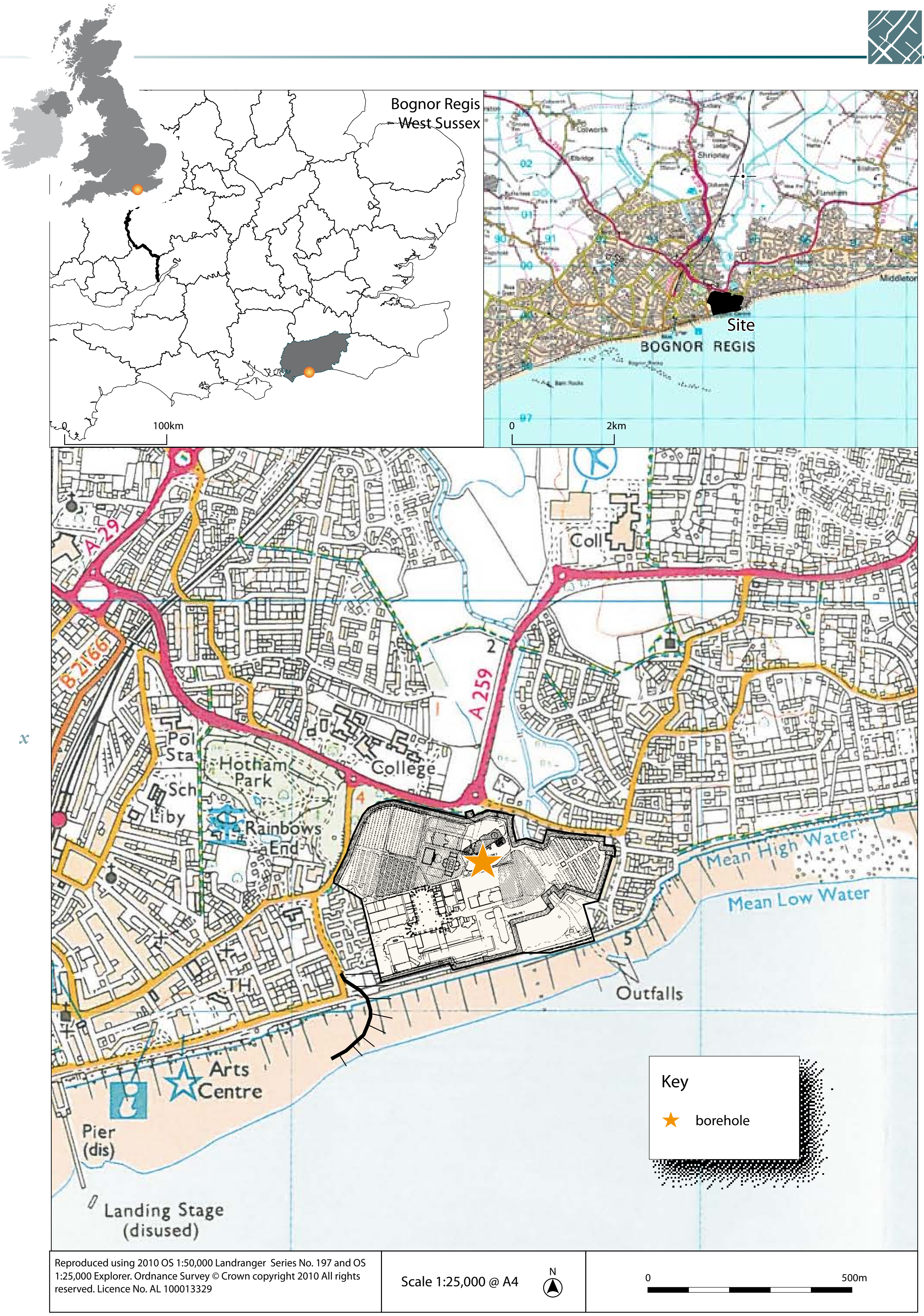

Illus 1

Site location plan showing position of borehole relative to previous works and a schematic section through the rife south of the study site

