Palaeobotanical investigations of buried peats along the route of the Carmarthen Eastern Bypass

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(Palaeoenvironmental Research Centre, University of Wales, Lampeter)

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Introduction

Reconnaissance work along the route of the proposed Carmarthen Eastern Bypass on the south side of the town of Carmarthen had revealed the presence of fibrous peats beneath an overburden of made ground. The age and origin of these deposits were not clear from the original survey work, but it was felt that the peats and associated silts and clays could potentially be of significance in reconstructing the environmental history of this part of the lower Towy Valley. This report presents a preliminary account of the palaeobotanical remains contained within these peats, evaluates their palaeoenvironmental significance, and makes recommendations for further work on these deposits.

Fieldwork

Following the initial survey in July 1995, and the site was revisited in September and two machine-cut trenches were excavated to depths of *c.* 2.8 m within the area of chainage 500 (NGR SN 4150 1950: Figure 1). In each trench, brown fibrous peats intercalated between grey silts/clays, were exposed beneath 1-2 m of made ground. Samples were taken from the exposed section faces in standard monolith tins, each 15 x 15 cm in cross section, and 30, 40 or 50 cm in length. The sampling column spanned the entire thickness of peat/organic mud and extended into both the overlying and underlying silts/clays. The monoliths were wrapped in clingfilm and transported to the laboratory where they have been stored in a deep-freeze.

The lithostratigraphic sequence exposed in the two trenches was as follows:

Site 1	(top of monolith sequence 1.85 cm below ground surface)
0-6 cm	Grey silt/clay with small stones/grit
6-10 cm	Inclined band of grey grit
10-13 cm	Fine grey silt/clay; paste-like and structureless with a small amount of organic matter

