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ARCHAEOLOGICAL EVALUATION OF THE MARKET DEEPING BYPASS

VOLUME 2: RESULTS OF THE ENVIRONMENTAL ASSESSMENT OF THE ARCHAEOLOGICAL DEPOSITS RECORDED ALONG THE LINCOLNSHIRE SECTION OF THE MARKET DEEPING BYPASS

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ARCHAEOLOGICAL
PROJECT
SERVICES

Lincolnshire County Council
Archaeology Section

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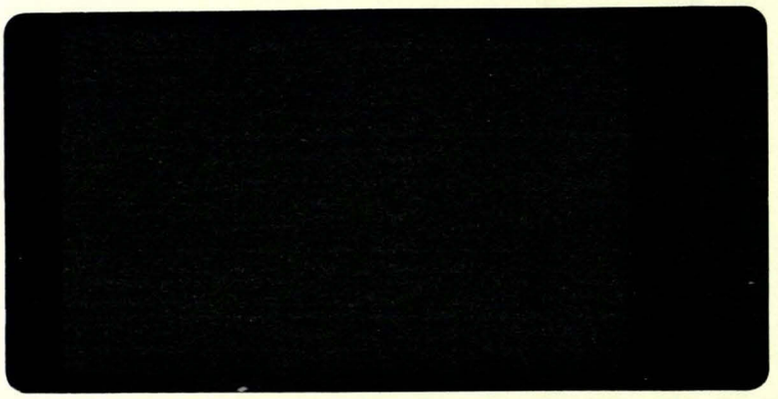

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Work Undertaken For
Environmental Consultancy Services

July 1999

Report compiled by Archaeoscape Consulting
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ArchaeoScape Consulting

Royal Holloway, University of London

in collaboration with
ENVIRONMENTAL ARCHAEOLOGY CONSULTANCY SERVICES
Maidenhead, Berkshire

MARKET DEEPING BYPASS (LINCOLNSHIRE) ASSESSMENT REPORT APRIL, 1996

report prepared for:-

Archaeological Project Services
Heritage Trust of Lincolnshire

compiled by: *N.P. Branch & J.J. Lowe*

~ for ~

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ENVIRONMENTAL ARCHAEOLOGY CONSULTANCY SERVICES

MARKET DEEPING BYPASS (LINCOLNSHIRE) ASSESSMENT REPORT APRIL, 1996

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MARKET DEEPING BYPASS (LINCOLNSHIRE) ASSESSMENT REPORT APRIL, 1996

PART A: SUMMARY ASSESSMENT REPORT (Vol. I)
PART B: TECHNICAL REPORTS & LOGS (Vol. II)

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MARKET DEEPING BYPASS

ASSESSMENT REPORT

APRIL, 1996

Part A: Summary Assessment Report

A1: INTRODUCTION

This part of the report summarises the overall findings and recommendations arising out of the assessment work undertaken by ***ArchaeoScape Consulting*** in connection with the construction of the proposed Market Deeping Bypass, Lincolnshire. Details of the analyses undertaken and of the logs recorded under this contract are provided in Part B.

In 1993, 49 geotechnical trial pits were excavated along the planned route of the Market Deeping Bypass (***Figure 1***) by *Engineering Consultancy Services*. A watching brief was undertaken during this work (Haynes & Start, 1993) because a number of features of archaeological significance had previously been reported from the locality, including, for example, Bronze Age burial mounds (ring ditches), Iron Age rectangular field systems and droveways, and Iron Age to Romano-British enclosures and drainage ditches. The Car Dyke, a notable waterway of Romano-British age, was also crossed by the planned Bypass route. No significant archaeological features were reported, however, as a result of the watching brief, although a possible major field boundary-ditch and possible ancient road construction materials were noted (Haynes & Start, 1993).

Subsequent to this, 31 evaluation trenches were excavated in 1996 along the proposed route between a point close to the River Welland, immediately to the west of Market Deeping, and a point to the east of Deeping Fen and north of Deeping St. Nicholas (***Figure 2***). These permitted a fuller examination of the local sediment successions, and thus an opportunity to establish their archaeological and palaeoenvironmental significance. Such an assessment was deemed necessary in view of the fact that the fens and lowland alluvial deposits adjacent to the planned route were known to be relatively rich in archaeological remains. Known records from the area include Neolithic ditch fills and an oval barrow near Maxey (French, 1991), a barrowfield and pottery of early Bronze Age from Deeping Fen (Hayes & Lane, 1992), various remains and field patterns of Bronze to Roman Ages near Market Deeping and Deeping St. James (Hayes & Lane, 1992; Murphy *et al.*, 1991), and a rich variety of archaeological features recorded throughout the Welland Valley (Pryor & French, 1985). Indeed, a high concentration of field boundaries and other archaeological trace features (depicted on aerial photographs) have been identified close to Trenches 7 to 12 and 30 and

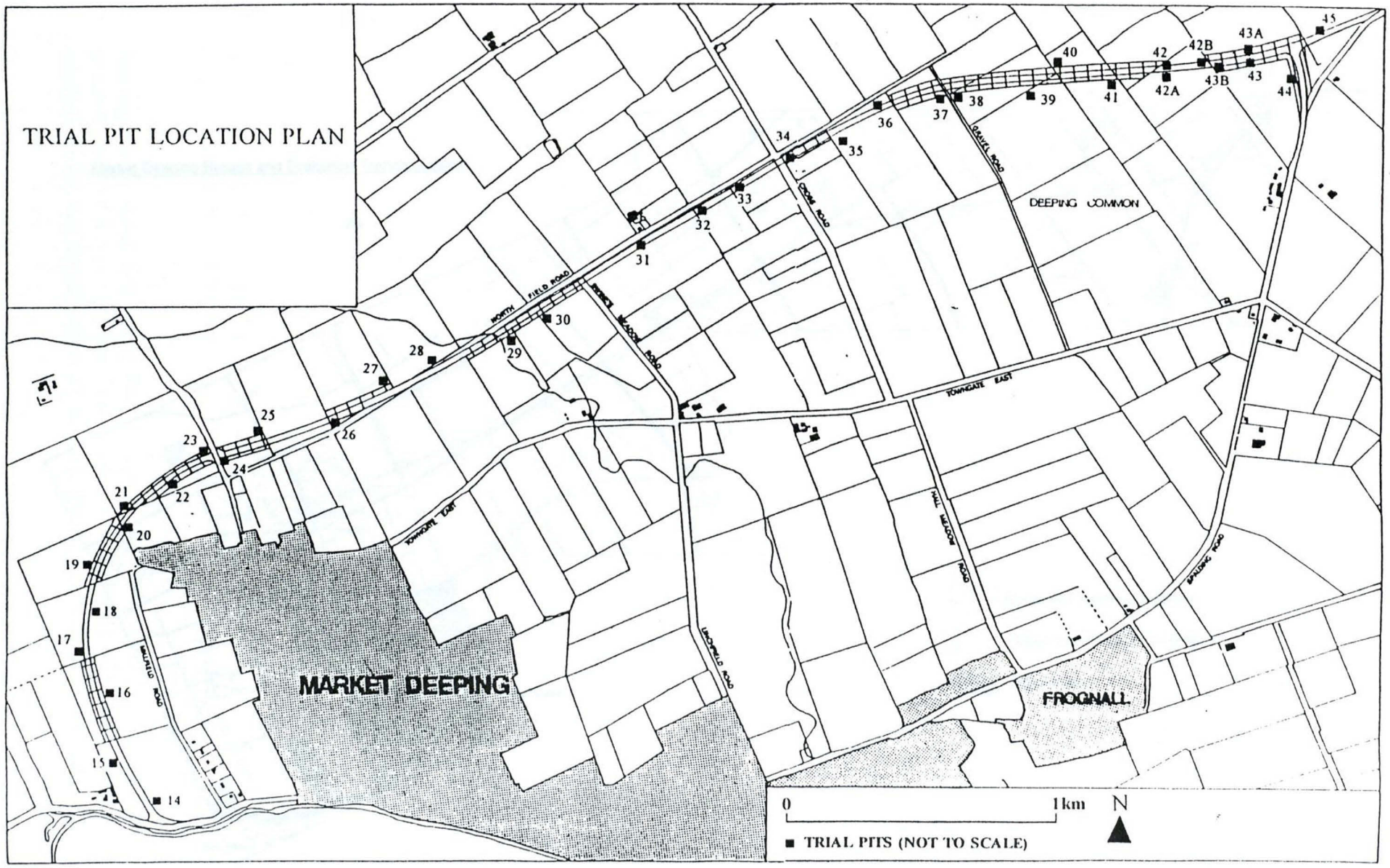


FIGURE 1: TRIAL PIT LOCATION PLAN

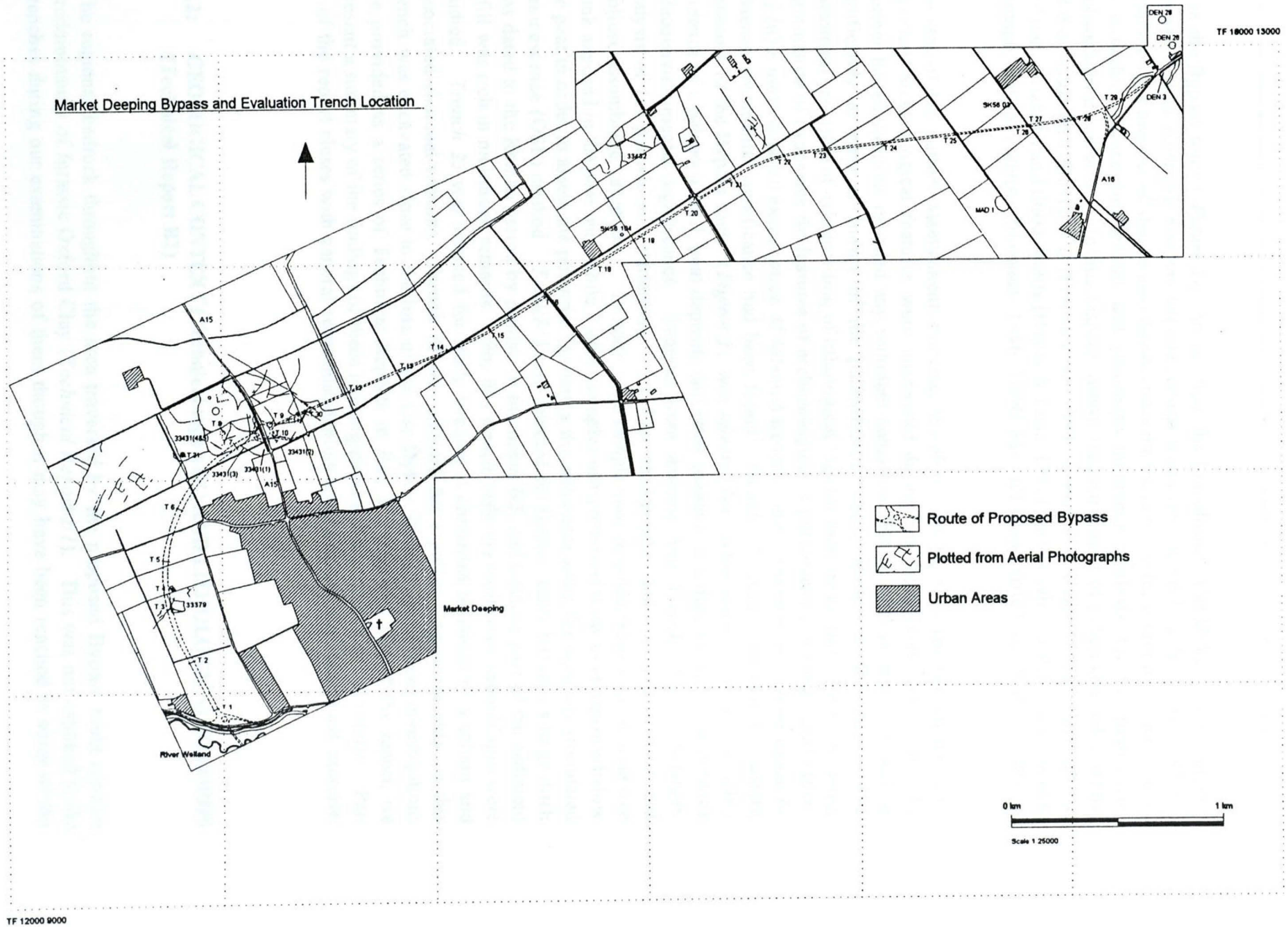

Market Deeping Bypass and Evaluation Trench Location
TF 18000 13000
TF 12000 9000
Market Deeping
River Welland
Route of Proposed Bypass
Plotted from Aerial Photographs
Urban Areas
0 km
1 km
Scale 1 25000

FIGURE 2

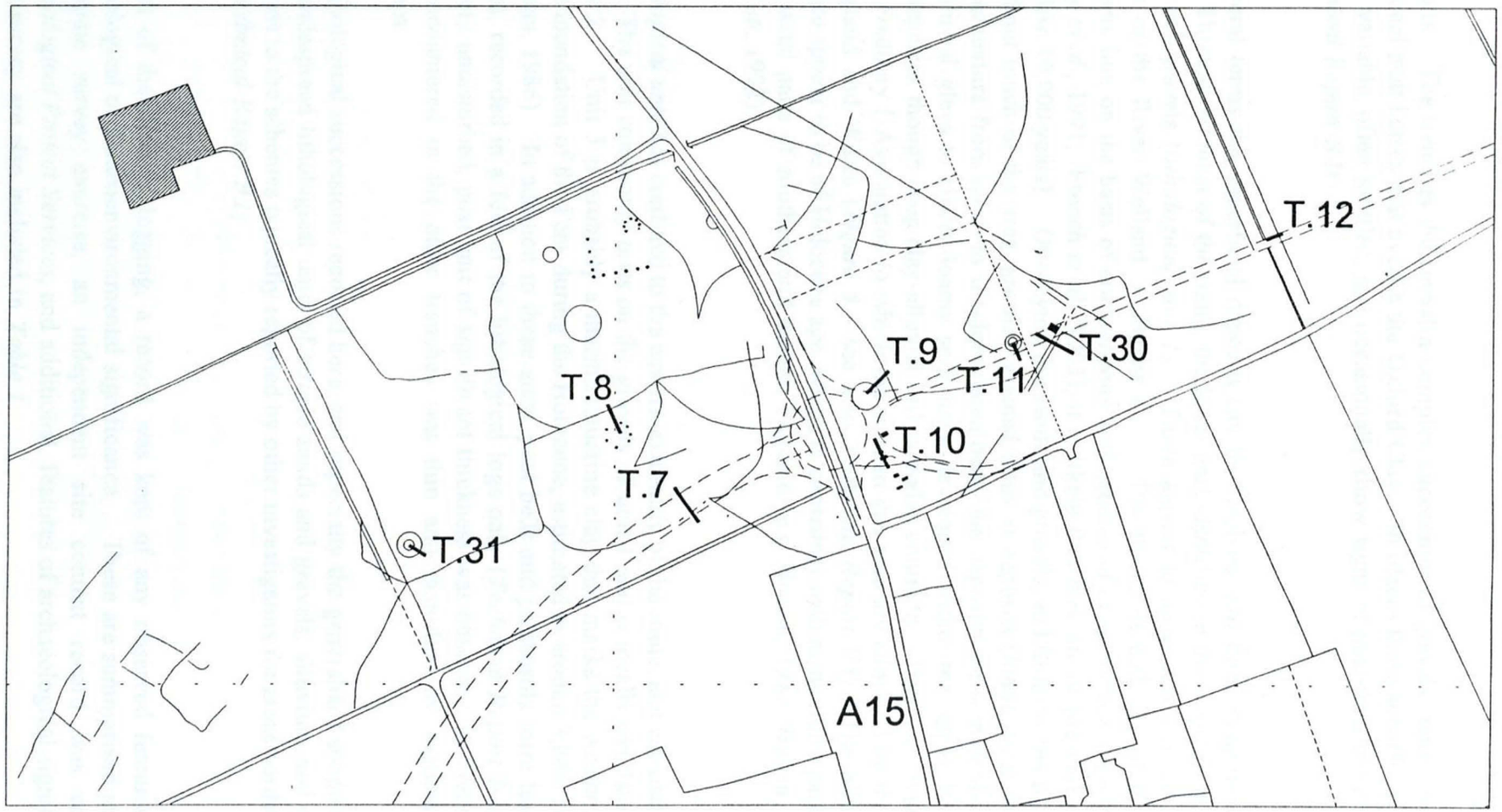
31 on the Bypass route (***Figure 3***). In addition, the Lincolnshire Car Dyke is an important Romano-British landmark that has attracted much scientific interest (e.g. Simmons, 1979). Furthermore, a number of studies also demonstrate the value of the local sediment successions for providing palaeogeographical and palaeoenvironmental contexts for the prehistoric (archaeological) records. In this respect, useful reconstructions of palaeochannel systems and their associated alluvial fills (French *et al.*, 1992; Brown & Keough, 1992), of prehistoric sea-level variations and flood events (Hayes & Lane, 1992), and of salt-marsh, tidal creek and drainage channel patterns (Shennan, 1986, 1994) have all been carried out in this region.