BUTLINS, BOGNOR REGIS

Palaeoenvironmental investigations at the Butlins Ocean Hotel site, Bognor, West Sussex

1. INTRODUCTION

This investigation was undertaken in order to address the nature of the sediments beneath the Ocean hotel at Butlins in Bognor Regis (Figure 1). The project was conceived in order to further investigate the development of the rife system first investigated during the previous works at the Butlins site (Bates et al., 2005). Specifically the project was developed in order to:

1. Recover a complete record of the sequences filling the rife.
2. Assess the palaeoenvironmental record of the sediments.
3. Provide a chronological framework for the sequences.
4. Determine the archaeological and palaeoenvironmental potential of the deposits.

2. REGIONAL BACKGROUND

The site of the Ocean hotel lies inland of the modern coast at Bognor Regis within an area of low lying ground behind the modern beach at the mouth of Aldingbourne Rife (Figure 1). Bedrock geologies consisting of Cretaceous Chalk beneath Tertiary clays and silts (Gallois, 1965) exist within the area.

Although a great deal of interest has been generated in the preserved sedimentary sequences and their associated archaeology of the West Sussex Coastal Plain (through the discoveries at Boxgrove (Roberts and Parfitt, 1999)) considerable problems still exist in the study of the channels revealed at low tide around the coast from West Wittering (Reid, 1903) through Earnley (West *et al.*, 1984) and Selsey (West and Sparks, 1960; Bates *et al.*, 2009) to Bognor Regis (Bates *et al.*, 2005). Furthermore while some progress has been made towards understanding the Pleistocene channels (Bates *et al.*, 2004, 2007) relatively little is known about the precise timing and infill of the Holocene channel fill sequences that are known to exist around the coastline. This is in part a result of difficulties in accessing these sequences that are visible only at low tides and following periods of major storm activity (that results in the temporary removal from the beach of the overlying modern sediment cover).

Recently however studies have been undertaken in Aldingbourne Rife (Wessex Archaeology, 1999; Allen *et al.*, 2004; Bates *et al.*, 2005; Roberts in progress) and Chichester Harbour (Mills *et al.*, 2007a and b) that have shed some light on Holocene changes in the region). These investigations have demonstrated that in all cases palaeoenvironmental material is often preserved in the sediments and that useful information can be revealed through their study. In particular questions regarding the regional vegetation development, possible human impact on the landscape, the nature of the flooding of the low lying regions following sea level rise and the timings of these events are recoverable.

2.1 Aldingbourne Rife

The Aldingbourne Rife forms a broad channel like feature, narrowing and bifurcating inland. Beneath the surface Holocene sediment sequences rest within a large channel like feature that is incised into the bedrock and cut through older pre-existing sediments associated with the Pagham Raised Beach (thought to be the youngest known Pleistocene beach on the lower coastal plain) and the brickearth deposits of last cold stage age (Devensian). Previous work at the Shoreline hotel (Bates *et al.*, 2005) indicated the presence of made ground and an upper minerogenic sequence showing evidence of disturbance in places above the main body of sediments filling the channel. The channel deposits consisted of sands and silts typical of Holocene tidal/sub tidal deposition. In some places a thin (c. 0.30 metre deep) basal organic silt unit was recorded immediately overlying bedrock (Reading Formation). This basal organic complex was considered comparable to silt rich organic units previously recorded

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in lower sections of major river systems such as the Thames (Devoy, 1979) and the Solent (Long *et al.*, 2000). The basal organic complex represents the onset of sedimentation in the rife coincident with increasing evidence for wetland conditions. Typically this was expected to be of freshwater character initially becoming increasingly brackish up-profile.

Previous work by Bates *et al.* (2005) examining pollen, molluscs, forams and ostracods as well as ^{14}C dating showed that a range of palaeoenvironmental indicators are preserved in the channel. Microfossil evidence was used to suggest that initial sedimentation in the valley involved material being deposited that originated in fully marine conditions (not freshwater as predicted) and that the valley was one dominated by marine waters after flooding. This pattern is atypical of normal transgressive sequences seen in the major river valleys in southern England and a catastrophic explanation was suggested to account for this feature. The timing of the inundation was difficult to determine. The two ^{14}C dates obtained from the sequence were considered suspect due to the presence of older carbon in the form of lignite in the local bedrocks.