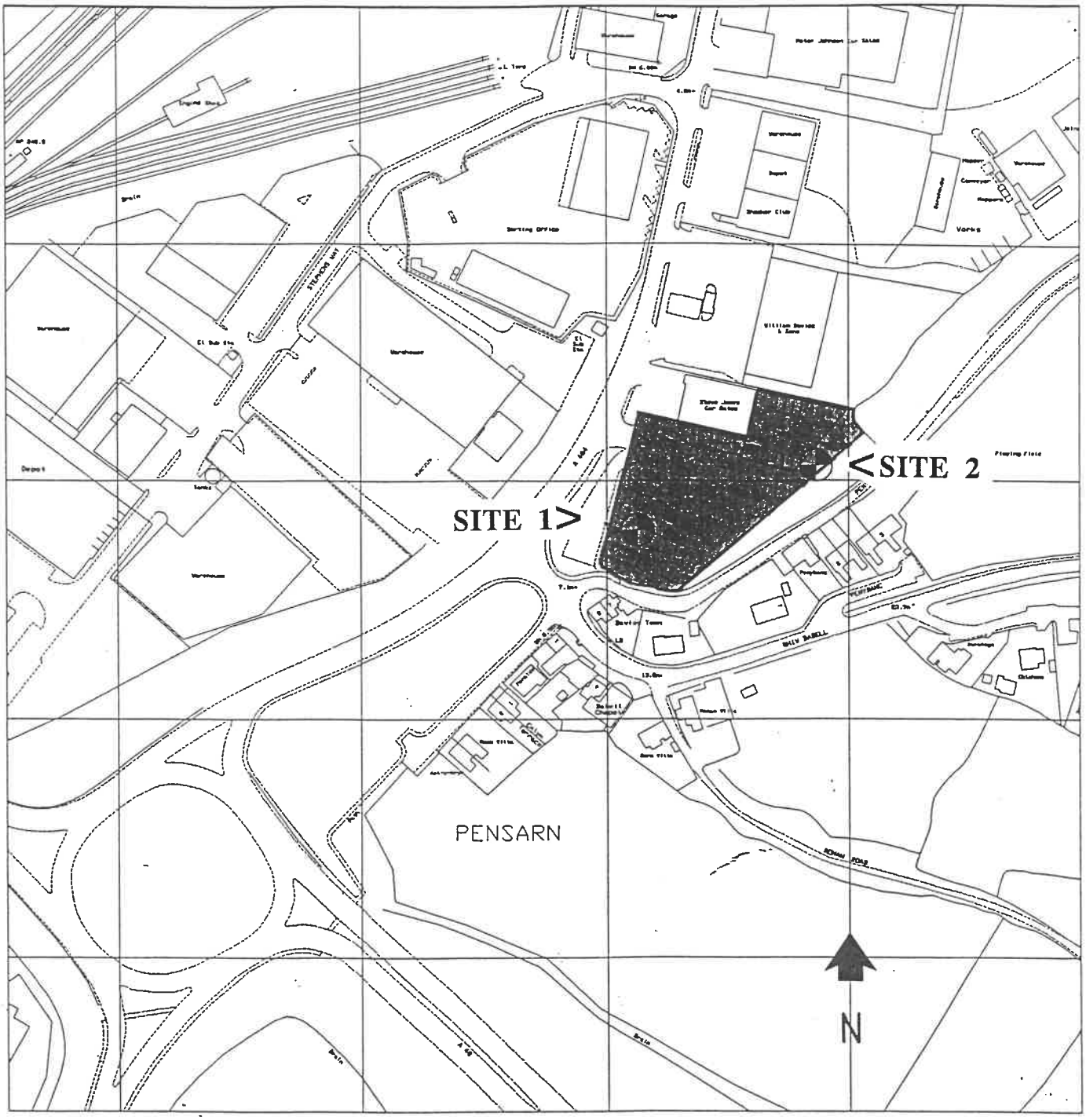

Figure 1: Location of the sampling sites

13-47 cm	Fine grey-brown mud, organic content gradually increasing with depth. Lower boundary sharp
47-73 cm	Light brown sedge (?) peat. Very fine in texture and relatively dry
73-88 cm	Gradual change to more organic mud; organic content decreases progressively towards the base of the unit
88-92 cm	Grey silt/clay. Fine, paste-like and structureless. Some organic content, but relatively little.

Site 2	(top of monolith sequence 1.05 m below ground surface)
0-7/18 cm	Grey-brown mud, paste like in texture, becoming gradually more organic with depth. Lower boundary diffuse over *c.* 10 cm
7/18-28 cm	Brown organic mud
28-48 cm	More fibrous organic mud/peat, with finer layers of drier paste-like mud/peat
48-75 cm	Light brown sedge (?) peat. Very fine in texture and relatively dry
75-95 cm	Woody peat, coarser in texture and more fibrous
95-109 cm	Brown organic mud/peat; much finer and with fewer macrofossils
109-147 cm	Intercalated brown organic mud and grey silt/clay. Macrofossils of wood near the base. Increasingly paste-like; clay content increasing downwards
147-151 cm	Grey silt/clay with some organic mud. Macrofossils of reeds and small wood fragments.

Laboratory methods

Samples for pollen analysis were prepared using standard techniques including digestion in 10% KOH followed by acetolysis (Moore *et al.*, 1991). Residues were mounted in safranin-stained glycerine jelly and analysed using a Vickers M15C microscope at x400 magnification, with critical identifications under oil at x1000. Pollen and spores were categorised on the basis of the key in Moore *et al.* (1991). As this was essentially a reconnaissance exercise, a sum of only 100 land pollen grains was adopted. Nine levels were counted from Site 1 and 15 from Site 2. All contained pollen, with the peats in particularly yielding relatively large numbers of well-preserved grains.