The aim of the current assesssment exercise, therefore, was to establish (a) whether any important archaeological features were uncovered during the engineering works and (b) whether the excavations revealed any sediment sequences that provide potential for adding significantly to what is known of the palaeoenvironmental history of the area. The assessment consisted of (i) recording of lithological logs for each excavation trench, including examination of exposures for features of archaeological or palaeoenvironmental significance; and (ii) a more detailed examination of selected trenches where features of archaeological or palaeoenvironmental significance had been found. *Trench 27*, located towards the eastern extremity of the Bypass route (***Figure 2***), was selected for further study because it revealed evidence of a palaeochannel, peat deposits and other material of palaeobiological, and hence palaeoenvironmental, significance. Samples were obtained from Trench 27 for preliminary analysis of (a) particle size variations, (b) pollen stratigraphy, and (c) plant, insect and mollusc assemblage variations. In addition, a sample was obtained from a 33cm wide tree trunk exposed in the peat unit, while 2 other samples were obtained from sand deposits below the peat in order to assess the potential for dating the sediments using the optically stimulated luminescence (OSL) method. *Trench 3* was selected for further study because a large ditch was dated to the Roman period by pottery in the upper fill, and because part of the sediment infill was rich in molluscan remains. For this trench, only the molluscan assemblages were studied. *Trench 23* was selected for study because it contained evidence of a saltern and associated charcoal remains. *Trench 12* was selected for a pollen assessment only, as this trench was excavated close to the line of the Car Dyke. The results of these investigations are provided as a series of Technical Reports in *Part B*. In this part of the report, we present a summary of the findings of these investigations and a synthesis of the results. Part A of the report closes with general recommendations arising out of the assessment exercise.

A2: GEOLOGICAL CONTEXT (Technical report B1) AND LITHOLOGICAL RECORDS (Technical Report B2)

The regional bedrock throughout the area traversed by the proposed Bypass route consists predominantly of Jurassic Oxford Clay (*Technical Report B1*). This was not exposed in the trenches during our examinations of them though it may have been reached in some of the

Market Deeping Bypass



Scale 1:5000

100m

FIGURE 3

trial pits. The trenches did reveal a complex succession of gravels, sands, silts, clays and occasional peat lenses that overlie the Oxford Clay. In places these superficial deposits are highly variable, often mottled, and occasionally show signs of post-depositional disturbance (*Technical Report B2*).

In general terms the superficial deposits can be resolved into three diagnostic lithological units. Throughout most of the route, the basal unit identified in the trenches is composed of sands and gravels (*lithological unit 1*). These appear to have accumulated within a low terrace of the River Welland (***Figure 4***). The thickness and age of the gravels are uncertain, but, on the basis of comparisons with studies of other terrace deposits in the area (Davey *et al.*, 1991; French *et al.*, 1993), it is likely that they are of pre-Holocene age (*i.e.* older than 10,000 years). OverLying the sands and gravels, and forming the surface deposits throughout much of the area, are fine-grained alluvial deposits (*lithological unit 2)*. These range in texture from sand- to silt-dominated beds, the deposits are commonly mottled, and pelo-alluvial gleys to clayey-loamy soils have developed within the upper 30 to 35 cm of these deposits, though deep clay-alluvial soils are also common. These soil types are typical of the Fladbury I Association to which the soils in this area are allocated by the Soil Survey of England and Wales (***Figure 5*** - see also *Technical Report B8*). The alluvial deposits therefore appear to be of Holocene age, which is consistent with many other parts of lowland, near-coastal parts of southern and eastern England (e.g. Brown, 1983; Burrin, 1988; Scaife & Burrin, 1992).

Lithological unit 3 is confined to the eastern extremity of the route, and consists of grey-blue clay. The unit commonly rests on the gravels of unit 1 and is locally overlain by alluvium of unit 2. Unit 3 is probably a marine/estuarine clay that marks the western limit of the marine inundation of the Fens during the Holocene, estimated to around 3,000-1900 years BP (Shennan, 1986). In addition to these units, peat beds and palaeosols form less widespread features, recorded in a few of the lithological logs only (*Technical Report B2*). Only one, relatively undisturbed, peat unit of significant thickness was observed, in Trench 27. The peat encountered in the other trenches was thin and disturbed by modern agricultural activities.

The lithological successions reported here, and especially the generalised subdivision into the three widespread lithological units of terrace sands and gravels, alluvium and marine clays, conforms to the schemes typically reported by other investigators for areas bordering the Fens (see *Technical Report B1*).

As part of the detailed logging, a record was kept of any observed features of possible archaeological or palaeoenvironmental significance. These are summarised in ***Table 1***. In a separate survey exercise, an independent site context record was completed by *Archaeological Project Services*, and additional features of archaeological significance noted in that survey are also included in ***Table 1***.

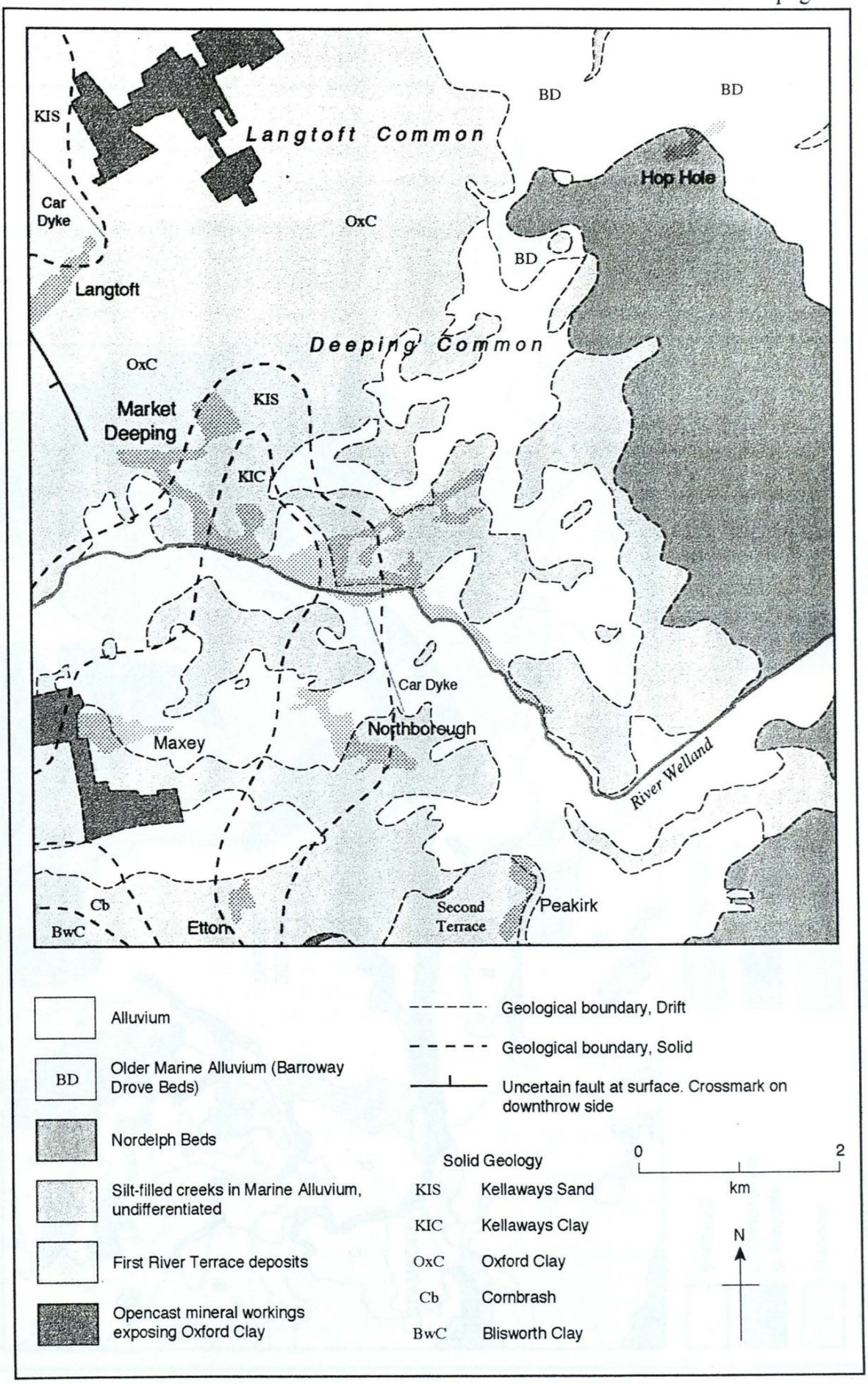


Figure 4. Solid and drift geology of the study area

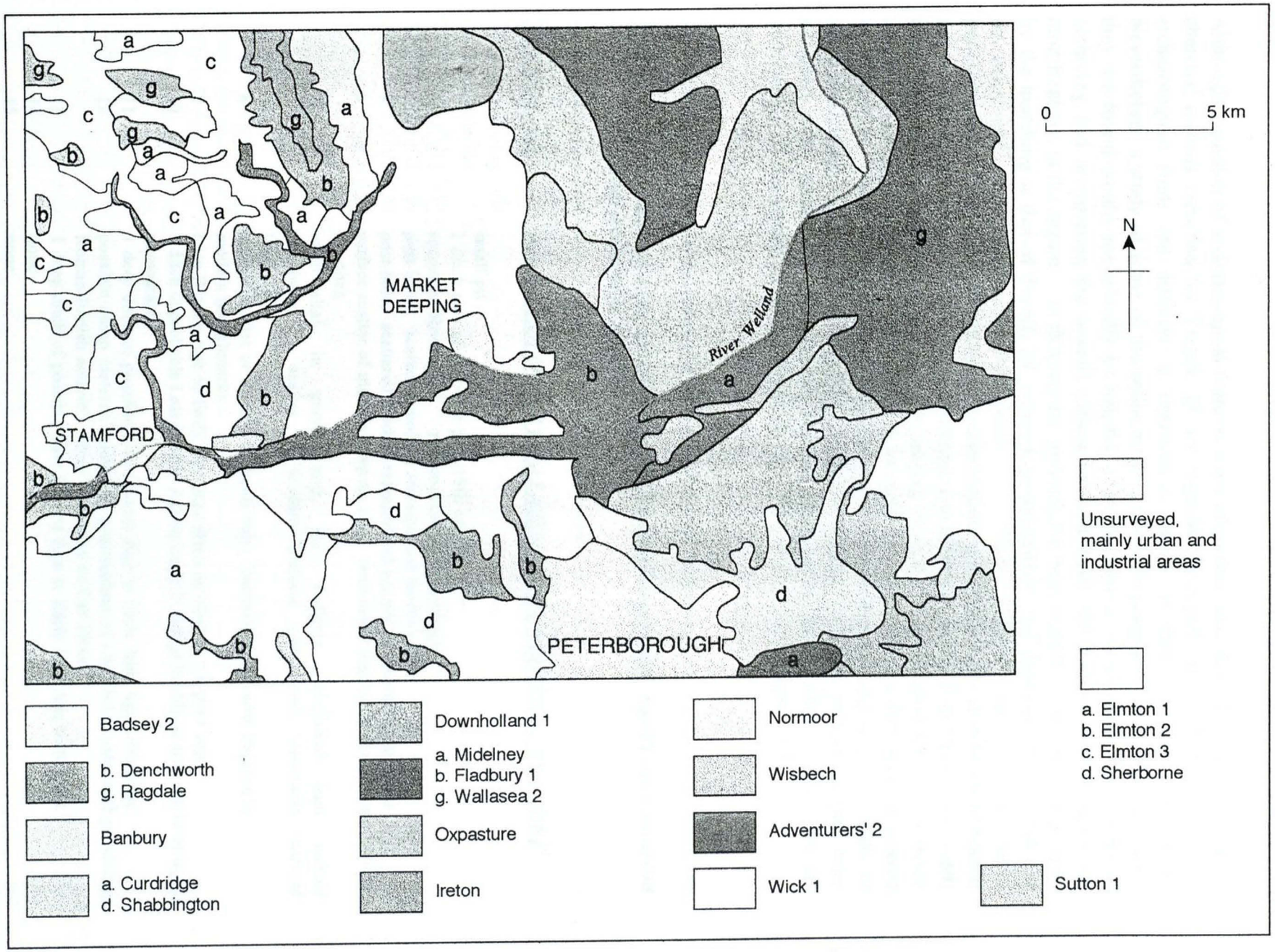


Figure 5. Distribution of soils in the study area

Although a number of archaeological features were identified, only the saltern and associated charcoal records recorded for Trench 23 are regarded as significant. Most of the other archaeological finds are difficult to characterise and/or to date with any confidence. Nevertheless, a study of some of the sedimentary and palaeogeographical contexts in which they are found would undoubtedly be helpful, since the results would assist the process of archiving and interpreting the overall pattern of settlement and human-induced landscape modifications in the region. In this respect, perhaps the most important sequence uncovered by the trenching is that of Trench 27, where a palaeochannel and channel-fill, peat bed and an associated tree stem were discovered. These deposits may provide useful geochronological and palaeoenvironmental information on both the relative intensity of human activities in the locality and the scale of landscape modifications (natural and human-induced) over the time period represented. For this reason, Trench 27 was selected for more detailed study. Also of significance, were units rich in molluscan assemblages that were uncovered by Trench 3. These may also provide useful palaeoenvironmental data, and so a study of these assemblages was included in the assessment. Finally, a number of spot samples were obtained from several of the trenches for sediment provenance studies and to test the consistency of the results of OSL dating (as specified in *Technical Report B2*).

Table 1 ***Features of archaeological and/or palaeoenvironmental significance recorded from excavation trenches***

TRENCH NO.	*ARCHAEOLOGICAL/PALAEOENVIRONMENTAL FEATURE*
1	small pit
2	2 ditch cuts of probable post-18th century age
3	suspected Roman fill - rich molluscan assemblages
4	post-holes; scattered modern remains and modern ditch
5	post-hole; scattered modern remains and occasional charcoal fragments
6	surface scatter of modern remains only; occasional fragments of charcoal; modern (?) ditch
7	micro-relief in gravel unit, may indicate periglacial land surface structures; scatter of modern material only, and occasional charcoal fragments
8	surface scatter of modern material only; occasional charcoal fragments; modern ploughmarks
9	Late Bronze Age to Early Iron Age ditch or barrow; buried soil
10	1 ditch of probable Late Bronze Age to Early Iron Age visible as crop marks in aerial photographs
11	1 deep ditch of possible Late Bronze Age to Early Iron Age settlement
12	possible dump material related to construction of Car Dyke; palaeosol pre-dating Roman-British activity; close proximity to Car Dyke
13	1 deep ditch of possible Late Bronze Age to Early Iron Age settlement
14	none
15	none
16	1 ditch of unknown age

17	not completed
18	none
19	none
20	none
21	none
22	none
23	several small pits filled with abundant fired lumps of red clay and charcoal fragments - interpreted as Iron Age saltmaking activities; post-holes
24	thin peat horizon, affected by modern ground disturbance
25	thin peat horizon, affected by modern ground disturbance
26	thin peat layer; possible buried soil; linear (modern ?) ditch
27	30 cm peat unit; palaeo-channel; tree stem and woody peat remains; dump material overlies peat, derived from excavation and cleaning of Cross Dyke
28	thin peat horizon, affected by modern ground disturbance
29	2 sets of superimposed plough marks; very shallow trench of unknown age
30	1 ditch of uncertain age
31	no evidence of archaeological features observed, although a double-ringed ditch located near this trench is clearly visible on aerial photographs; numerous surface scatters lf modern material and occasional fragments of charcoal.