2.2 Chichester Harbour

Recent palaeoenvironmental work by Mills *et al*, (2007a and b) has formed part of an extensive archaeological investigation of Chichester Harbour. Cores were taken from a number of locations around the harbour and those thought most likely to provide information on the changing habitats in the harbour during the Holocene were selected for detailed analysis. For example cores from Thorney Island preserved the best evidence for Mesolithic environments and landscapes dominated by freshwater streams draining dry, open grassy habitats. Estuarine environments encroaching up the valley systems and into the harbour area were also recorded. Almost all the cores show that the estuarine incursion was associated with erosion and a turbulent depositional environment perhaps as a result of storm surges rather than a gradual process of waterlogging of a formerly dry landscape. Pollen from the estuarine habitats documents the changing forestscape and its subsequent reduction by people from the Neolithic onwards. By the Iron Age many cores record a contraction of estuarine environments accompanied by a change from mudflats to a salt marsh environment.

The importance of these previous investigations is three-fold:

1. The evidence obtained from the Aldingbourne Rife by Bates *et al.* (2005) provides a picture of changing patterns of local vegetation across the Mesolithic to Bronze Age periods (similar changes were noted by Mills *et al.* (2007a and b) in Chichester Harbour).

2. The explanation for initial inundation of the rife and harbour system as a result of catastrophic breeching of an offshore bar system suggests that there is a need to reconsider the palaeogeography of the earlier and middle Holocene environments of the area. Considerable local topographic change has been noted throughout the area since the 19th century and this must now be extrapolated back into the Prehistoric past.

3. The breeching hypothesis suggests that inundation will have dramatically altered the nature of resources available in the area and local patterns of accessibility and land use by contemporary human groups. The possibility that this occurred during the Mesolithic/Neolithic period suggests that changes in the nature of the archaeological record from this period may be expected in response to these changes.

3. LITHOLOGY

Data on the lithology was gained from a borehole drilled for sample recovery. The location of the borehole is shown in Figure 1. The elevation of the borehole surface was +1.5m O.D. Because of poor sample recovery during the previous phase of borehole investigation a piston sampler was used to recover samples from the soft, unconsolidated sands that form the majority of the sequence. Unfortunately even using a piston sampler samples were difficult to retain in the core tubes and consequently only the bottom 2m of sediments were adequately recovered.

Three lithological units were present within the borehole (in order of deposition (Table 1):

1. Bedrock. This consisted of stiff fissured grey sandy clay. This was not penetrated and has been interpreted as Reading Beds.

2. Lower Minerogenics. Dark grey sandy clay with some shell fragments and organic material was present above the bedrock. Similar sediments were seen in the previous work at Bognor (Bates *et al.*, 2005). Plant fragments and organic matter were noted in places.

3. Sands and silts. These comprised of loose grey clayey sand with some organic material. This unit was well bedded in places with thin (<0.5cm thick) sub-parallel laminate and shell beds.

The results of the purposive drilling for the recovery of samples for palaeoenvironmental assessment were broadly in agreement with the information derived from the previous work at the site. The following points were noted:

- The upper c. 3.50 metres were made ground. Made ground extends from +1.5m O.D. to -2.0m O.D.
- The main body of sediment present in the boreholes consisted of sands and silts typical of Holocene tidal/sub tidal deposition. No major breaks or changes in depositional character were suggested by sediment patterns. However, direct observations were difficult due to the disturbed nature of the deposits recovered from much of this sequence. Sample recovery from this part of the sequence was not possible due to the very soft nature of the sequences. These deposits extended from -2.0m to -6.5m O.D.
- The basal part of the sequence consisted of compact clay-silts with shell debris and plant fragments. These deposits extended from -6.5m to -8.5m O.D. Recovery of these sediments was possible in two core samples.