As a rapid means of assessing the plant macrofossil potential of the deposits, the residues retained in the 106 micron sieves during the pollen preparation process were examined. The plant remains recorded are presented in Tables 1 and 2. Other remains were also noted. However, as these samples were very small (*c.* 1ml) and therefore larger seeds likely to be underrepresented, a further nine samples, 10ml in size, were selected on the basis of the stratigraphic and pollen evidence for examination. The sieve mesh size for these samples was 250 microns. These samples are not reported in detail but reference will be made to them where they provide additional

information. The 10ml samples examined from Site 1 were from 25-30cm, 50-55cm and 75-80cm, and from Site 2 from 20-25cm, 40-45cm, 60-65cm 80-85cm, 100-105cm and 120-125cm. Identifications were based on comparison with modern reference material and standard identification texts. Nomenclature follows Stace (1991).

Radiocarbon dating

Support was available for two ^{14}C dates. As Site 2 contained the longer record, both samples were taken from this profile. The upper sample (CEB-14) was taken at 14 cm which lies at the base of the transitional unit from overlying silts/clays to underlying organic mud. The sampling point was at that part of the profile where organic sediment become predominant. The lower sample (CEB-109)

The pollen record

Pollen diagrams from the two profiles are shown in Figures 2 and 3. The records are very similar, and can be divided into three local pollen assemblage zones:

CEB-1: A biozone dominated by woody plant pollen, particularly *Alnus*, but also *Quercus*, *Corylus* and, to a lesser extent, *Fraxinus*. This biozone is more strongly represented at Site 2, where the upper levels are also characterised by a significant increase in Apiaceae.

CEB-2: A biozone dominated by Poaceae and Cyperaceae, during which there is a marked reduction in pollen of woody plants. Pteropsida counts also increase in this biozone.

CEB-3: A biozone dominated by Poaceae, with relatively high counts for Asteraceae, Lactuceae and *Rumex*, with important contributions from Caryophyllaceae, *Plantago* spp and *Ranunculus*. This zone is more strongly represented at Site 1, where there is also a clear increase in woody plants, initially *Quercus* and *Corylus*, but subsequently also *Alnus*.

The plant macrofossil record

Site 1

The lowest two samples (Table 1 90cm and 80cm) contained little macroscopic vegetative material but large quantities of *Juncus* seeds. *Mentha* and Poaceae seeds were also recorded. In 75-80cm monocotyledonous remains dominated and *Alisma* and *Ranunculus* were present. Monocot. remains were much more frequent in samples 70cm, 60cm and 50cm. *Juncus* seeds were much less abundant and *Carex* and *Lychnis flos-cuculi* seeds were present. In 50-55cm monocot. remains were abundant and occasional fragments of wood occurred. Larger seeds, notably *Carex*,