A3: RESULTS OF STRATIGRAPHICAL ANALYSIS OF TRENCH 27

A3i: Lithostratigraphy

The lithostratigraphic succession revealed in Trench 27 is described in *Technical Report B2*. A representative monolith was abstracted for detailed laboratory analysis. The lithostratigraphical record for the monolith is shown in ***Figure 6***, and this can be summarised as follows. A basal unit of gravel (128 cm to base) represents the upper part of lithological unit 1 (Welland terrace gravels). The variable sands, clays and silts (128 cm to top of sequence) represents lithological unit 2 (alluvium), though the basal part of the sequence may represent a transitional deposit between the lower gravels and overlying alluvium. The accumulation of alluvium was temporarily interrupted at this locality, and a peat layer was able to accumulate. Humification measures were obtained from the peat to test for variations in the nature of the peat and as an aid to interpreting the biostratigraphicalrecord obtained from the unit (*Technical Report B10*). Grain-size analysis of 5 samples abstracted from the alluvial deposits (*Technical Report B3*) and measured using a Sedigraph analyser show that the uppermost deposits (overlying the peat) are silt-dominated (>67% by weight) with a high clay content. The deposits below the peat are much coarser by comparison, with sand accounting for between 20 and 81% of the samples by weight. The data suggest a higher flow regime during the deposition of the lower alluvial deposits by comparison with the upper ones. It is interesting to note that there appears to be a coarsening upwards trend between 120 and 84 cm, culminating in a sandy unit which then gives way abruptly to the peat bed. This abrupt transition from sand to peat indicates a marked change in local sedimentation

ArchaeoScape Consulting — **Section Log**

Location: Market Deeping Bypass **Project Number:** 96/1

Trench Number: 27 **Elevation:** + 5m asl.

Section Number: **Date Started:** 13.03.96 **Date Completed:** 14.03.96

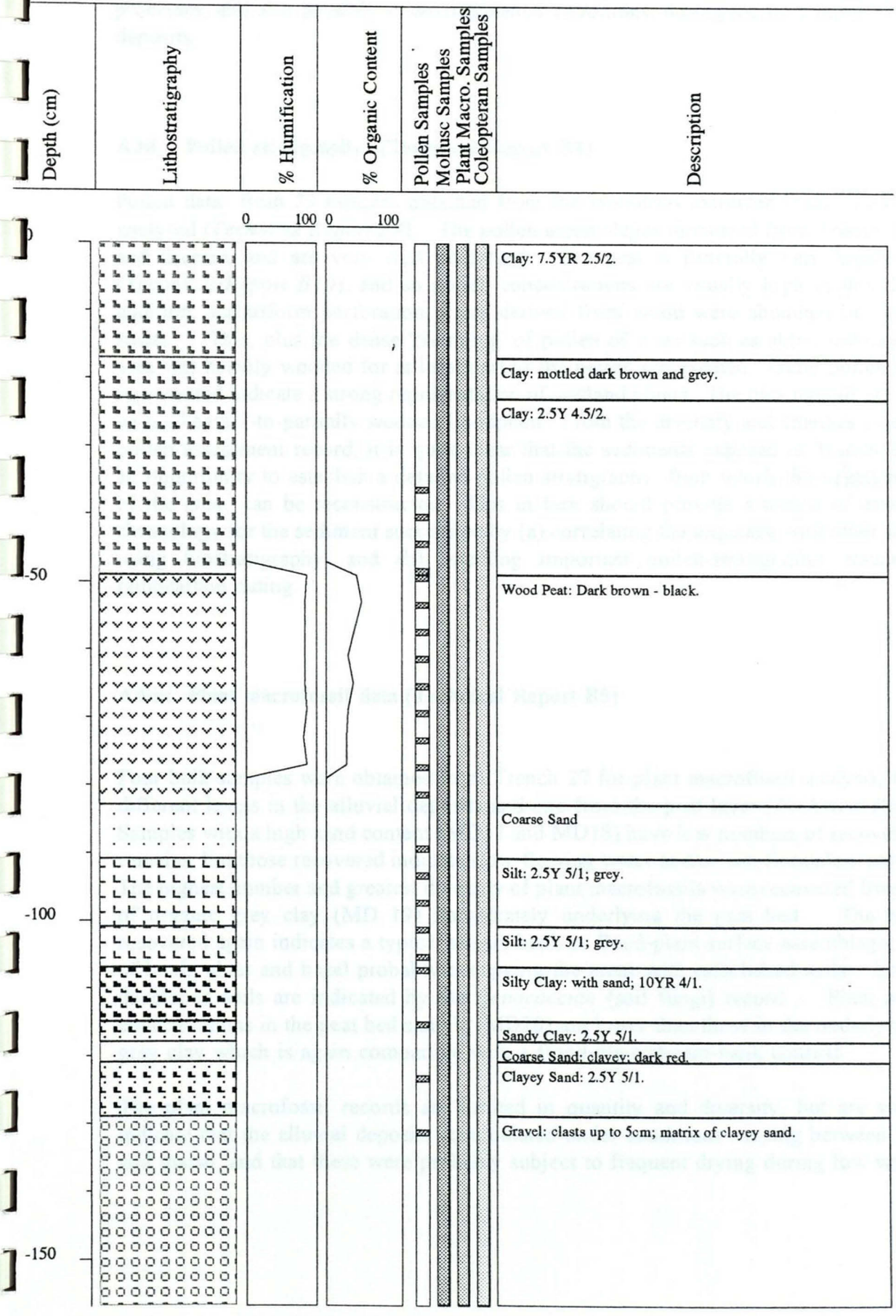


FIGURE 6

processes, and also possibly in environmental conditions, during the time represented by the deposits.

A3ii: Pollen stratigraphy (Technical Report B4)

Pollen data from 29 samples obtained from the monoliths extracted from Trench 27 were analysed (*Technical Report B4*). The pollen assemblages recovered from Trench 27 are rich and diverse, and are very well preserved. The peat is generally very highly humified (*Technical Report B10*), and so pollen concentrations are unually high in this deposit In addition, scalariform perforation plates derived from wood were abundant on some of the slides. This, plus the dense 'clumping' of pollen of trees such as alder, indicates that the area was heavily wooded for at least part of the period represented. Other pollen types well represented indicate a strong representation of wetland plants. The data overall are consistent with a heavily-to-partially wooded floodplain. From the diversity and changes evident in the pollen assessment record, it is quite clear that the sediments exposed in Trench 27 provide an opportunity to establish a detailed pollen stratigraphy, from which the vegetation history of the area can be reconstructed. This in turn should provide a means of establishing a chronology for the sediment succession by (a) correlating the sequence with other site records using biostratigraphy, and (b) selecting important pollen-stratigraphic boundaries for radiocarbon dating.

A3iii: Plant macrofossil data (Technical Report B5)

Four bulk samples were obtained from Trench 27 for plant macrofossil analysis, three from different levels in the alluvial deposits and one from the peat layer (*Technical Report B5*). Samples with a high sand content (MD17 and MD18) have low numbers of recoverable plant remains, but those recovered indicate slow-flowing water and/or wet floodplain communities. The highest number and greatest diversity of plant macrofossils were recovered from a sample of organic grey clay (MD 19) immediately underlying the peat bed. The assemblage recovered again indicates a typical stream bank or flood-plain surface assemblage, with trees of birch, alder and hazel probably occupying the areas with established soils. Locally well developed soils are indicated by the *Cenococcum* (soil fungi) record. Plant macrofossil concentrations in the peat bed sample (MD20) are lower than those in the underlying organic grey clay which is again compatible with a flood-plain/stream-bank context.

The plant macrofossil records are limited in quantity and diversity, but are sufficient to indicate that the alluvial deposits accumulated under conditions varying between freshwater and marsh, and that these were probably subject to frequent drying during low water levels.

A3iv: Insect assemblage data .(Technical Report B6)

The richest assemblages of beetle remains were also recovered from samples MD19 (organic grey clay) and MD20 (peat bed). These assemblages are dominated by aquatic species, especially those characteristic of sluggishly flowing water and the vegetated margins of streams, and by species that occupy marshy depressions that are rich in decaying vegetal matter. The lower, coarser-grained alluvial samples (MD17 and MD18) are poor in insect remains. The data suggest a change through the sediment sequence from flowing water (and hence removal of light, insect macrofossils) in the lower alluvial units to marsh/swamp conditions associated with the peat bed.

A3v: Molluscan assemblage data (Technical Report B7)

Samples MD16 to MD20 from Trench 27 (*Technical Report B7*) were analysed for molluscan remains, but none were recovered.

A3vi: Synthesis

The lithological, palynological, insect and plant macrofossil records obtained from Trench 27 provide consistent palaeoecological information. All of the data point to the likelihood that a coherent stratigraphic succession is preserved at this site, and that this record will yield valuable and diverse biostratigraphical information. The data suggest that alluvial and peat sediments accumulated on a floodplain over a significant period during the mid- to late Holocene (ca. 5,000 BP onwards). This contention can be checked by radiocarbon dating either (a) bulk samples of the peat deposits or preferably (b) plant macrofossils washed out of the sediments. A detailed biostratigraphy coupled with a precise chronology will enable the evolution of the floodplain to be reconstructed and thus provide a context for evaluating some of the archaeological finds recorded from this part of the Bypass route.

A.3.vii: Recommendations, Sequence exposed in Trench 27

Important palaeoenvironmental information could be obtained from the Trench 27 sediment sequence over a short time period and at a moderate cost. The most useful objectives would appear to be:

1. Complete detailed analyses of the diversity, concentration and state of preservation of pollen assemblages throughout the monolith sequence (ca. 50 samples to be analysed).

2. Undertake more detailed analysis of plant macrofossils from ca. 12 samples in order (i) to provide additional palaeobotanical data to complement the pollen data, but more importantly (ii) to select suitable materials for precise radiocarbon measurements.

3. Select 4 bulk peat samples and 3 plant macrofossil samples for radiocarbon dating.

4. Undertake 4 OSL measurements in order to date the lower alluvial deposits and thereby to test whether there is a significant time gap between alluvial deposition and the onset of peat accumulation.

5. Undertake a detailed biostratigraphic correlation with published pollen diagrams from the Fenlands and adjacent areas.

A4: RESULTS OF STRATIGRAPHICAL ANALYSIS OF TRENCH 3

A4i: Lithostratigraphy

Over 1.3 m of alluvial deposits (dominantly clayey-silts) lie beneath ca. 63 cm of topsoil at Trench 3 (***Figure 7***). The site lies close to what is believed to be a fill deposit of Roman age, though there is little evidence for this in the lithological log obtained during our survey. The sediments from this locality did, however, contain mollusc remains, which were examined during the assessment.

ArchaeoScape Consulting — ***Section Log***

Location: Market Deeping Bypass **Project Number:** 96/1

Trench Number: 03 **Elevation:** + 8.14m asl.

Section Number: **Date Started:** 03.04.96 **Date Completed:** 03.04.96

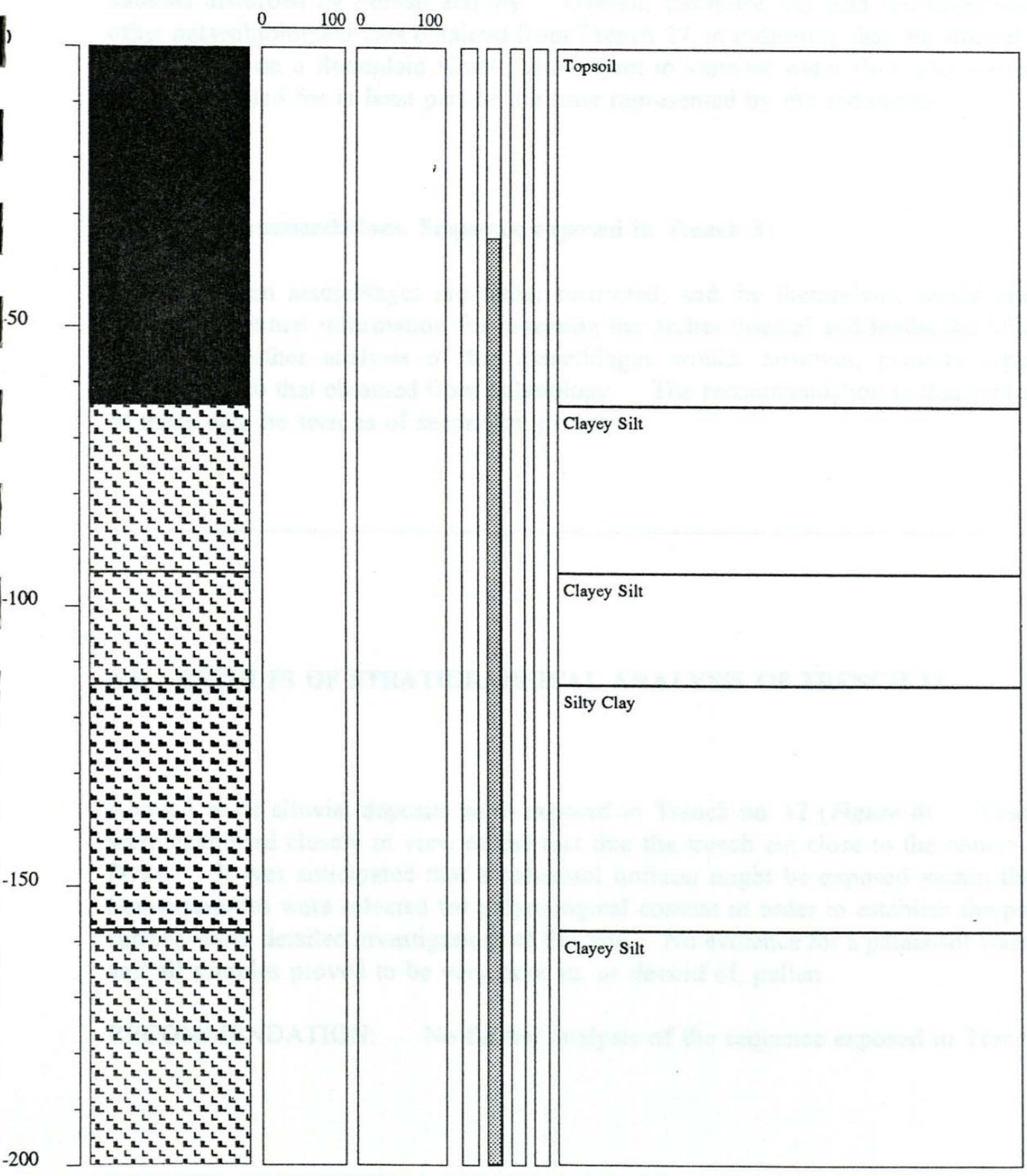


FIGURE 7

A4ii: Molluscan assemblages (Technical Report B7)

6 samples (labelled A to G in *Technical Report B7*) were analysed from Trench 3. Although not rich in molluscan remains, the samples nevertheless provide a coherent data-set indicating derivation from a shallow body of hard water (a ditch, mire or slow-moving stream) which frequently dried out, but which supported abundant vegetation. Many of the species indicate the local presence of moist meadows, while one species recorded is commonly associated with habitats disturbed by human activity. Overall, therefore, the data are consistent with the other palaeobiological data obtained from Trench 27, in indicating that the alluvial sediments accumulated on a floodplain which was subject to variable water flow and was partially or heavily wooded for at least part of the time represented by the sediments.

A4iii: Recommendations, Sequence exposed in Trench 3

The molluscan assemblages are rather restricted, and, by themselves, would only provide limited contextual information for assessing the archaeological and landscape history of the area. Further analysis of the assemblages would, however, provide supplementary information to that obtained from palynology. The recommendation is that further analysis of these data be seen as of secondary priority.

A5: RESULTS OF STRATIGRAPHICAL ANALYSIS OF TRENCH 12

About 1 m of alluvial deposits were exposed in Trench no. 12 (***Figure 8***). These deposits were examined closely in view of the fact that the trench cut close to the course of the Car Dyke. It was anticipated that a palaeosol horizon might be exposed within the trench. Seven samples were selected for palynological content in order to establish the potential for further, more detailed investigations of this site. No evidence for a palaeosol was recovered, and all samples proved to be very poor in, or devoid of, pollen.

RECOMMENDATION: No further analysis of the sequence exposed in Trench 12.

ArchaeoScape Consulting — *Section Log*

Location: Market Deeping Bypass **Project Number:** 96/1

Trench Number: 12 **Elevation:** + 5m asl.