4. POLLEN ASSESSMENT

Samples were processed using floatation to maximise their potential for analysis. All samples were found to contain pollen grains and recommendations have been made on their potential for future pollen analytical work. All samples derive from the lower 2m of the borehole.

4.1 Method

Pollen preparation was undertaken using a floatation method (Nakagawa *et al.*, 1998) due to the sediments being largely silts. This enabled the pollen within these low organic sediments to be condensed so as to increase the potential of these levels for any future pollen analysis. The pollen samples were then scanned using a stereo microscope to look for the presence/absence of pollen, non-pollen palynomorphs (e.g. fungal spores) and microscopic charcoal.

4.2 Results/Discussion

The results of the pollen assessment are shown in Table 2.

All samples were found to contain pollen, which showed good preservation with few degraded, broken and crumpled grains observed on the slides. However, pollen abundance was noted as being low on the slides. This demonstrates how important using a floatation method was; should standard preparation techniques have been used (*e.g.* the use of hydrofluoric acid) it is unlikely any pollen would have been observed.

A rapid scan of the pollen slides revealed a probable coastal woodland environment dominated by *Quercus* (oak) and *Corylus* (hazel) pollen. Other arboreal taxa observed included *Pinus* (pine) and *Alnus* (alder). Herbaceous taxa were also observed with the presence of Chenopodiaceae (goosefoots), which is likely to represent the presence of saltmarsh vegetation. There is some evidence for burning episodes taking place with microscopic charcoal fragments also observed on the slides (however these may be lignite fragments from the bedrock).

This evidence agrees well with previous investigations (Bates *et al.*, 2005) that suggested that initial accumulation in the rife probably occurred in the mid-Holocene (late Mesolithic-Neolithic) when the regional vegetational cover was one of mixed oak woodland. Later elements in the rife appear to have accumulated in the late Neolithic (post 5800 cal yrs BP) through into the Middle or perhaps even the later Bronze Age.

The presence of non-pollen palynomorphs (NPP's) was noted as being low on the slides. Initial observations from the pollen present on the slides suggests it may represent former coastal woodland similar to that of low inter-tidal submerged forests, such as those in the Severn Estuary (e.g. Bell *et al.*, 2003; Bell, 2007) and Langstone Harbour, Hampshire (Clapham and Allen, 2000).

5. FORAMINIFERA AND OSTRACODA ASSESSMENT

5.1 Method

A total of nine samples were submitted for investigation from the lower part of the borehole. Each sample was weighed and placed in a ceramic bowl and, thoroughly dried in an oven. Boiling water was then poured on the sample and a little sodium carbonate added to help remove the clay fraction. It was then left to soak overnight. The samples, which were of shelly sand, sand or silty-sand, readily broke down. Next, each sample was washed through a 75 micron sieve with hot water and the resulting residue decanted back into the bowl for drying back in the oven. When dry, the sample was finally stored in a labelled plastic bag. Picking was undertaken under a binocular microscope. Foraminifera and ostracods were picked out with a fine camel-haired brush from a tray and placed into 3x1" faunal slides. Other interesting organic remains (molluscs, plant debris and seeds, etc.) were noted and recorded on a simple presence/absence basis on the distribution chart (Table 3). The abundance of each foraminiferal and ostracod species was recorded

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in a semi-quantitative manner (as present, common or abundant).

5.2 Results/discussion

The main organic remains are shown in Table 3. In addition to forams and ostracods shell debris and occasional plant remains were found in most samples. Ecological preferences are colour coded and these preferences are taken from Murray (1971) for the foraminifera and Athersuch *et al.* (1989) for the ostracods.

The foraminiferal and ostracods faunas are almost invariably extremely rich. The microfaunas recovered are representative of estuarine mudflats, situated in the seaward part of tidal inlet. The marine component decreases up-sequence after the initial breaching event.

All of the boreholes have a low-diversity but sizeable "indigenous" brackish inner estuarine fauna of foraminifera and ostracods throughout their sequences, indicating the presence of an estuary/embayment, with extensive mudflats and associated fringing salt-marsh. There are also a significant number of outer estuarine and marine species which may have been washed in (in part). This second assemblage is commonest in the lower part of the sequence.