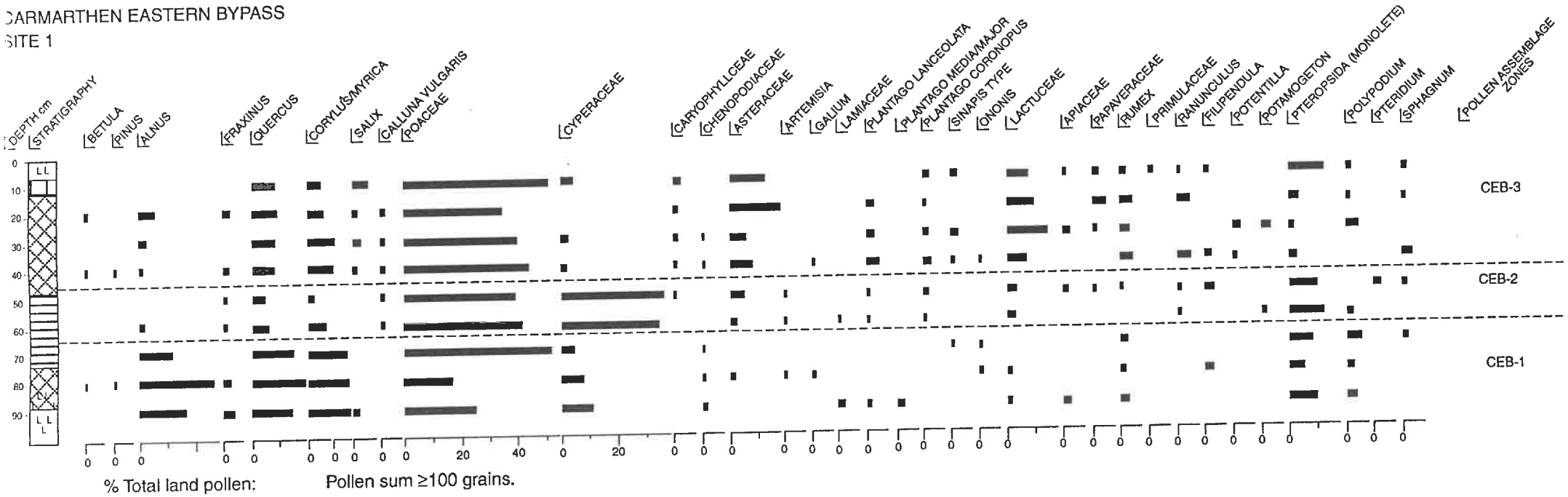

Figure 2: Pollen diagram from Site 1

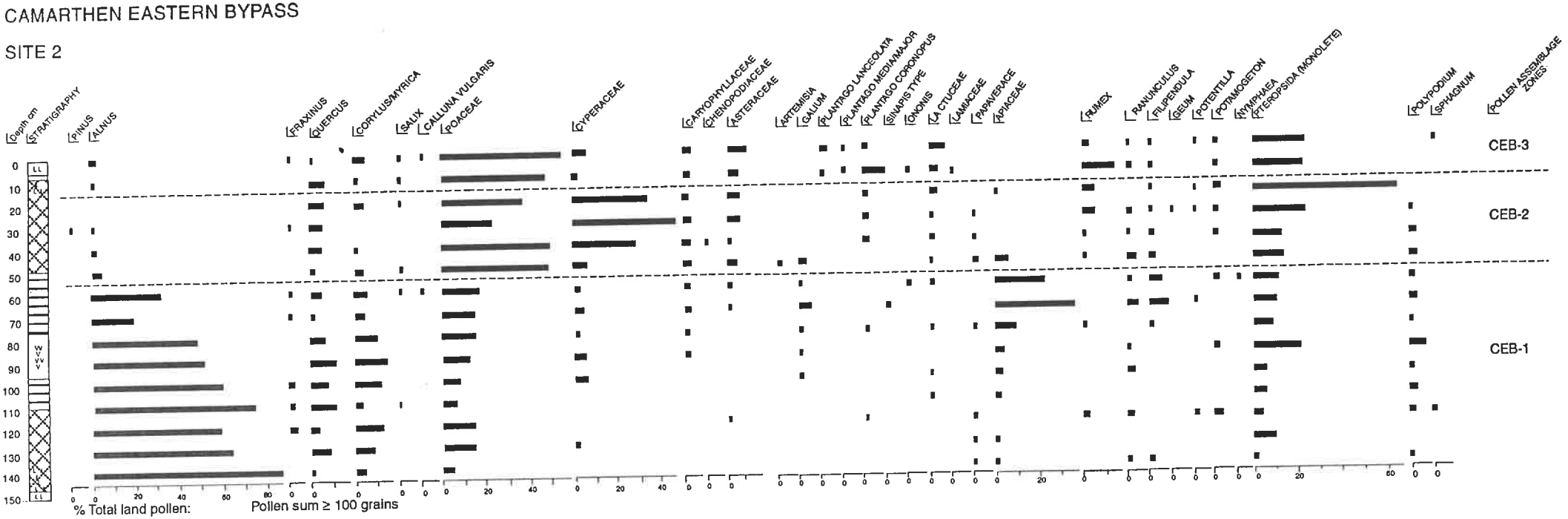

Figure 3: Pollen diagram from Site 2

were frequent. Other seeds included *Lychnis flos-cuculi* and other Caryophyllaceae. In the remaining samples (40cm, 30cm and 20cm) *Juncus* became more frequent again and *Montia fontana*, *Ranunculus*, Poaceae and *Sagina* type occurred. These were also present in 25-30cm as well as Apiaceae. Apart from *Juncus*, Poaceae and *Carex* seeds were recorded at 10cm.