Section Number: **Date Started:** 13.03.96 **Date Completed:** 14.03.96

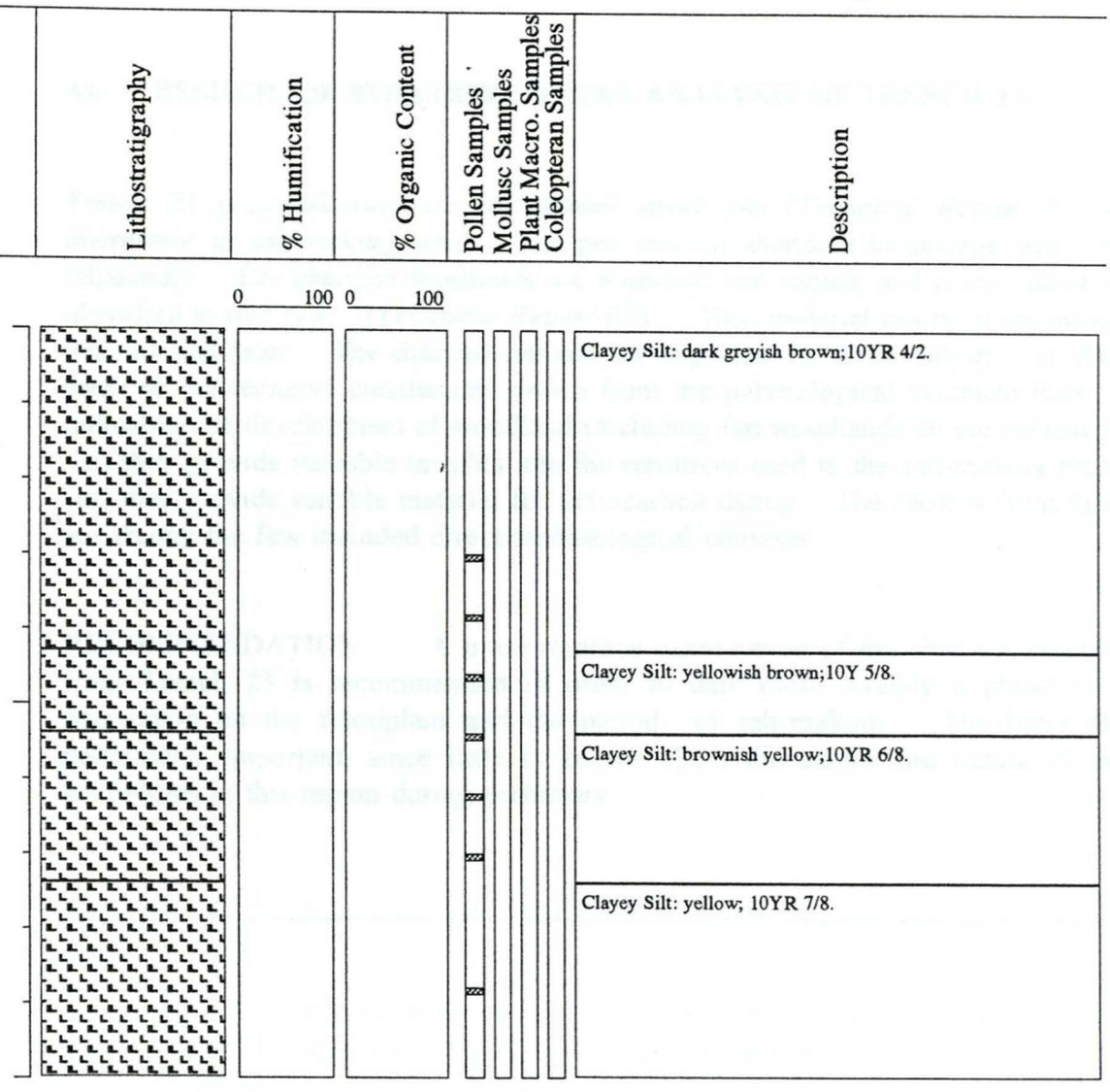


FIGURE 8

A6: RESULTS OF STRATIGRAPHICAL ANALYSIS OF TRENCH 23

Trench 23 provided evidence for several small pits (*Technical Report B2*) which are interpreted as salt-making sites. The pits contain abundant briquetage and fuel residues (charcoal). The charcoal fragments are abundant and robust, and many samples could be identified to tree type (*Technical Report B9*). Thus material has been identified as alder, oak, ash and hazel. The charcoal remains are important for three reasons: (i) they confirm some of the tentative conclusions drawn from the palynological evidence from Trench 27 indicating the development of woodland (including fen woodland) on the ancient floodplain; (ii) they provide valuable insights into the resources used in the salt-making process; and (iii) they provide suitable material for radiocarbon dating. The records from this sequence are among the few included direct archaeological contexts.

RECOMMENDATION: A more rigorous examination of the charcoal records obtained from Trench 23 is recommended in order to date more directly a phase of woodland occupation on the floodplain and the period of salt-making. The latter objective is particularly important, since little is known about the extent and nature of salt-making procedures in this region during prehistory.

A7: OVERALL CONCLUSIONS AND RECOMMENDATIONS

The excavation trenches have not disturbed any major archaeological features, nor have they uncovered any extensive organic deposits of palaeoenvironmental significance. By far the most important deposits exposed are those in Trenches 27, 23 and 3. If any enlargement of the trenches is envisaged, or the ecavation on new trenches, then a watching brief and appropriate assessment studies must be maintained, in view of the known archaeological heritage of the area. In the meantime, the current assessment results indicate that only a modest scientific study is warranted, one which is designed to provide an adequate archive of the recovered materials. , This should comprise:

1. Palynological analysis of 50 samples, plant macrofossil analysis of 12 samples and radiocarbon analysis of 7 samples from Trench 27 (as outlined in section A3vii). All materials have already been recovered.

2. Detailed analysis of 5 samples of charcoal remains from Trench 23, and radiocarbon dating of material selected from each sample (5 dates in total).

3. A limited but expanded analysis of 5 of the 6 molluscan levels from Trench number 3.

4. 4 OSL dates from the lower alluvium in Trench 27 (as specified in section A3vii).

5. A desk-top study to relate all of the biostratigraphical and chronological data from Trenches 27, 23 and 3 to regional biostratigraphical and geochronological schemes.

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MARKET DEEPING BYPASS (LINCOLNSHIRE) ASSESSMENT REPORT APRIL, 1996

report prepared for:-

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Heritage Trust of Lincolnshire

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MARKET DEEPING BYPASS (LINCOLNSHIRE) ASSESSMENT REPORT APRIL, 1996

PART A: SUMMARY ASSESSMENT REPORT (Vol. I)
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MARKET DEEPING BYPASS ASSESSMENT REPORT

APRIL, 1996

Part B: Technical Reports and Associated Logs

This part of the report presents the results of the independent field and laboratory analyses undertaken by ***ArchaeoScape Consulting*** for Archaeological Project Services, Heritage Trust Lincolnshire, as part of the assessment of the archaeological and palaeoenvironmental potential of the sediments exposed by the trial pits and trenches excavated along the proposed Bypass route at Market Deeping, Lincolnshire. The primary results of each consultant are summarised as a series of independent Technical Reports.

TECHNICAL REPORT B1: DESK-TOP STUDY OF THE GEOLOGICAL CONTEXT OF THE MARKET DEEPING BYPASS

Consultant: Dr. C.P. GREEN

Introduction

Although there have been preliminary studies of Holocene palaeoenvironmental conditions in the lower valley of the River Welland (French *et al.*, 1993), these have been largely undertaken in a relatively small area immediately to the south of Market Deeping, between the River Welland and the Maxey Cut. In the same area, in the neighbourhood of Maxey, evidence of pre-Flandrian palaeoenvironmental conditions has been described (French, 1982; Davey *et al.*, 1991). None of this work has extended into the area traversed by the proposed route of the Market Deeping Bypass, to the north of Market Deeping. However, the regional geological and geomorphological setting of the Bypass route can be established in general terms, and preliminary site investigations have given an indication of the local palaeoenvironmental conditions (Anon, 1993).

The settlements of Market Deeping and Deeping St. James are situated on remants of the 'First Terrace' of the River Welland, close to the modern river and near to the point where the river enters the Fens. This is a position close to the central axis of an area of river terrace deposits, manily composed of sand and gravel, "laid down as a broad fan where the river emerged into the Fen lowlands" (Horton, 1989). The fan has its apex in the neighbourhood of Uffington, 2 km east of Stamford, and spreads out eastward over a distance of some 10-12 km towards Thurlby in the north and Peakirk in the south. These river terrace deposits form a westward extension of the fen margin gravel, which north of Thurlby has a narrow outcrop only about 2 km in width. In general, the surface of the fen margin gravel slopes gently eastward to pass beneath the marine alluvium of the Fens. In the area traversed by the proposed Bypass route, the present-day ground surface declines eastward from levels of ca. 7-8 m at the western end of the proposed route to ca. 4 m at the eastern end. The modern floodplain of the River Welland is at a level slightly below the surrounding river terrace deposits. This fan-like area of river terrace deposits, and the fen edge gravel in general, are believed to owe their present surface form to deposition in the Mid- to Late-Devensian (last cold stage - 50,000-10,000 BP). In places, however, the Devensian deposits are underlain by older sediments of Late and possibly Late Middle Pleistocene age (older than 50,000 BP, perhaps as old as hundreds of thousands of years ago).

The work of French et al. (1993) shows that around Maxey this fan-like area of river terrace deposits is traversed by a series of interconnected alluvial belts separated by upstanding remnants of the First Terrace and marking former courses of the River Welland occupied successively during the Holocene. Aerial photographs reveal the presence of complex patterns of palaeochannels within these alluvial belts. The alluvial belts are underlain by silts and clays which overlie gravels.

Among the palaeochannels, those to which an Early Flandrian age (10,000-7,000 BP) can be assigned indicate a meandering river, but by the Middle Neolithic period (ca. 5000 BP) the river had assumed an anastomosing habit. French *et al.* (1993) suggest that this transformation reflects the combined effect of rising base-level, brought about by rising Holocene sea level, and an influx of fine-grained sediment resulting from accelerated soil erosion following the Neolithic extension of clearance and cultivation in the hinterland.

French *et al.* (1993) note that fine-grained sediment (freshwater alluvium) has continued to accumulate through the prehistoric and historic periods and has progressively enveloped the higher ground, represented in this area by remnants of the First Terrace of the Welland. In many places where the alluvial deposits have been examined in detail, a palaeosol is found developed in the sediments immediately underlying the freshwater alluvium. The palaeosol is usually a brown earth of argillic brown earth. Micromorphological studies of the palaeosol (French, 1985) and its relationship to prehistoric structures show that it experienced an initial stage of development under a cover of woodland, followed by clearance and cultivation in the prehistoric period prior to the Bronze Age. Bodies of fine-grained

alluvium generally similar to that in the lower valley of the Welland are present on the floodplains of many rivers in southern and eastern England. Examples include the Thames (Limbrey & Robinson, 1988) and Severn (Brown, 1983). In the latter case, the alluvial cover is attributed to the same cause - namely, land degradation associated with the intensification and extension of agricultural activity within the catchment supplying the depositional site. These bodies of alluvium are commonly devoid of fossil material and exact dating of the period or periods of deposition may be difficult.

The area to the north of Market Deeping traversed by the proposed route of the Bypass was not investigated by French *et al.* (1993). It is not known, therefore, whether any alluvial belts similar to those detected in the Maxey area are present there. However, in preliminary investigations of the area to the north of Market Deeping (Haynes *et al*, 1993), there was no sign of any palaeochannels of sufficient size to represent the former course of the River Welland.

Geology of the Bypass route

1. Bedrock Geology

The bedrock traversed by the proposed route to the north of the River Welland includes the Jurassic Oxford Clay, probably the lower part of this formation where it is represented by dark blue to lead grey clays, sometimes laminated and with discontinuous bands of sand; and the underlying Kellaways Sand and Kellaways Clay which resemble quite closely the more variable lower part of the Oxford Clay (Figure 4).

In none of the trial pits (Haynes *et al*, 1993) can bedrock be recognised with confidence, but in the lower parts of pits 10, 18 and 19, blue-grey clays, sand and 'sandstone' are recorded beneath Pleistocene sand and gravel. These sediments might represent upstanding areas of Jurassic bedrock but could also be alluvium occupying channels beneath the Welland floodplain. The Welland is known to have a buried channel extending landward from the fen margin, and, in additiion, pre-Devensian palaeochannels of last (Ipswichian) interglacial age (French, 1982) and of pre-Ipswichian age (Davey *et al*., 1992) have been detected beneath the sand and gravel in the Maxey area.

2. Quaternary Geology

The Quaternary sediments overlying the Jurassic bedrock can be divided into three generalised lithological units.

Lithological Unit 1 - Sand and Gravel (First Terrace of the River Welland):
Calcareous sand and gravel is seen in the lower part of all the trial pits. The full thickness of this unit may have been visible in pits 10, 18 and 19 where thicknesses of 1.5 m, 2.3 m and 1.9 m respectively were recorded overlying the blue-grey clays, sand and 'sandstone' which may represent the Jurassic bedrock (see above). Elsewhere, up to 1.6 m of sand and gravel were visible in the trial pits, but depths of gravel considerably greater than this (up to 8.2 m in the area to the east of Peterborough) are known to exist beneath the First Terrace (Horton, 1989). However, in general the sand and gravel beneath the First Terrace is less than 5.0 m in thickness.

For most of the proposed Bypass route, between pits 17 and 40 (inclusive), the surface of the sand and gravel is uneven at levels between 0.3 and 0.8 m below ground surface.

To the west of Market Deeping, the surface of the sand and gravel declines slightly in a southward direction towards the River Welland, and beneath the Welland floodplain is more uneven and falls in one place (trial pit 9) to 1.7 m below ground surface.

At the eastern end of the proposed route, to the east of trial pit 40, the gravel surface is found at a level no higher than 1.2 m below ground surface, and falls unevenly eastward to as low as 2.2 m below ground surface (pit 43A).

In trial pits 25 and 26, the surface of the sand and gravel falls to 1.1 m and 0.9 m respectively, indicating a slightly more substantial ineqaulity in the surface of the sand and gravel.

In trial pit 22, the surface of the sand and gravel falls to 1.8 m in a narrow feature that has been interpreted as an ice-wedge cast.

Lithological unit 2 - Freshwater alluvium:
The freshwater alluvium is most commonly an orange brown or brown silty clay, occasionally mottled grey, or grey in colour. At the ground surface a soil layer, usually 0.3 to 0.35 m in depth, is developed in this unit. The soil is usually a pelo-alluvial gley or clay-loam and is classified within the Fladbury I Association on the regional soil map (***Figure 5***). Including this pedogenic horizon, the alluvium is generally between 0.3 and 0.8 m in thickness. Pebbles are often recorded within the alluvium. In most of the trial pits the alluvium contains an admixture of sand and in some cases sandy sediments replace the silty clay completely. It may then be difficult to distinguish between sandy beds of the alluvium and sands associated with lithological unit 1 (the underlying terrace sand and gravel).

Lithological unit 3 - Grey-blue clay:
This unit occurs only at the extreme eastern end of the proposed route in trial pits 44 and 45, where the surface of the underlying sand and gravel is falling eastward. It rests on the sand and gravel of lithological unit 1 and is overlain by the alluvium of lithological unit 2. A thickness of 0.8 m was recorded in the most easterly trial pit (45). It thins westward and passes in colour from blue-grey to brown, becoming difficult to distinguish from the overlying alluvium.

3. Environmental History of the area traversed by the Bypass route

Between trial pits 17 and 40 (inclusive) the sand and gravel of lithological unit 1 represents a low river terrace, the First Terrace of the River Welland. The character of the deposit suggests a date for the deposition of sand and gravel no later than the earliest Holocene, and more likely Late Devensian (last cold stage). Elsewhere in eastern England, deposition of gravel by low-gradient rivers appears to have ceased early in the Holocene (Rose *et al.*, 1980).
The uneven surface of lithological unit 1 is probably due in part to the survival of primary depositional features and in part to post-depositional dissection of the surface of the sand and gravel by minor streams draining across the terrace surface. Exposures in the trial pits reveal the presence and cross-sectional form of minor channels which, in most instances, have been buried beneath the pervasive alluvium.

At the western end of the proposed route, to the west of Market Deeping, the lower level of the surface of lithological unit 1 probably reflects a phase of downcutting by the Welland. This area underlies the modern floodplain of the Welland and is occupied by a distinctive association of gley soils. The lower surface here probably marks the northern margin of the zone of palaeochannels detected by French et al. (1993) to the south of Market Deeping.