6. DISCUSSION

By comparison with the previous investigation (Bates *et al.,* 2005) the results of the 2008 investigation are disappointing. The recovery of samples from the borehole was poor due to the very soft nature of the sediments. This was despite the use of a piston sampler. Additionally the thicknesses of the sequences present at the site were considerably reduced due to the shallowing of the rife margins. Consequently there is no possibility of attaining the depths (and time depth) of the previous work (Bates *et al.*, 2005).

Assessment of the recovered samples indicates that similar ranges of material are preserved in the sequences although molluscs were only typically fragmentary throughout. On the whole the pollen, although low in abundance does appear countable due to the good preservation of those grains observed on the slides. Good preservation of forams and ostracods was also noted.

The absence of any substantial organic horizons (coupled with the previous problems of sampling lignite) has rendered any ^{14}C dating impossible at this stage of works.

The evidence obtained indicates that a sequence of deposits infilling the rife at the site, probably from the later prehistoric to recent periods, are preserved. These document deposition under estuarine conditions becoming removed from open marine access up sequence.

7. CONCLUSION

The assessment of the recovered material from the Ocean Hotel site, Bognor, has shown that whilst the preservation of microfossils (pollen, foraminifera and ostracods) is generally good within the sequence, the sequence encountered is shallower than that found in previous studies of the area. The absence of suitable dating material also poses a problem to reconstructing the chronology of sediment deposition. It is therefore suggested that the sequence from the Ocean Hotel is not subjected to any further work and that instead, other, more suitable sequences should be sought for analyses similar to those previously recorded.

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Table 1

Lithology from borehole

Depth (m)	***Description***
0.0-0.1	Tarmac
0.0 – 3.5	Made Ground
3.5 – 8.0	Mid to dark grey sand. Very soft and unconsolidated. Weakly laminated in places and occasional shell fragments.
8.0 – 10.0	Mid dark grey silt with slight sand fraction, occasional shell and plant fragments. Becoming denser and more compact with depth.
10.0 -	Mid brown clay silt. Very dense firm and compact

Table 2

Pollen Assessment Results from Bognor Regis

Depth (m)	***Pollen Present***	***Abundance***	***Preservation***	***Observed taxa***
8.05	Yes	Low	Good	*Quercus, Corylus*
8.25	Yes	Low	Good	*Chenopodiaceae, Quercus, Corylus*
8.45	Yes	Low	Good	*Pinus, Quercus, Corylus, Alnus*
8.65	Yes	Low	Good	*Quercus, Corylus*
9.05	Yes	Low	Good	*Quercus, Corylus, Alnus*
9.25	Yes	Low	Good	*Quercus, Corylus*
9.45	Yes	Low	Good	*Quercus, Pinus, Alnus, Corylus, Chenopodiaceae*
9.65	Yes	Low	Good	*Quercus, Polypodium, Corylus*
9.85	Yes	Low	Good	*Quercus, Corylus, Chenopodiaceae*

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Table 3

Foraminifera and Ostracoda from samples assessed

	C3				C4				
ORGANIC REMAINS	***8.05m***	***8.25m***	***8.45m***	***8.65m***	***9.05m***	***9.25m***	***9.45m***	***9.65m***	***9.85m***
brackish/outer estuarine/marine foraminifera	x	x	x	x	x	x	x	x	x
brackish/outer estuarine/marine ostracods	x	x	x	x	x	x	x	x	x
molluscs	x	x	x	x	x	x	x	x	x
freshwater ostracods	x	–	–	–	–	–	–	–	–
plant debris	–	x	x	–	–	x	–	–	x
Ecology	estuarine mudflats, situated in seaward part of tidal inlet; marine component decreasing after initial breaching event								

	C3				C4				
BRACKISH INDIGENOUS FORAMINIFERA	***8.05m***	***8.25m***	***8.45m***	***8.65m***	***9.05m***	***9.25m***	***9.45m***	***9.65m***	***9.85m***
Haynesina germanica	xx	xx	xx	xx	xx	xx	xx	xx	xx
Elphidium williamsoni	xx	x	x	xx	–	x	x	x	x
Ammonia aberdoveyensis	xx	x	xx	xx	x	xx	xx	xx	xx
Elphidium waddense	–	–	–	–	x	–	x	x	x
Ammoscalaria runiana	–	–	–	–	x	x	x	xx	–