Site 2

The lower samples (Table 2 140cm-80cm,) contained cone-scales and fruits of *Alnus*. Fragments of wood and leaves dominated the samples. *Urtica dioica*, Brassicaceae, *Rumex* and *Rubus* were present and fern sporangia were frequent. In contrast the upper samples (70cm-10cm) were dominated by monocotyledonous remains. The final sample (0cm) was dominated by minerogenic material. *Stellaria/Cerastium* type seeds occurred in a number of samples and Apiaceae, *Persicaria*, *Urtica dioica* and *Ranunculus* were present occasionally. A similar range of material was recorded in the 10ml samples but the larger seeds were better represented. For example, *Carex* seeds were particularly frequent in 20-25cm and *Ranunculus* and *Rubus* were also present. In addition, *Rubus* and *Alnus*, not recorded at 60cm in the sample from the pollen sievings, were recorded in the 60-65cm sample.

Discussion

The palaeobotanical data from the two sites reflect an initial episode of woodland, in which *Alnus glutinosa* was the dominant element, with *Quercus* and *Fraxinus* on drier sites around on the valley floor and also, perhaps, on the surrounding hillslopes. The very high counts for *Alnus* pollen, especially at Site 2, suggest that an alder carr was well established on the river floodplain, and this is confirmed by the plant macrofossil evidence. The progressive decline in *Alnus* throughout local paz CEB-1 and the abrupt rise in Cyperaceae pollen in CEB-2 appears to reflect the replacement of this alder carr by open sedge fen. Again the pollen evidence is supported by the plant macrofossil evidence which demonstrates the presence of sedges (Carex) locally. This may have been due to a gradual rise in the regional water-table for, particularly at Site 2, the rise in the curve for sedge pollen is preceded by an increase in taxa frequently associated with damper habitats, most noticeably species of Apiaceae (Umbelliferae) which are also present in the plant macrofossil record, *Filipendula ulmaria* and perhaps also *Ranunculus* (*Caltha palustris/R aquatilis*?) and *Galium* (*G. palustre/G.uliginosum*?). The duration of this event cannot be established on present evidence. Subsequently, drier conditions appear to have obtained, with a slight increase in woody plant pollen and a limited re-establishment of alder carr (Site 1). The upper part of the record seems to be dominated, however, by taxa associated with grassy or waste places. These include *Plantago lanceolata*, *P. coronopus*, *Rumex*, *Potentilla*, and species of Poaceae, Caryophyllaceae, Asteraceae and Lactuceae. Several (e.g. *P. lanceolata*) are often associated with agricultural activity (Behre, 1986), although they also occur as ruderals in natural habitats. An open

grassland, with intermittent patches of bare ground, appears to be reflected in the record. An open environment is also indicated by the plant macrofossils. Further detailed plant macrofossil analysis may provide more precise information about the open habitats available.