At the eastern end of the proposed route, the lower level of the surface of lithological unit 1 reflects proximity to a marine margin and to the complex system of tidal creeks which is known to exist in the area of Deeping Fen, immediately to the east. Lithological unit 3 - the grey-blue clay - may be of marine origin and mark the western limit of marine deposition during a Holocene transgressive marine event. In Deeping Fen, archaeological evidence suggests that the onset of marine conditions post-dates the Early Bronze Age, with a return to freshwater conditions by the Middle Iron Age. Shennan (1986) suggests that the maximum extent of marine influence in this part of the Fen Basin relates to his Wash VI phase, dated by him to ca. 3000-1900 BP.

The freshwater alluvium which mantles the whole area is a deposit of the River Welland and its tributaries, and appears to extend indiscriminantly across the floodplain and low terrace

of the Welland, and onto the area of marine deposition and tidal creek formation within the Fens. Given the supposed age of the maximum extent of the Holocene marine transgression in this part of the Fen Basin, placed between the Early Bronze Age and the Middle Iron Age, much of the alluvium is likely to be post-Roman in age. However, fine-grained deposits will have formed an element of the fluvial sediment association throughout the Holocene. In consequence, the age of the alluvium at any particular site may be difficult to determine. The presence of Neolithic and possibly even Mesolithic flint scatters on the surface of the freshwater alluvium may be evidence for its deposition over a long period of time. However, the alluvium is only 30 cm in thickness in many places and ploughing may have brought to the present-day ground surface artefacts that were originally discarded on the surface of the underlying sand and gravel.

4. SUMMARY

The proposed route of the Market Deeping Bypass appears to be situated almost entirely on a remnant of the First Terrace of the River Welland, lying to the north of a complex of palaeochannels that dissect the terrace in the Maxey area. Throughout most of its length the proposed Bypass route is therefore underlain by the sand and gravel of the river terrace deposit, probably mainly of Late Devensian (last cold stage) age, which is overlain by a more or less continuous cover of freshwater alluvium of Holocene age that forms the present ground surface in most of the area. The full depth of the terrace sediments is unknown and there is a possibility, by analogy with the Maxey evidence (Davey *et al.*, 1991), that pre-Devensian deposits, including organic-rich channel fills, may be present beneath the Late Devensian deposits that form the terrace surface. At the extreme eastern end of the proposed route the sand and gravel passes beneath a blue-grey clay which probably marks the landward margin of the marine clays of the Fens. At its western end, the proposed route may extend onto the margin of the modern Welland floodplain. Freshwater alluvium is continuous over both of these areas. The main source of variability in the sequence of sediments is the presence of minor channels representing lines of drainage across the terrace surface either before or during the deposition of the freshwater alluvium.

TECHNICAL REPORT B2: LITHOLOGICAL LOGS OF EXCAVATION TRENCHES 1 TO 31

Consultant: ***Mr. J-L. SCHWENNINGER***

Trench 1

General
Location: Near A16
GPS position: 52° 40' 31" 62N / 000° 19' 50" 93W / Alt: 5m (WGS 84, 2D, Averaging mode).
Photography: None
Weather: Cold, overcast.
Landuse: Grassland.
Topography: Level
Average depth of trench: 40cm

Horizons (cm)

0-20cm Ap
Very dark grey (2.5Y3/1), slightly stony loamy clay. Massive structure becoming angular blocky upon drying. Abrupt, smooth lower boundary. No visible or audible reaction with Hcl. Common fine roots and charcoal fragments.

20-59cm Bg
Brown (10YR5/3 to 2.5Y7/8), non-calcareous, slightly to moderately stony, moist, silty clay. Massive structure when wet, becoming prismatic upon drying. Stones generally 0.5 to 4cm with occasional quartzite pebbles up to 10cm. Common charcoal fragments. Common grey mottles (7.5YR6/1) and larger patches of similar colour due to localizrd gleying.

>59cm Cu
This horizon is only exposed at one location within the trench. Very to extremely stony sandy loam matrix. Slight to moderate effervescence with Hcl confirms the presence of calcium carbonate. Predominantly very small to small stones (3-5mm), well rounded to angular. Gravel mainly consisting of rounded oolithic limestone and angular to sub-angular flint. Common well rounded quartzite pebbles up to 10cm.

Tentative interpretation: Pelo-alluvial gley soil developed over irregular bedded calcareous gravels forming level river terrace deposits largely derived from material eroded from limestone outcrops located to the West. The overlying clayey loamy soil has its origin in alluvial flood deposits. The common occurrence of moderately sized quartzite pebbles suggests the proximity to a river, most probably the nearby Welland river.

Archaeology: No archaeological features observed within the trench although charcoal and fired stone material have been observed in section.

Notes: Very common earthworm burrowing observed throughout the profile.

Samples: None

Trench 2

General

Location: Near A16 and West of Millfield Road
GPS position: 52° 40' 39'' 19N / 000° 19' 55'' 06W / Alt: 5m (WGS 84, 2D, Averaging mode).
Photography: None
Weather: Cold, overcast.
Landuse: Grazing
Topography: Level
Average depth of trench: 46cm

Horizons (cm)

0-25cm Ap

Very dark greyish brown (10YRY3/2), sandy clayey loam, slightly stony. Massive structure becoming angular blocky upon drying. Gradual smooth lower boundary. No visible or audible reaction with Hcl. Common fine roots and charcoal fragments.

25-92cm Bg1

Light olive brown (2.5Y5/4), non-calcareous, moderately stony, moist, silty clay. Massive structure when wet, becoming prismatic upon drying. Stones generally 0.5 to 4cm with occasional tabular limestone fragments up to 12 cm. Common charcoal fragments, pottery, one old iron nail and a piece of clay pipe. One large clast (15cm) of iron impregnated gravel was also noticed at a depth of 82cm. The absence of weathering on the outer surface of the limestones suggests that they may not have been there for long. Abrupt, smooth boundary in terms of particle size but gradual change of colour.

92-104cm Bg2

Light yellowish brown (2.5Y6/3) non-calcareous silty clay, slightly stony. Few small red mottles (2.5YR4/6) indicative of iron oxidation. Common mottling and patches of gleying associated with grey colour (7.5YR6/1). Presence of few non-wethered limestone fragments, 5 to 10 cm.

>92cm Cu

This horizon is only exposed at the deepest location within the trench. Very to extremely stony with sandy loam matrix. Slight to moderate effervescence with Hcl confirms the calcareous nature of the Cu horizon. The surface of the gravel is indurated by very common, hard ferruginous concretions which have partially impregnated and cemented the upper 5cm of the gravel deposit forming. Predominantly very small to small stones (3-5mm), consisting mainly of rounded oolithic limestone and angular to sub-angular flint but also including quartzite pebbles up to 15cm.

Tentative interpretation: Pelo-alluvial gley soil developed over irregular bedded calcareous gravels forming level river terrace deposits largely derived from material eroded from limestone outcrops located to the West. The overlying clayey loamy soil has its origin in alluvial flood deposits which may have been disturbed by man made earthworks and cultivation as indicated by the fragment of iron impregnated gravel within Bg1 which is out of context and occurs naturally in the Cu horizon. The common occurrence of moderately sized quartzite pebbles suggests the proximity to a river, most probably the nearby Welland river. Oxidation of iron related to fluctuations in the water table has resulted in the formation of thick continous iron concretions at the surface of the gravel depsoit which is impenetrable by roots and enhances waterlogging.

Archaeology: Two ditch cuts probably of recent age (e.g. post 18th century).
Notes: Very common earthworm burrowing observed throughout the profile. Water table at approximately 130cm.

Samples: Small bulk sample (MD4) of indurated ferruginous gravel collected at a depth of 108cm below the modern surface from the top of the gravel unit.

Trench 4

General

Location: West of Millfield Road
GPS position: 52° 40' 50'' 98N / 000° 20' 00'' 06W / Alt: 5m (WGS 84, 2D, Averaging mode).
Photography: None
Weather: Cold, overcast.
Landuse: Arable, winter crop.
Topography: Level
Average depth of trench: 0.6m

Horizons (cm)

0-38cm Ap

Very dark grey (2.5Y3/1), slightly stony clayey loam admixed with little sand. Massive structure becoming angular prismatic upon drying. 36 to 47cm thick, generally 40-45cm. Abrupt, smooth lower boundary. No visible or audible reaction with Hcl. Common to many fine roots. Concentration of 'fresh' straw between 15 and 20 cm as a result of turf reversal through recent ploughing. Few to common fragments of pottery, red tile, slate, glass and charcoal.

38-85cm Bw

Yellow (10YR7/8 to 2.5Y7/8), slightly to moderately stony, moist, silty loam with little sand. Massive structure when wet, becoming prismatic upon drying. Weak audible and visual effervescence with HCl. Stones more common in basal 5cm. Thickness 11-34cm, generally 10-15cm. Common small to large patches of gleying (20 to 160cm across) associated with grey colour change (7.5YR6/1) in shallow depressions of the underlying gravel unit and perhaps indicating the location of former taproots and lateral rooting over Cu horizon. The same colour change (10YR4/11) occurs around a 6cm wide drain which diagonally cuts the trench at a 65cm below the modern landsurface. Gleying may be caused by water leeking from the ceramic pipe segments.

>85cm Cu

This horizon is only exposed at one location within the trench. Very to extremely stony sandy loam matrix. Slight to moderate effervescence with Hcl confirms the calcareous nature of the Cu horizon. Predominantly very small to small stones (3-5mm), well rounded to angular. Gravel mainly consisting of rounded oolithic limestone and angular to sub-angular flint. Other rock fragments include common well rounded quartzite up to 6cm. The surface of this context is generally level but may present gentle depressions although this is difficult to establish as the trench is not sufficiently deep to establish such surface irregularities.

Soil classification: England and Wales (1984), typical of Badsey 2 association.

Tentative interpretation: Brown loamy soil developed over irregular bedded calcareous gravels forming level river terrace deposits largely derived from material eroded from limestone outcrops located to the West. The overlying clayey loamy soil has its origin in alluvial flood deposits probably derived from the nearby river Welland or perhaps an extinct tributary or an old riverbed of the Welland.

Archaeology: Except for a modern drain there are no archaeological features. But common surface scatter finds of pottery, brick, tile and glass also encountered within cultivated horizon together with occasional fragments of charcoal.
Notes: Very common earthworm burrowing observed throughout the profile. Water table at 85 cm below ground surface.

Samples: One large, badly preserved horse or bovine tooth recovered from moist yellow Bw horizon at a depth of 58cm from the modern surfacefor Electron Spin Resonance dating (MD3). Enamel is in poor state of preservation and easily flakes into brittle elongated fragments.

Trench 5

General

Location: West of Millfield Road.
GPS position: 52° 40' 53'' 99N / 000° 20' 01'' 92W / Alt: 5m (WGS 84, 2D, Averaging mode).
Photography: None
Weather: Dry and sunny, cold, easterly winds, blue sky with fast moving clouds causing rapid changes in light intensity.
Landuse: Arable land, recently ploughed.
Topography: Level
Average depth of trench: 55 to 60cm

Horizons (cm)

0-38cm Ap

Dark grey (10YR4/1), slightly stony clayey loam admixed with little sand. Apedal. 38 to 47cm thick, generally 40-45cm. Abrupt, smooth lower boundary. No visible or audible reaction with Hcl. Common to many fine roots. Concentration of 'fresh' straw between 15 and 20 cm as a result of turf reversal through recent ploughing. Few to common fragments of pottery, red tile, slate, glass and charcoal.

38-82cm Bw

Yellow (10YR7/8), slightly to moderately stony, moist, silty loam with little sand. No audible effect with HCl. Stones more common in basal 5cm. Thickness 11-34cm, generally 10-15cm. Common pockets of gleying associated with grey colour change (7.5YR6/1) in shallow depressions of the underlying gravel unit and perhaps former taproots and lateral rooting over Cu horizon.

>82cm Cu

This horizon is only exposed at one location within the trench. Very to extremely stony with sandy loam matrix. Moderate effervescence with Hcl confirms presence of calcium carbonate. Predominantly very small to small stones (3-5mm), well rounded to angular. Gravel mainly consisting of rounded oolithic limestone and angular to sub-angular flint gravel. Other rock fragments include rare well rounded quartzite. The surface of this context is generally level but may present gentle depressions up to 40cm deep.

Tentative interpretation: Apedal brown calcareous loamy soil developed over irregular bedded calcareous gravels forming level river terrace deposits largely derived from material eroded from limestone outcrops located to the West. The overlying clayey loamy soil has its origin in alluvial flood deposits probably derived from the river Welland or an extinct nearby river.

Archaeology: No evidence of archaeological features but very common surface scatter finds of pottery, brick, tile and glass also observed in section. Occasional fragments of charcoal.

Notes: Very common earthworm burrowing observed throughout the profile. Water table at 81 cm below ground surface.

Samples: No samples were collected from this trench.

Trench 6

General

Location: Near Towngate House farm.
GPS position: 52° 41' 08" 34N / 000° 19' 55" 79W / Alt: 5m (WGS 84, 2D, Averaging mode).
Photography: None
Weather: Dry and sunny, cold, easterly winds, blue sky with fast moving clouds causing rapid changes in light intensity.
Landuse: Arable land, recently ploughed.
Topography: Level
Average depth of trench: 55-60cm

Horizons (cm)

0-52cm Ap

Very dark grey (7.5YRY3/1-10YR3/1), slightly stony clayey loam admixed with little sand. Apedal. 46 to 58cm thick, generally 45-50cm. Abrupt, smooth lower boundary. No visible or audible reaction with Hcl. Very common uncollapsed biopores probably related to earthworm activity further causing bioturbation. Common to many fine roots. Concentration of 'fresh' straw between 15 and 20 cm as a result of turf reversal through recent ploughing. Few to common fragments of pottery, red tile, glass and charcoal. Consistent change of colour noticeable in lower 5cm of this horizon, grading into gray (10YR5/1).

52-62cm Bw

Yellow (10YR7/8 to 10YR6/8), slightly to moderately stony silty loam with little sand. Slightly audible effect with HCl related to carbonate granules and outer cortex of flint. Stones more common in basal 5cm. Thickness 11-34cm, generally 10-15cm. Occasional pockets of gleying associated with grey colour change (10YR5/1), 20-50cm wide and 10 to 20cm deep in shallow depressions of the underlying gravel unit.

>62cm Cu

This horizon is only exposed at one end of the trench. Very to extremely stony sandy loam matrix. Strong effervescence with HCl confirms the higly calcareous nature of the Cu horizon. Predominantly very small to small stones (3-5mm), well rounded to angular. Rare large pebbles up to 4cm. Gravel mainly consisting of rounded oolithic limestone, very well rounded 1-4mm 'soft' carbonate granules and angular to sub-angular flint gravel. Other rock fragments include rare well rounded quartzite. The surface of this context is generally level but may present gentle depressions up to 20cm deep. The gravels are very porous and well drained.

Tentative interpretation: Apedal brown calcareous soil developed over irregular bedded calcareous gravels forming level river terrace deposits largely derived from material eroded from limestone outcrops located to the West. The overlying clayey loamy soil has its origin in alluvial flood deposits probably derived from the river Welland or an extinct nearby river.

Archaeology: No evidence of archaeological features but very common surface scatter finds of pottery, brick, tile and glass also observed in section. Occasional fragments of charcoal. The proximity to the nearby farm may explain higher concentrations of recent 'cultural' debris and humic material through manuring.

Notes: Very common earthworm burrowing observed throughout the profile.
Samples: No samples were collected from this trench.

Trench 7

General

Location: Near A15 Peterborough to Lincoln, west of road.
GPS position: 52° 41' 14'' 27N / 000° 19' 47'' 00W / Alt: 5m (WGS 84, 2D, Averaging mode).
Photography: None
Weather: Dry and sunny, cold, easterly winds, blue sky with fast moving clouds causing rapid changes in light intensity.
Landuse: Cultivated surface, recently ploughed and flattened.
Topography: Level
Average depth of trench: 61cm

Horizons (cm)

0-47cm Ap

Very dark grey (10YR3/1), slightly stony clayey loam admixed with little sand. 29 to 51cm thick, generally 45-50cm. Abrupt, smooth lower boundary. Very slightly to slightly calcareous due to the presence of few individual carbonate granules. Common uncollapsed biopores probably related to earthworm activity also causing bioturbation. Common to many fine roots. Concentration of 'fresh' straw between 15 and 20 cm as a result of tillage. Few to common fragments of pottery, red tile, glass and charcoal. Occasional colur change noticeable in lower 5cm, grading into grey (10YR5/1 to 10YR4/1).