	C3				C4				
OUTER ESTUARINE & MARINE FORAMINIFERA	***8.05m***	***8.25m***	***8.45m***	***8.65m***	***9.05m***	***9.25m***	***9.45m***	***9.65m***	***9.85m***
Ammonia batavus	x	–	x	–	–	x	x	x	xx
Elphidium macellum	x	–	–	o	–	–	x	x	x
Quinqueloculina spp.	x	–	x	x	–	x	x	x	x
Elphidium margaritaceum	x	–	x	x	–	x	–	–	–
Elphidium excavatum	–	–	–	x	–	x	xx	x	xx
discorbids	–	–	–	x	–	–	–	–	–
lagenids	–	–	–	–	–	x	–	x	–

	C3				C4				
BRACKISH INDIGENOUS OSTRACODS	***8.05m***	***8.25m***	***8.45m***	***8.65m***	***9.05m***	***9.25m***	***9.45m***	***9.65m***	***9.85m***
Cyprideis torosa (smooth)	xx	o	x	x	–	x	–	o	o
Leptocythere porcellanea	x	–	x	–	–	–	–	–	–
Leptocythere castanea	x	x	x	x	x	x	x	x	x
Leptocythere lacertosa	x	x	x	x	–	x	x	x	x
Leptocythere psammophila	x	–	–	o	–	–	–	x	x
Loxoconcha elliptica	x	–	–	x	–	–	–	–	–
Cytherois fischeri	o	–	–	o	o	–	o	–	–

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	C3				C4				
OUTER ESTUARINE & MARINE OSTRACODS	**8.05m**	**8.25m**	**8.45m**	**8.65m**	**9.05m**	**9.25m**	**9.45m**	**9.65m**	**9.85m**
Loxoconcha rhomboidea	xx	x	x	xx	x	x	xx	xx	xx
Hemicythere villosa	xx	x	x	x	–	x	x	x	xx
Pontocythere elongata	x	–	–	x	–	x	–	x	x
Heterocythereis albomaculata	x	–	o	x	–	x	x	x	xx
Semicytherura nigrescens	–	x	–	–	–	–	–	–	–
Hirschmannia viridis	–	–	x	x	o	–	x	x	x
Semicytherura sella	–	–	x	–	–	–	o	o	–
Palmoconcha laevata	–	–	–	x	–	o	–	–	–
Leptocythere pellucida	–	–	–	–	–	x	x	x	xx
Bonnyannella robertsoni	–	–	–	–	–	–	x	–	xx
Palmoconcha guttata	–	–	–	–	–	–	–	x	x
Leptocythere tenera	–	–	–	–	–	–	–	–	x
Paracytheridea cuneiformis	–	–	–	–	–	–	–	–	x

	C3				C4				
"EXOTIC" OSTRACODS	**8.05m**	**8.25m**	**8.45m**	**8.65m**	**9.05m**	**9.25m**	**9.45m**	**9.65m**	**9.85m**
Aurila convexa	x	–	–	x	o	o	x	xx	xx

	C3				C4				
FRESHWATER OSTRACODS	**8.05m**	**8.25m**	**8.45m**	**8.65m**	**9.05m**	**9.25m**	**9.45m**	**9.65m**	**9.85m**
Ilyocypris sp.	o	–	–	–	–	–	–	–	–

Organic remains are listed on a presence (x)/absence basis only

Foraminifera and ostracods are listed: o - one specimen; x - several specimens; xx - common

calcareous foraminifera of low-mid saltmarsh and tidal flats

agglutinating foraminifera of estuarine tidal flats

brackish ostracods of mudflats and creeks

essentially marine foraminifera and ostracods, but can penetrate outer estuaries

warm “southern” marine species (at limit of northern distribution)

freshwater ostracods

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