What is not clear from the present evidence, is the nature of the underlying and overlying silty clays. One hypothesis might be that they are estuarine muds, and hence the transition from mineral sediment to peats in the lower parts of the profiles represents a relative fall in sea-level (a marine regression), while the upper levels of the profiles, the gradual change from organic to mineral sediment is indicative of a relative rise in sea-level (a marine transgression). The River Towy is currently tidal to this point in the valley, and therefore a marine influence at the site would not be unexpected. In other parts of South Wales, a relative fall in sea-level has been dated to around 5.9 k ^{14}C yrs BP and a relative rise to c. 2.5 k ^{14}C yrs BP (Godwin & Willis, 1964; Smith & Morgan, 1989; Walker & James, 1993). In the pollen records from the two sites described here, however, there are no obvious indicators of a marine influence (Chenopodiaceae, for example), although it possible that some of the species included in the Asteraceae and Caryophyllaceae categories could have maritime affinities. Similarly there are no clear indicators of a brackish-water environment in the plant macrofossil record. One way in which this problem might be addressed would be to employ diatom analysis, but this lies outside the scope of the current report. Other hypothesis regarding the silts and clays involve changes in fluvial régime (although the fine-grained and cohesive nature of the sediments suggest low energy environments of deposition), or backswamp sedimentation on the Towy floodplain governed, perhaps, by local hydrological variations.

Conclusions and Recommendations

The peats that underlie the made ground on the Towy floodplain to the south of Carmarthen contain a rich pollen and plant macrofossil record that reflects local and regional vegetational changes during the mid-Holocene. It is difficult to establish, on the evidence so far available, the nature of the overlying and underlying mineral sediments, nor of the processes that led to the onset and subsequent cessation of peat accumulation in the area. The deposits are, however, of considerable ecological interest, and could add significantly to our knowledge of mid-Holocene landscape changes in this part of South Wales.

It is therefore **RECOMMENDED** that further work be undertaken on these peats. While abundant material has been retained in the laboratory in Lampeter for further analysis, it would be extremely valuable to obtain further material from the field area. Should the proposed bypass go ahead as planned, it may well prove necessary to strip away the peats along the length of the roadway, as these will clearly not possess the load-bearing capacity to support a modern roadway.

This should offer a unique opportunity to establish the lateral extent of the peats, and top obtain a set of samples that would enable a three-dimensional representation to be obtained of the development and subsequent demise of vegetation on the floodplain. The programme of research should involve not only pollen and plant macrofossil analysis, but also diatom analysis, and physical and chemical analysis of the sediments. The programme should also be underpinned by a suite of ^{14}C dates.

In the interim, it is **RECOMMENDED** that further work be carried out on the material that has been obtained so far, along the following lines:

1. Pollen analysis should be carried out throughout the two profiles at a minimum sampling interval of 5 cm, and at 2 cm where necessary, with a pollen sum of 300 grains at all levels. Those levels already counted to 100 grains should have the pollen sum increased to 300.

2. Further plant macrofossil analysis should be undertaken to underpin and augment the pollen analytical results. In particular the sample size of the 9 samples already selected should be increased and detailed work carried out.

3. Diatom analyses should be carried out on the upper and lower sections of the profiles.

4. Sedimentological analysis (particle size etc) should be undertaken on the upper and lower minerogenic deposits to characterise these sedimentary units.

5. Radiocarbon dates should be obtained on the following horizons:

(i)	The upper and lower organic/inorganic contacts in Site 1	(2 dates)
(ii)	The pollen assemblage zone boundaries	(4 dates)
(iii)	The rise in Apiaceae at Site 2	(1 date)
(iv)	The transition from organic mud to woody peat in Site 2	(1 date)
		8 dates in all

These additional analyses will help to answer many of the unanswered questions that have been raised during the preliminary investigations of the peats, and should provide a palaeonvironmental picture that is sufficiently detailed for publication.

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Table 1: The plant remains from Site 1