47-54cm Bw

Yellow (10YR7/8 to 2.5Y7/8), slightly to moderately stony clayey loam with little sand. Stones more common in basal 5cm. Rare charcoal flecks. Thickness 11-40cm, generally 10-15cm. Weak localized gleying associated with grey colour change (10YR6/1) in shallow depressions of the underlying gravel unit, also revealing wide biopores (1-1.5cm wide) filled with dark grey soil material probably as a result of root decomposition or root void collapse and subsequent infilling. Rare yellowish-red oxidation patches. Common earthworm activity observed throughout.

>54cm Cu

Very to extremely stony sandy loam. Very calcareous. Predominantly very small to small stones (3-5mm), well rounded to angular. Rare large pebbles up to 6.5cm. Gravel mainly consisting of rounded oolithic limestone, very well rounded 1-4mm 'soft' carbonate granules and angular to sub-angular flint gravel. Other rock fragments include rare, well rounded quartzite, platy to tabular sandstone often with internal iron impregnations and carbonaceous cortex (sometimes only the ferruginous inner part is preserved) as well as rare, abraded complete or fragmented fossils such as Devil's claw and belamites which show weathering patterns typical of fluvial transport. The surface of this context is generally level but may present gentle depressions up to 40cm deep which offer better soil moisture conditions for plant growth and are expected to produce differential ripening of crop and hence to be visible from air as crop marks. This deposit is finely bedded with layers of well to moderately sorted, very small to small gravels and highly calcareous coarse sand bands. The gravels appear very porous and well drained.

Tentative interpretation: Brown calcareous loamy soil developed over irregular bedded calcareous gravels forming level river terrace deposits largely derived from material eroded from limestone outcrops located to the West. The overlying clayey loamy soil has its origin in alluvial flood deposits probably derived from the river Welland or an extinct river. The sediments have been strongly influenced by cutltivation and mauring. The uneven micro-relief of the gravel deposit may be related to cryoturbation under periglacial conditions causing polygonal and stripped reticulate patterns.
Archaeology: No evidence of archaeological features except for nearby surface scatter finds of pottery, brick, tile and glass also observed in section. Occasional fragments of charcoal.

Notes: Earthworm burrowing commonly observed throughout the profile.
Samples: No samples were collected from this trench.

Trench 8

General

Location: Near A15 Peterborough to Lincoln, west of road.
GPS position: 52° 41' 07'' 72N / 000° 19' 43'' 79W / Alt: 5m (WGS 84, 2D, Averaging mode).
Photography: Negative film 1, frame 28, ploughmarks.
Slide film 1, frame 16 and 17, ploughmarks.
Weather: Dry and sunny, cold, easterly winds, blue sky with fast moving clouds causing rapid changes in light intensity.
Landuse: Cultivated surface, recently ploughed and flattened.
Topography: Level
Average depth of trench: 0.6m

Horizons (cm)

0-41cm Ap

Very dark grey to black (7.5YR3/1 to 7.5YR2.5/1), slightly stony clayey loam admixed with little sand. 41 to 49cm thick. Abrupt, smooth lower boundary. Very slightly to slightly calcareous due to the presence of few localized carbonate granules. Common uncollapsed biopores probably related to earthworm activity further responsible for bioturbation. Common to many fine roots. Concentration of 'fresh' straw between 15 and 20 cm as a result of tillage. Few to common fragments of pottery, red tile, glass and charcoal. This upper horizon may extend all the way down to Cu when this lower horizon is located closer to the surface.

41-69cm Bw

Brownish yellow to yellow (10YR6/6 to 10YR7/8), slightly to moderately stony clayey loam with little sand. Stones more common in basal 5cm. Rare charcoal flecks, soft texture and producing sharp edge with surrounding soil when sliced with a knife. Thickness 0-32cm. This horizon may be absent when the underlying gravel deposit crops out at slightly higher elevations and is best expressed over depressions within Cu horizon. Common earthworm burrowing observed throughout.

>69cm Cu

Very to extremely stony sandy loam. Very calcareous. Predominantly very small to small stones, well rounded to angular. Rare large pebbles up to 8cm. Gravel mainly consisting of rounded oolithic limestone, very well rounded 1-4mm 'soft' carbonate granules and angular to sub-angular flint gravel. Other rock fragments include rare well rounded quartzite, platy to tabular sandstone often with internal iron impregnations and carbonaceous cortex (sometimes only the ferruginous inner part is preserved) as well as rare, abraded complete or fragmented fossils such as Devil's claw and belamites showing typical signs of fluvial transport. The surface of this context is generally level but may present gentle depressions up to 15 cm deep. This deposit is finely bedded with layers of well to moderately sorted, very small to small gravels and highly calcareous sand bands. The gravels are very porous and well drained.

Tentative interpretation: Brown calcareous loamy soil developed over bedded calcareous gravels forming level river terrace deposits largely derived from material eroded from limestone outcrops located to the West. The overlying clayey loamy soil has its origin in alluvial flood deposits most probably derived from the river Welland or an extinct river. Cultivation and manuring have strongly affected soil development in the upper 50cm.

Archaeology: No evidence of archaeological features except for nearby surface scatter finds of pottery, brick, tile and glass also observed in section. Occasional fragments of charcoal up to 1.5 cm in top soil and the underlying Bw.

Notes: Good example of ploughmarks (in northern part of trench only) cutting into surface gravel deposit and consisting of soil material identical to top dark grey soil horizon. The orientation of the 'buried' ploughmarks is 345° compared to 341° for modern surface ploughing. Such almost identical direction suggests that the ploughmarks might be of recent age and were probably caused by deep ploughing with modern machinery. The parallel furrows are located approximately 35cm apart. Maximum depth of striae is 52cm from surface. At a depth of 40cm, the marks still have a width of about 15cm.

Earthworm burrowing commonly observed throughout the profile.

Samples: One sample (MD2) collected for optically stimulated luminescence dating of ploughmarks for research purposes by JLS. Expect near zero age. Ploughng and cultivation may induce bleaching of quartz grains and thus enable to date buried soils affected by human activity. This would provide a new and original application of OSL dating especially with respect to archaeological sites and the dating of buried soils. The sample was taken 37cm below the modern surface. There is a potential dosimetry problem due to the immediate proximity of the boundary with the underlying gravel deposit which may contain different concentrations of radioactive elements. This could be alleviated by in situ δ-spectrometry.

One medium sized bag with gravel material (MD1) collected from surface of gravel unit for provenace studies and perhaps particle shape and size analysis.

Trench 9

General

Location: Near A15 Peterborough to Lincoln, east of road.
GPS position: 52° 41' 15'' 80N / 000° 19' 34'' 40W / Alt: 5m (WGS 84, 2D, Averaging mode).
Photography: None
Weather: Cold and overcast
Landuse: Arable land, winter crop.
Topography: Level
Average depth of trench: 0.6m

Horizons (cm)

0-43cm Ap

Very dark greyish brown (2.5Y3/2), slightly stony clayey loam. 39 to 50cm thick. Abrupt, smooth lower boundary. Non-calcareous. Common to many fine roots. Concentration of 'fresh' straw between 15 and 20 cm as a result of tillage. Few to common fragments of pottery, red tile, glass and charcoal.

43-72cm Bw

Yellowish brown (10YR5/6), slightly to moderately stony clayey loam with little sand, becoming lighter and stonier in basal part. Dry and friable consistency. Rare charcoal flecks. Thickness 0-32cm, generally 10cm. This horizon is absent from parts of the trench where the uneven surface of the underlying gravel deposit is slightly more elevated. Common earthworm burrowing observed throughout. A man made ditch probably dating to the Late Bronze Age - Early Iron Age has been cut through this horizon. The darker colour at the top of the Bw may be related to feeble soil development in which case this horizon could represent the remnants of a buried soil. The upper part of the palaeosol may be truncated possibly as a result of ploughing.

>72cm Cu

Very to extremely stony sandy loam. Very calcareous. Predominantly very small to small stones, well rounded to angular. Bedded gravel mainly consisting of rounded oolithic limestone, very well rounded 1-4mm 'soft' carbonate granules and angular to sub-angular flint gravel. The surface of this context is generally level but may present gentle depressions up to 15 cm deep. The gravels are very porous and well drained.

Tentative interpretation: Shallow brown calcareous loamy soil developed over bedded calcareous gravels forming level river terrace deposits largely derived from material eroded from limestone outcrops located to the West. The overlying clayey loamy soil has its origin in alluvial flood deposits most probably derived from the river Welland or an extinct river. This was succeeded by a period of relative landscape stability strecthing up to the Early Iron Age as inferred from the remnants of a buried soil within the Bw. This was followed by further deposition of alluvium and renewed soil formation, strongly affected by cultivation and manuring in historic times.

Archaeology: Late Bronze Age to Early Iron Age ditch or barrow present in the middle of the trench, cut through the Bw horizon and extending into the gravel deposit. Sealed by Ap horizon. Moderately stony grey fill with few small ochreous mottles and pottery.

Notes:
Earthworm burrowing commonly observed throughout the profile.

Samples: None

Trench 10

General

Location: Near A15 Peterborough to Lincoln, east of road.
GPS position: 52° 41' 11'' 94N / 000° 19' 33'' 20W / Alt: 5m (WGS 84, 2D, Averaging mode).
Photography: None
Weather: Cold and overcast
Landuse: Arable land, winter crop.
Topography: Level
Average depth of trench: 0.6m

Horizons (cm)

0-33cm Ap

Greyish brown (2.5Y5/2), slightly stony clayey loam. 39 to 50cm thick. Abrupt, smooth lower boundary. Non-calcareous. Common to many fine roots. Few to common fragments of pottery, red tile, glass, bone and charcoal.

33-55cm Bw

Yellowish brown (10YR5/6), slightly to moderately stony clayey loam with little sand, becoming very stony in basal part. Dry and friable consistency. Rare charcoal flecks. Thickness 0-26cm, generally 10cm. Generally non-calcareous except for disparate carbonate granules. This horizon is absent from parts of the trench where the uneven surface of the underlying gravel deposit is slightly more elevated. Where it is only 5 to 7cm thick it also tends to be very stony and slightly calcareous. Common earthworm activity observed throughout.

>55cm Cu

Very to extremely stony sandy loam. Strongly calcareous. Predominantly very small to small stones, well rounded to angular. Bedded gravel mainly consisting of rounded oolithic limestone, very well rounded 1-4mm 'soft' carbonate granules and angular to sub-angular flint gravel. The surface of this context is generally level but may present gentle depressions up to 15 cm deep. The gravels are very porous and well drained with thin inter-bedded coarse to medium sand bands.

Tentative interpretation: Shallow brown calcareous loamy soil developed over bedded calcareous gravels forming level river terrace deposits largely derived from material eroded from limestone outcrops located to the West. The overlying clayey loamy soil has its origin in alluvial flood deposits most probably derived from the river Welland or an extinct river.

Archaeology: One ditch perhaps related to Late Bronze Age to Early Iron Age enclosures visible as crop marks on aerial photographs. Fill consists of clayey grey loam with common charcoal flecks.

Notes:Earthworm burrowing commonly observed throughout the profile. Water table at 1.08m.

Samples: One sample collected for Optically Stimulated luminescence dating of gravel deposit (MD5). Sample taken from a thin 8cm thick well sorted sand band located 6cm into the gravel unit and 72cm below the modern landsurface.

Trench 11

General

Location: Opposite Northfield Poultry Farm
GPS position: 52° 41' 18'' 53N / 000° 19' 23'' 55W / Alt: 5m (WGS 84, 2D, Averaging mode).
Photography: None
Weather: Cold and overcast
Landuse: Arable land, winter crop.
Topography: Level
Average depth of trench: 0.7m

Horizons (cm)

0-42cm Ap
Olive brown (2.5Y4/3), slightly stony clayey loam. 42 to 50cm thick. Abrupt, smooth lower boundary. Non-calcareous. Common to many fine roots. Few to common fragments of pottery, red tile and glass as surface scatter on cultivated field.

42-75cm Bw
Light yellow brown (10Y5/6), slightly to moderately stony clayey loam, becoming very stony in basal part. Thickness 12-35cm, generally 25cm. Non-calcareous but slight effervescence noted in basal part and confined to individual carbonate grains. Common earthworm activity observed throughout.

>75cm Cu
Very to extremely stony sandy loam. Strongly calcareous. Predominantly very small to small stones, well rounded to angular. Bedded gravel mainly consisting of rounded oolithic limestone, very well rounded 1-4mm 'soft' carbonate granules and angular to sub-angular flint gravel. The surface of this context is generally level but may present gentle depressions up to 15 cm deep. The gravels are very porous and well drained.

Tentative interpretation: Shallow brown calcareous soil developed over bedded calcareous gravels forming level river terrace deposits largely derived from material eroded from limestone outcrops located to the West. The overlying clayey loamy soil has its origin in alluvial flood deposits most probably derived from the river Welland or an extinct river.

Archaeology: One deep ditch perhaps related to Late Bronze Age to Early Iron Age settlement, cut into Bw and Cu horizons to max. depth of 160cm.

Notes:
Earthworm burrowing commonly observed throughout the profile. Water table at 1.54m below modern surface.

Samples: None

Trench 12

General

Location: Just east of Car Dyke
GPS position: 52° 41' 19'' 60N / 000° 19' 14'' 59W / Alt: 5m (WGS 84, 2D, Averaging mode).
Photography: Slide film 1, exposure 18, view of Car dyke and yellow streak along eastern margin.
exposure 23, position of monolith sample.
Negative film 1, exposure 29, position of monolith.
Weather: Very foggy and cold.
Landuse: Arable land, freshly ploughed.
Topography: Level
Average depth of trench: 0.75m

Horizons (cm)

0-43cm Ap
Dark greyish brown (10YRY4/2), very stony clayey loam. 40 to 56cm thick. Abrupt, smooth lower boundary. Non-calcareous. Common to many fine roots. Few to common fragments of pottery, red tile and glass as surface scatter on cultivated field. Strongly disturbed by modern tillage practices. Fresh straw layer at 20cm caused by turf reversal during ploughing.

43-54cm Bw1
Yellowish brown (10Y5/8), moderately stony, clayey loam. Thickness 9-14cm, generally 1cm. Non-calcareous. Diffuse lower boundary. Common earthworm activity observed throughout.

54-74cm Bw2
Brownish yellow (10YR6/8) slightly stony clayey loam. Slightly calcareous.

>74cm Bw3
Yellow (10YR7/8) slightly stony clayey loam. Slightly calcareous. Very dry, friable and stiff. Occasionl small grey (2.5Y6/1) patches probably reflecting gleying around former root channels.

Tentative interpretation: Shallow brown calcareous loamy soil developed in alluvial flood deposits most probably derived from the river Welland or an extinct tributary. The upper 50cm are strongly affected by modern cultivation and subjected to disturbance by agricultural machinery and earthworm activity. The colour of the Ap horizon in this trench is slightly lighter than elsewhere probably as a consequence of the admixture of yellow clayey loam derived from the construction of the nearby dyke. The unusual high stoniness of the topsoil may also be a result of the dumping of sediment retrieved from the basal gravel deposits during the excavation of the nearby Car dyke and subsequent dredging related to its maintenance. The upper part of the Bw1 horizon may represent a palaeosol pre-dating a subsequent second phase of river flooding and/or the construction of the watercourse believed to be of Roman age and which have effectively buried the pre-existing landsurface. This palaeosol may be related to that disclosed in trench 9 and does indeed posseses simmilar field properties. The height of the added overburden has been sufficient to avoid the complete alteration of the buried landsurface through disturbance by cultivation in historic and modern times. The Ap horizon may also continue to receive additional sediment and organic debris ncluding abundant quantities of freshwater and terrestrial snails, via the dumping of material during regular maintenance work of the dyke.

Archaeology: Proximity of the Car Dyke believed to be a Roman watercourse and which may have been much wider in the past. According to the APS archaeologists the scatter of lithic finds noticed during field surveys shows a higher density along a roughly 30m band running parallel to the watercourse and coinciding with the lighter discolouration of the cultivated topsoil. This is probably

related to the construction of the dyke which involved the excavation of underlying sediments and simulataneous unearthening of pre-roman material culture.

Notes: Although the gravel deposit was not visible in the excavated trench it was clearly visible within the nearby dyke section at an approximate depth of 1.5m. The dyke itself is at present approximately 5 to 6 meters wide and 3 to 4 meters deep.

Samples: One bulk sample of humic surface sediment (MD 11) derived from the most recent cleaning operation of the dyke to provide a modern analogue of the faunal assemblages notably insects and molluscs, which are associated with the artificial micro-habitats created by the construction of the watercourse. This sample containing modern and sub-fossil material may provide a good indication of the present conservation value of the dyke and provide valuable comparative information for palaeoecological studies of fossil assemblages and their interpretation in terms of changes in the management, usage or disuse of the watercourse in historic times.

One monolith (MD 10) extending from the Ap into the Bw3 horizon (e.g. from 30 to 85cm) to confirm the presence of a buried soil and assess the suitability of palynological and mollscan analysis.

One sample for optically stimulated luminescence dating (MD 12) to obtain a date for the deposition of the widespread alluvium recorded along the route of the bypass. The sample was collected in vertical position from the basal part of the Bw2 horizon, stretching from 66 to 76cm below the modern groundsurface.

Trench 13

General

Location: Opposite industrial estate.
GPS position: 52° 41' 20'' 65N / 000° 19' 00'' 72W / Alt: 5m (WGS 84, 2D, Averaging mode).
Photography: Slide film 1, exposures 19 to 21.
Weather: Cold and overcast
Landuse: Arable land, winter crop.
Topography: Level
Average depth of trench: 0.7m

Horizons (cm)

0-42cm Ap
Olive brown (2.5Y4/3), slightly stony clayey loam. 42 to 50cm thick. Abrupt, smooth lower boundary. Non-calcareous. Common to many fine roots. Few to common fragments of pottery, red tile and glass as surface scatter on cultivated field.

42-75cm Bw
Light yellow brown (10Y5/6), slightly to moderately stony clayey loam, becoming very stony in basal part. Thickness 12-35cm, generally 25cm. Non-calcareous but slight effervescence noted in basal part and confined to individual carbonate grains. Common earthworm activity observed throughout.

>75cm Cu
Very to extremely stony sandy loam. Strongly calcareous. Predominantly very small to small stones, well rounded to angular. Bedded gravel mainly consisting of rounded oolithic limestone, very well rounded 1-4mm 'soft' carbonate granules and angular to sub-angular flint gravel. The surface of this context is generally level but may present gentle depressions up to 15 cm deep. The gravels are very porous and well drained.

Tentative interpretation: Shallow brown calcareous loamy soil developed over bedded calcareous gravels forming level river terrace deposits largely derived from material eroded from limestone outcrops located to the West. The overlying clayey loamy soil has its origin in alluvial flood deposits most probably derived from the river Welland or an extinct river.

Archaeology: One deep ditch perhaps related to Late Bronze Age to Early Iron Age settlement, cut into Bw and Cu horizons to max. depth of 160cm.

Notes:
Earthworm burrowing commonly observed throughout the profile. Water table at 1.54m below modern surface.

Samples: None

Trench 14

General

Location: Opposite industrial estate.
GPS position: 52° 41' 25'' 57N / 000° 18' 49'' 83W / Alt: 5m (WGS 84, 2D, Averaging mode).
Photography: None
Weather: Cold and very foggy.
Landuse: Arable land, freshly ploughed.
Topography: Level
Average depth of trench: 0.55m

Horizons (cm)

0-34cm Ap
Very dark greyish brown (2.5Y4/3), slightly stony clayey loam. 47 to 50cm thick. Abrupt, smooth lower boundary. Non-calcareous. Common to many fine roots. Few to common fragments of pottery, red tile and glass as surface scatter on cultivated field.

34-55cm Bw
Light olive brown (2.5Y5/6), slightly stony clayey loam, becoming very stony in basal part. Thickness 14-30cm, generally about 20cm. Non-calcareous but slight effervescence noted in basal part and confined to individual carbonate grains. Common earthworm activity observed throughout.

>55cm Cu
Very to extremely stony sandy loam. Moderately calcareous. Predominantly very small to small stones, well rounded to angular. Bedded gravel mainly consisting of rounded oolithic limestone and angular to sub-angular flint gravel with occasional well sorted sand bands. The surface of this context is generally level but may present gentle. The gravels are very porous and well drained.

Tentative interpretation: Shallow brown calcareous loamy soil developed over bedded calcareous gravels forming level river terrace deposits largely derived from material eroded from limestone outcrops located to the West. The overlying clayey loamy soil has its origin in alluvial flood deposits most probably derived from the river Welland or an extinct river.

Archaeology: None

Notes: Earthworm burrowing commonly observed throughout the profile.

Samples: None

Trench 15

General

Location: South side of Northfield Road.
GPS position: 52° 41' 27'' 43N / 000° 18' 38'' 27W / Alt: 5m (WGS 84, 2D, Averaging mode).
Photography: None
Weather: Cold and very foggy.
Landuse: Arable land.
Topography: Level
Average depth of trench: 0.75m

Horizons (cm)

0-37cm Ap
Very dark greyish brown (2.5Y4/3), slightly stony clayey loam. 47 to 50cm thick. Abrupt, smooth lower boundary. Non-calcareous. Common to many fine roots. Few to common fragments of pottery, red tile and glass as surface scatter on cultivated field.

37-76cm Bw
Strong brown (7.5YR5/6), slightly stony clayey loam, becoming very stony in basal 10cm. Non-calcareous but slight effervescence noted in basal part and confined to individual carbonate grains. Common earthworm activity observed throughout.

>55cm Cu
Very to extremely stony and wet sandy loam. Moderately calcareous. Predominantly very small to small stones, well rounded to angular. Bedded gravel mainly consisting of rounded oolithic limestone and angular to sub-angular flint gravel.

Tentative interpretation: Shallow brown calcareous soil developed over bedded calcareous gravels forming level river terrace deposits largely derived from material eroded from limestone outcrops located to the West. The overlying clayey loamy soil has its origin in alluvial flood deposits most probably derived from the river Welland or an extinct river.

Archaeology: None

Notes: Earthworm burrowing commonly observed throughout the profile.

Samples: None

Trench 16

General

Location: South side of Northfield Road adjacent to Catchwater Drain.
GPS position: 52° 41' 30'' 32N / 000° 18' 22'' 54W / Alt: 5m (WGS 84, 2D, Averaging mode).
Photography: None
Weather: Cold and very foggy.
Landuse: Arable land, root crop.
Topography: Level
Average depth of trench: 0.55m

Horizons (cm)

0-51cm Ap
Very dark greyish brown (2.5Y3/2), moderately stony, silty clay. Non-calcareous. Abrupt, smooth lower boundary. Common to many fine roots. Few to common fragments of pottery, red tile and glass as surface scatter on cultivated field. Piece of plastic wire at 32cm.

51-63cm Bw
Yellowish brown (10YR5/8), slightly stony clayey loam grading into lighter moderately stony clayey loam in basal 5cm. Non-calcareous but slight effervescence noted in basal part and confined to individual carbonate grains. Common earthworm activity observed throughout.

>63cm Cu
Very to extremely stony and wet sandy loam. Moderately to slightly calcareous. Predominantly very small to small stones, well rounded to angular. Bedded gravel mainly consisting of rounded oolithic limestone and angular to sub-angular flint gravel.

Tentative interpretation: Shallow brown loamy soil developed over bedded calcareous gravels forming level river terrace deposits largely derived from material eroded from limestone outcrops located to the West. The overlying clayey loamy soil has its origin in alluvial flood deposits most probably derived from the river Welland or an extinct river. The higher degree of stoninesss of the topsoil may be a result of the dumping of gravel deposits from the excavation and maintenance of the adjacent Catchwater Drain.

Archaeology: One ditch of unknown age running perpendicular to the trench.

Notes: Earthworm burrowing commonly observed throughout the profile.

Samples: None

Trench 18

General

Location: South side of Northfield Road opposite Willowfield house.
GPS position: 52° 41' 37'' 61N / 000° 18' 09'' 00W / Alt: 5m (WGS 84, 2D, Averaging mode).
Photography: None
Weather: Cold and very foggy.
Landuse: Arable land, root crop.
Topography: Level
Average depth of trench: 0.40m

Horizons (cm)

0-38cm Ap

Very dark greyish brown (2.5Y3/2), slightly stony, silty clay. Non-calcareous. Abrupt, smooth lower boundary. Common to many fine roots. Few to common fragments of pottery, red tile and glass as surface scatter on cultivated field.

38-46cm Bw

Yellowish brown (10YR5/6), slightly stony clayey loam. Non-calcareous. Common earthworm activity observed throughout. This horizon is completely absent in some parts of the trench and is generally very thin, varying between 3 and 10cm in thickness.

>63cm Cu

Very to extremely stony and wet sandy loam. Moderately to slightly calcareous. Predominantly very small to small stones, well rounded to angular. Bedded gravel mainly consisting of rounded oolithic limestone and angular to sub-angular flint gravel.

Tentative interpretation: Shallow brown loamy soil developed over bedded calcareous gravels forming level river terrace deposits largely derived from material eroded from limestone outcrops located to the West. The overlying clayey loamy soil has its origin in alluvial flood deposits most probably derived from the river Welland or an extinct river.

Archaeology: Absent

Notes: Earthworm burrowing commonly observed throughout the profile.

Samples: None

Trench 19

General

Location: South side of Northfield Road opposite Willowfield house.
GPS position: 52° 41' 40'' 64N / 000° 17' 59'' 84W / Alt: 5m (WGS 84, 2D, Averaging mode).
Photography: None
Weather: Cold and very foggy.
Landuse: Grassland.
Topography: Level
Average depth of trench: 0.42m

Horizons (cm)

0-32cm Ap
Very dark grey (10YR3/1), slightly stony, silty clay. Non-calcareous. Abrupt to gradual, smooth lower boundary. Common to many fine roots.

32-41cm Bw
Thin, yellowish brown (10YR5/6), slightly stony clayey loam. Non-calcareous. Common earthworm activity observed throughout.

>46cm Cu
Very to extremely stony sandy loam. Moderately to slightly calcareous. Predominantly very small to small stones, well rounded to angular. Bedded gravel mainly consisting of rounded oolithic limestone and angular to sub-angular flint gravel.

Tentative interpretation: Shallow brown loamy soil developed over bedded calcareous gravels forming level river terrace deposits largely derived from material eroded from limestone outcrops located to the West. The overlying clayey loamy soil has its origin in alluvial flood deposits most probably derived from the river Welland or an extinct river.

Archaeology: Absent

Notes: Earthworm burrowing commonly observed throughout the profile.

Samples: None

Trench 20

General

Location: South side of Northfield Road and West of Cross Road
GPS position: 52° 41' 43'' 48N / 000° 17' 49'' 17W / Alt: 5m (WGS 84, 2D, Averaging mode).
Photography: None
Weather: Cold and very foggy.
Landuse: Arable, cereal crops.
Topography: Level
Average depth of trench: 0.44m

Horizons (cm)

0-35cm Ap

Dark greyish brown (10YR4/2), slightly stony, clayey loam. Granular structure. Furrowed surface. Non-calcareous. Abrupt to gradual, smooth lower boundary. Common to many fine roots. Layer of reversed straw turf at 20cm caused by ploughing.

35-43cm Bw

Thin, yellowish brown (10YR5/6), slightly stony clayey loam. Non-calcareous. Common earthworm activity observed throughout. Very common small grey patches due to localized gleying around former root channels. Small area of in situ charred wood and/or heavily reduced organic debris believed to represent the base of a small tree stem with its side-roots, approximately 6cm wide and 8cm deep, associated with tiny red oxidized rock fragments and gleying around central woody parts.

>43cm Cu

Very to extremely stony sandy loam. Sightly calcareous. Predominantly very small to small stones, well rounded to angular. Bedded gravel mainly consisting of rounded oolithic limestone and angular to sub-angular flint gravel, partially cemented by ferruginous concretions as a result of iron oxidation.

Tentative interpretation: Shallow brown loamy soil developed over bedded calcareous gravels forming level river terrace deposits largely derived from material eroded from limestone outcrops located to the West. The overlying clayey loamy soil has its origin in alluvial flood deposits most probably derived from the river Welland or an extinct river. Oxidation due to fluctuations in the local water table have resulted in iron oxidation and the formation of ferruginous concretions which cement the upper part of the gravel deposit. As a consequence, these become less permeable hence promoting waterlogging and restricting root penetration.

Archaeology: Absent

Notes: Earthworm burrowing commonly observed throughout the profile.

Samples: One sample collected for 14C dating (MD 6). This sample may be expected to provide a minimum age for the alluvium. During collection of the sample it was noted that numerous fresh fine rootlets where present within the sample and these could be a potential source of contamination.

Trench 21

General

Location: Next to Shanne's Road.
GPS position: 52° 41' 48'' 20N / 000° 17' 37'' 21W / Alt: 5m (WGS 84, 2D, Averaging mode).
Photography: None
Weather: Cold and very foggy.
Landuse: Arable, furrowed.
Topography: Level
Average depth of trench: 0.47m

Horizons (cm)

0-36cm Ap

Very dark greyish brown (10YR3/2), slightly stony, clayey loam. Granular structure. Furrowed surface. Non-calcareous. Abrupt, smooth lower boundary. Common to many fine roots. Layer of reversed straw turf at 18cm caused by ploughing.

36-48cm Bw

Thin, yellowish brown (10YR5/8), slightly stony clayey loam. Non-calcareous. Common earthworm activity observed throughout.

>48cm Cu

Extremely stony sandy loam. Sightly calcareous. Predominantly very small to small stones, well rounded to angular. Bedded gravel mainly consisting of rounded oolithic limestone and angular to sub-angular flint gravel.

Tentative interpretation: Shallow brown loamy soil developed over bedded calcareous gravels forming level river terrace deposits largely derived from material eroded from limestone outcrops located to the West. The overlying clayey loamy soil has its origin in alluvial flood deposits most probably derived from the river Welland or an extinct river.

Archaeology: Absent

Notes: Earthworm burrowing commonly observed throughout the profile.

Samples: None

Trench 22

General

Location: Next to Shanne's Road and Drain.
GPS position: 52° 41' 52'' 94N / 000° 17' 26'' 47W / Alt: 5m (WGS 84, 2D, Averaging mode).
Photography: None
Weather: Cold and very foggy.
Landuse: Root crop, furrowed.
Topography: Level
Average depth of trench: 0.45m

Horizons (cm)

0-37cm Ap
Very dark greyish brown (2.5YY3/2), slightly stony, clayey loam. Furrowed surface. Non-calcareous. Abrupt, smooth lower boundary. Common to many fine roots.

37-42cm Bw
Yellowish brown (10YR5/6), slightly stony clayey loam. Non-calcareous. Common earthworm activity observed throughout. Common, irregular shaped grey patches caused by localized gleying around former roots spreading laterally above the underlying Cu horizon.

>42cm Cu
Extremely stony sandy loam. Sightly calcareous. Predominantly very small to small stones, well rounded to angular. Bedded gravel mainly consisting of rounded oolithic limestone and angular to sub-angular flint gravel.

Tentative interpretation: Shallow brown loamy soil developed over bedded calcareous gravels forming level river terrace deposits largely derived from material eroded from limestone outcrops located to the West. The overlying clayey loamy soil has its origin in alluvial flood deposits most probably derived from the river Welland or an extinct river.

Archaeology: Absent

Notes: Earthworm burrowing commonly observed throughout the profile.

Samples: None

Trench 23

General

Location: Next to Drain Gravel Road
GPS position: 52° 41' 54'' 37N / 000° 17' 16'' 11W / Alt: 5m (WGS 84, 2D, Averaging mode).
Photography: None
Weather: Cold and very foggy.
Landuse: Arable, furrowed.
Topography: Level
Average depth of trench: 0.44m

Horizons (cm)

0-38cm Ap
Very dark grey (2.5YY3/1), slightly stony, clayey loam. Furrowed surface. Non-calcareous. Abrupt, smooth lower boundary. Common to many fine roots.

38-44cm Bw
Yellowish brown (10YR5/6), slightly stony, silty, clayey loam. Non-calcareous. Common earthworm activity observed throughout. Common, irregular shaped grey patches caused by localized gleying around former roots spreading laterally above the underlying Cu horizon.

>44cm Cu
Extremely stony sandy loam. Sightly calcareous. Predominantly very small to small stones, well rounded to angular. Bedded gravel mainly consisting of rounded oolithic limestone and angular to sub-angular flint gravel with thin bands of well sorted medium to coarse sand.

Tentative interpretation: Shallow brown loamy soil developed over bedded calcareous gravels forming level river terrace deposits largely derived from material eroded from limestone outcrops located to the West. The overlying clayey loamy soil has its origin in alluvial flood deposits most probably derived from the river Welland or an extinct river.