	90cm	80cm	70cm	60cm	50cm	40cm	30cm	20cm	10cm
Minerogenic material	+	+	+	-	-	+	+	+	+
Wood frags.	-	+	-	-	-	-	-	-	-
Dicot. leaf frag.	-	+	-		-	-	-	-	-
Monocot. remains	+	+	+	+	+	+	+	+	+
Moss	-	-	-	+	+	+	+	-	-
Charcoal	-	+	-	-		-	-	-	-
Ranunculus sp.	-	-	-	-	-	2	1	-	-
Montia fontana L.	-	-	-	-	-	1	-	-	-
Sagina type	-	-	-	-	-	3	1	-	-
Lychnis flos-cuculi L.	-	-	-	-	1	-	-	-	-
Mentha sp.	-	1	-	-	-	-	-	-	-
Juncus sp.	66	103	11	2	1	8	16	43	9
Carex sp. - biconvex	-	-	-	2	2	-	-	-	1
Poaceae	-	2	1	-	-	-	1	-	1
Foraminifera	+	-	-	-	-	-	-	-	-
Insects	+	+	+	+	+	+	+	+	+
cf. Cladocera	-	+	+	+	+	+	+	-	-

Table 2: The plant remains from Site 2

	140cm	130cm	120cm	110cm	100cm	90cm	80cm	70cm
Minerogenic material	+	-	+	-	+	-	+	+
Wood frags.	+	+	+	+	+	+	-	+
Dicot. leaf frags.	+	+	+	+	+	+	+	+
Monocot. remains	+	+	+	+	+	+	+	+
Moss	+	-	+	+	-	-	-	-
Charcoal	-	-	-	-	-	-	-	-
Ranunculus sp.	-	-	-	-	-	-	-	-
Urtica dioica L.	-	-	-	-	-	1	-	-
Stellaria/Cerastium type	-	-	-	-	1	-	-	-
Sagina type	-	-	-	-	1	-	-	-
Alnus fruits	-	1	-	1	8	-	1	-
Alnus cone	-	-	-	-	-	-	1	-
Alnus cone frags	8	-	5	-	-	-	-	-
Alnus cone-scales	4	4	2	-	-	-	1	-
Rumex sp.	-	-	-	1	1	-	-	-
Persicaria sp.	-	-	-	-	-	-	-	-
Brasscaceae	-	1	-	-	2	1	2	1
Rubus sp. frags	-	-	-	-	-	-	2	-
Apiaceae	-	-	-	-	-	-	-	2
Juncus sp.	-	-	-	-	-	-	-	-
Carex sp. biconvex	-	-	-	-	-	-	-	-
Poacae	-	-	-	-	-	-	-	1
Scale	-	1	1	1	3	-	-	-
Fern sporangia	+	+	+	+	+	+	+	+
Insects	+	+	+	+	+	+	+	+
Mites	-	-	-	+	-	+	+	-
cf. Cladocera	-	+	+	-	+	+	+	+

	60cm	50cm	40cm	30cm	20cm	10cm	0cm
Minerogenic material	+	+	+	+	+	+	+
Wood frags.	+	-	-	-	-	-	-
Dicot. leaf frags.	+	-	-	+	-	-	-
Monocot. remains	+	+	+	+	+	+	-
Moss	-	+	+	+	+	+	-
Charcoal	+	-	-	-	-	-	+
Ranunculus sp.	-	-	1	-	-	-	-
Urtica dioica L.	1	-	-	-	-	-	-
Stellaria/Cerastium type	1	4	2	2	3	-	-
Sagina type	-	-	1	-	-	-	-
Alnus fruits	-	-	-	-	-	-	-
Alnus cone frags	-	-	-	-	-	-	-
Alnus cone-scales	-	-	-	-	-	-	-
Rumex sp.	-	-	-	-	-	-	-
Persicaria sp.	1	-	-	-	1	-	-
Brassicaceae	3	-	-	-	-	-	-
Rubus sp. frags	-	-	-	-	-	-	-
Apiaceae	-	-	-	-	-	-	-
Juncus sp.	-	100+	1	1	1	1	13
Carex sp. biconvex	-	-	1	1	-	-	-
Poaceae	-	3	-	-	-	-	-
Scale	-	-	-	-	-	-	-
Fern sporangia	+	+	+	+	+	-	-
Insect	+	+	+	+	+	+	+
Mites	+	-	-	+	-	+	-
cf. Cladocera	+	+	+	+	+	+	-