Archaeology: Several small pits 0.5m to 1.0m wide and up to 50cm deep, filled with abundant fired lumps of red clay (3 to 8cm wide) and charcoal fragments within a black (5YR2.5/1) loamy matrix. The pits are located within the yellowish brown Bw horizon, approximately 35cm below the modern surface. These are interpretated as typical features associated with Iron Age saltmaking sites which have also been found elsewhere within the Deeping Fen. If this interpretation is correct then the presence of these archaeological features may also suggest the proximity of the sea and hence the possibility of marine flooding and deposition of marine alluvium in addition to freshwater alluvium.

Notes: Earthworm burrowing commonly observed throughout the profile. Faint plougmmarks visible at base of the trench, cut into yellow alluvium and running parallel to the direction of the trench.

Samples: Three samples were collected for OSL dating. MD 7 represents a fragment of fired clay taken within the pit at a depth of 65cm. Sample MD 8 consists of presumed heated sediment making up the fill of the pits and collected at a depth of 45 cm. MD 9 was positioned vertically in a 12cm thick band of sand within the gravel unit exposed at the base of one of the pits at a total depth of 67 to 77cm from the modern surface.

Trench 24

General

Location: East of Drain Gravel Road
GPS position: 52° 41' 56'' 58N / 000° 16' 57'' 78W / Alt: 5m (WGS 84, 2D, Averaging mode).
Photography: None
Weather: Cold and very foggy.
Landuse: Arable, furrowed.
Topography: Level
Average depth of trench: 0.38m

Horizons (cm)

0-36cm Ap
Black (2.5YY3/2), humic, slightly stony, clayey loam. Furrowed surface. Non-calcareous. Abrupt, smooth lower boundary. Common to many fine roots.

>36 Bg (Eg)
Strong brown (10YR5/6), clayey loam. Non-calcareous. Common small ochreous mottles. Common earthworm activity and roots.

Tentative interpretation: Shallow brown loamy soil developed within clayey alluvium derived from flood deposits by the river Welland or an extinct river. The darker colour and more humose nature of the topsoil may be related to waterlogged conditions in the past and accumulation of organic material (e.g. thin peat) which has largely wasted as a consequence of recent drainage and tillage. The ochreous mottles found within the Bg horizon may represent relict features testifying waterlogged conditions and past fluctuations of the water table.

Archaeology: Absent

Notes: Very shallow trench

Samples: None

Trench 25

General

Location: Next to drain and track
GPS position: 52° 41' 55" 50N / 000° 16' 38" 27W / Alt: 5m (WGS 84, 2D, Averaging mode).
Photography: Slide film 1, exposures 24 and 25 showing general stratigraphic sequence as revealed by freshly cleaned drain.
Weather: Cold and sunny
Landuse: Arable, mounded.
Topography: Level
Average depth of trench: 0.47m

Horizons (cm)

0-37cm Ap
Black (2.5Y3/2), humic, slightly stony, clayey loam. Mounded surface. Non-calcareous. Abrupt, smooth lower boundary. Common to many fine roots.

37-47cm Eg
Dark grey (10YR5/6), humic clayey loam. Non-calcareous. Very common small to large ochreous mottles and hard ferritic root pseudomorphs. Gradual lower boundary.

>47cm Bg
Yellowish brown clayey loam (10YR5/6) containing abundant yellowish red (5YR5/8) and common red (2.5YR4/8) mottles and hard ferritic root pseudomorphs with hollow internal channel. Common large irregular shaped grey patches caused by gleying.

Tentative interpretation: Shallow moderate to strongly humic, loamy soil developed within clayey alluvium derived from flood deposits by the river Welland or an extinct river. The darker colour and more humose nature of the topsoil may be related to waterlogged conditions in the past and accumulation of organic material (e.g. thin peat) which has largely wasted as a consequence of recent drainage and tillage. The ochreous mottles found within the Eg and Bg horizon may represent relict features testifying waterlogged conditions and periodic saturation with water associated with alteration of the original material by reduction and segregation of iron.

Archaeology: Absent

Notes: Very shallow trench. The presence of the underlying gravel deposit was confirmed by the inspection of a recently cleaned drain located in vicinity of the trench. The gravel unit is located at approximately 2m below the modern landsurface.

Samples: None

Trench 26

General

Location: To the West of the Cross Dyke
GPS position: 52° 41' 56'' 30N / 000° 16' 22'' 57W / Alt: 5m (WGS 84, 2D, Averaging mode).
Photography: None
Weather: Cold and sunny
Landuse: Arable, mounded.
Topography: Level
Average depth of trench: 0.55m (maximum 74cm)

Horizons (cm)

0-32cm Ap

Very dark grey (10YR3/1), humic, slightly to moderately stony, clayey loam. Mounded surface. Non-calcareous. Abrupt, smooth lower boundary. Common to many fine roots. The reversing of turf by recent ploughing has resulted in a concentration of fresh straw at 20cm.

32-40cm Eg

Black (5YR2.5/1), srongly humified amorphous peat. Dry and friable. Non-calcareous. Very common small to large ochreous mottles and hard ferritic root pseudomorphs. Gradual lower boundary.

>40cm Bg

Dark brown (7.5YR3/2) peaty loam containing abundant yellowish red (5YR5/8) and common red (2.5YR4/8) mottles and hard ferritic root pseudomorphs with hollow internal channel. Larger and more abundant at top becoming smaller and less numerous towards the base. Very dry deposit displaying polygonal surface cracking at freshly excavated base of the trench. Old root channels clearly visible as long streaks extending downwards 2 to 4mm wide. Common fresh fine roots also noticed throughout.

Tentative interpretation: Shallow moderate to strongly humic, soil developed within former peat admixed with alluvial sediment and gravels partly derived from the excavation and regular cleaning of the Cross Dyke which has resulted in the burial of the peat. The ochreous mottles as well as the common ferritic root pseudomorphs found within the Eg and Bg horizon may represent relict features testifying periodic saturation with water associated with alteration of the original material by reduction and segregation of iron. Recent (postwar) draining of the land has caused oxidative wastage and shrinkage of the peat.

Archaeology: Absent

Notes: Very shallow trench. The presence of the underlying gravel deposit was confirmed by the inspection of the Cross Drain where gravels are present at a depth of approximately 2.5 m below the modern surface.

Samples: None

Trench 27

General

Location: To the East of the Cross Dyke, opposite trench 26
GPS position: 52° 41' 55'' 71N / 000° 16' 21'' 94W / Alt: 5m (WGS 84, 2D, Averaging mode).
Photography: Slide film 1, exposure 29. Trench profile
Weather: Cold and sunny
Landuse: Arable, furrowed.
Topography: Level
Average depth of trench: 0.8m (maximum 1.30m). A pit was excavated at the base of the trench to reveal the complete sediment sequence of a buriied palaeo-channel.

Horizons (cm) (For detailed description refer to monoliths samples)

0-42cm Ap
Very dark grey, humic, slightly to moderately stony, clayey loam. Furrowed surface. Non-calcareous. Abrupt, smooth lower boundary. Common to many fine roots.

42-67cm Bg-Eg
Yellowish brown clayey loam with few small reddish mottles.

67-100cm Of
Brown woody peat, very dry and friable.

100-104cmCg1
Band of well sorted medium sand.

104-132cm Cg2
Greyish brown organic clay with wood fragments. Wet.

132-183cm
Succession of largely inorganic clays affected by gleying. 'Blue' clay grading into 'green' clay grading into stony loamy flint and limestone gravel.

Tentative interpretation: Shallow moderate to strongly humic, soil developed within former peat admixed with alluvial sediment and gravels partly derived from the excavation and regular cleaning of the Cross Dyke which has resulted in the burial of the peat. The ochreous mottles as well as the common ferritic root pseudomorphs found within the Eg and Bg horizon may represent relict features testifying periodic saturation with water associated with alteration of the original material by reduction and segregation of iron. Recent (postwar) draining of the land has caused oxidative decomposition and shrinkage of the peat. Organic excrements belonging to soil invertebrates and characterisitic feeding patterns found within large pieces of wood and a tree stem also reflect the continuing decomposition of woody and peaty remains. This trench also revealed a palaeo-channel. The channel which is capped by overlying peat and grey alluvium appears to be cut into a thick alluvial Cg horizon and must therefore post date the deposition of this widespread yellow alluvium.

Archaeology: Absent

Notes: For detailed description refer to monoliths and section logs. The presence of the underlying gravel deposit was confirmed by the inspection of the Cross Drain where gravels are present at a depth of approximately 2.5 m below the modern surface.

Samples:

3 monoliths (MD 16 (top), MD 15 (middle) and MD 14 (base)) representing the complete stratigraphic sequence of the palaeo-channnel from 22cm below the modern landsurface.

4 bulk samples (MD 17 (inorganic green clay), MD 18 (inorganic blue clay), MD 19(grey organic clay) and MD 20 (peat)) for assessing the preservation of plant macrofossils, insects and snails.

One sample (MD 21) removed from a 33cm wide tree trunk within the peat (90cm from surface) at the southern end of the trench.

Two samples sub-sampled in sub-dued laboratory light from the monoliths to assess the potential for OSL dating. MD 22 from the band of sand at the base of the woody peat, approximately 102cm from the modern surface. MD 23 from a lens of sandy clay within the green clay unit, at a depth of approximately 142cm.

Trench 28

General

Location: Near Cradge Bank
GPS position: 52° 41' 55'' 70N / 000° 16' 08'' 58W / Alt: 5m (WGS 84, 2D, Averaging mode).
Photography: None
Weather: Cold and very foggy.
Landuse: Arable, furrowed.
Topography: Level
Average depth of trench: 0.68m

Horizons (cm)

0-54cm Ap-Op
Black (5YR2.5/1), humic, slightly stony, clayey loam. Furrowed surface. Non-calcareous. Fresh straw at 20cm due to turf reversal by ploughing. Common to many fine roots. From 36cm onwards gradual change into dry, dark reddish brown peat. Abrupt lower boundary.

54-75cm Bg
Dark grey (10YR5/6), clayey loam. Non-calcareous. Very common small to large mottles ochreous (2.5YR4/8) mottles.

>75cm Cg
Yellowish brown (10YR5/4) slightly stony, sandy loam. Non-calcareous. Common ochreous (2.5YR4/8) and grey (7.5YR5/1) mottles related to oxidation and gleying.

Tentative interpretation: Humic soil developed within clayey alluvium and wasted peat. The darker colour and more humose nature of the topsoil may be related to waterlogged conditions in the past and accumulation of organic material (e.g. thin peat) which has undergone oxydation and shrinkage as as a consequence of recent drainage and tillage. The ochreous mottles found within the Bg and Cg horizons may represent relict features testifying waterlogged conditions and past fluctuations of the watertable.

Archaeology: Absent

Notes: Very shallow trench

Samples: None

Trench 29

General

Location: Just East of Spalding Road
GPS position: 52° 41' 59'' 14N / 000° 15' 58'' 34W / Alt: 5m (WGS 84, 2D, Averaging mode).
Photography: None
Weather: Cold but sunny.
Landuse: Arable, furrowed.
Topography: Level
Average depth of trench: 0.45m

Horizons (cm)

0-41cm Ap
Black (7.5YR2.5/1), slightly stony, peaty, clayey loam. Furrowed surface. Non-calcareous. Common to many fine roots and earthworm activity. Abrupt lower boundary.

>41cm Bg
Yellowish brown (10YR5/8), sandy loam. Non-calcareous. Very common small to large ochreous (2.5YR4/8) and grey mottles as well as hard ferritic root pseudomorphs, 0.5 to 1.5cm wide.

Tentative interpretation: Humic soil developed within clayey alluvium and wasted peat and strongly affected by cultivation. The darker colour and more humose nature of the topsoil may be related to waterlogged conditions in the past and accumulation of organic material (e.g. thin peat) which has undergone oxydation and shrinkage as as a consequence of recent drainage and tillage. The ochreous mottles found within the Bg and Cg horizons may represent relict features testifying waterlogged conditions and past fluctuations of the watertable.

Archaeology: Two sets of superimposed ploughmarks. One series at an average depth of 35cm and orientated 43°N. Second series at 40 to 53cm, orientated 334°N. The latter have a width of 2-3cm at a depth of 40cm. Modern ploughing is carried out at 45°N, roughly parallel to the nearby road.

Notes: Very shallow trench.

Samples: One sample (MD 13) for optically stimulated luminescence dating of sandy yellow alluvium. Height of overburden is 48cm._

Trench 30

General

Location: Opposite Northfield Poultry Farm
GPS position: 52° 41' 15'' 79N / 000° 19' 24'' 03W / Alt: 5m (WGS 84, 2D, Averaging mode).
Photography: None
Weather: Cold and overcast
Landuse: Arable land, winter crop.
Topography: Level
Average depth of trench: 0.54m

Horizons (cm)

0-32cm Ap
Very dark greyish brown (2.5Y3/2), slightly stony clayey loam. 42 to 50cm thick. Abrupt, smooth lower boundary. Non-calcareous. Common to many fine roots. Few to common fragments of pottery, red tile and glass as surface scatter on cultivated field.

42-75cm Bw
Light yellow brown (10Y5/6), slightly to moderately stony clayey loam, becoming very stony in basal part. Thickness 12-26cm, generally 20cm. Slightly calcareous especially in basal part. Common earthworm activity observed throughout.

>75cm Cu
Very to extremely stony sandy loam. Strongly calcareous. Predominantly very small to small stones, well rounded to angular. Bedded gravel mainly consisting of rounded oolithic limestone, very well rounded 1-4mm 'soft' carbonate granules and angular to sub-angular flint gravel as well as rare fossils (Devil's claw and belamites) which show weathering patterns typical of fluvial transport. The gravels are very porous and well drained.

Tentative interpretation: Shallow brown calcareous loamy soil developed over bedded calcareous gravels forming level river terrace deposits largely derived from material eroded from limestone outcrops located to the West. The overlying clayey loamy soil has its origin in alluvial flood deposits most probably derived from the river Welland or an extinct river. Alluvial sediments strongly affected by modern cultivation and subjected to disturbance by agricultural machinery and earthworm activity.

Archaeology: One ditch of uncerain age..

Notes: Earthworm burrowing commonly observed throughout the profile.

Samples: None

Trench 31

General

Location: North of Towngate House farm and East of drainage gully.
GPS position: 52° 41' 08'' 34N / 000° 19' 55'' 79W / Alt: 5m (WGS 84, 2D, Averaging mode).
Photography: None
Weather: Dry and sunny, cold, easterly winds, blue sky with fast moving clouds causing rapid changes in light intensity.
Landuse: Arable land, recently ploughed.
Topography: Level
Average depth of trench: 63cm

Horizons (cm)

0-48cm Ap

Very dark grey (2.5Y3/1), slightly stony clayey loam admixed with little sand. 39 to 53cm thick, generally 45-50cm. Abrupt, smooth lower boundary. No visible or audible reaction with Hcl. Common uncollapsed biopores probably related to earthworm activity also responsible for bioturbation. Common to many fine roots. Concentration of 'fresh' straw between 15 and 20 cm as a result of turf reversal by recent ploughing. Few to common fragments of pottery, red tile, glass and charcoal. Occasional colur change noticeable in lower 5cm of this horizon, grading into gray (10YR5/1). This lighter sub-horizon is generally absent along the section and found only over shallow depression in the Cu horizon where the profile is slightly deeper.

48-58cm Bw

Yellow (10YR7/8 to 2.5Y7/8), slightly stony, silty loam with little sand. Stones more common in basal 5cm. Thickness 11-40cm, generally 10-15cm. Rare weak gleying associated with grey colour change (10YR7/1) in shallow depressions of the underlying gravel unit. Faint, dry, friable, strongly calcareous light grey mottles also observed as dendritic network in horizontal section, probably the result of secondary carbonate precipitation within and surrounding roots spreading over less penetrabable Cu horizon.

>58cm Cu

Very to extremely stony with sandy loam matrix. Very calcareous. Predominantly very small to small stones (3-5mm), well rounded to angular. Rare large pebbles up to 6.5cm. Gravel mainly consisting of rounded oolithic limestone, very well rounded 1-4mm 'soft' carbonate granules and angular to sub-angular flint gravel. Other rock fragments include rare well rounded quartzite, platy to tabular sandstone often with internal iron impregnations and carbonaceous cortex (sometimes only the ferruginous inner part is preserved) as well as rare, abraded complete or fragmented fossils such as Devil's claw and belamites. The surface of this context is generally level but may present gentle depressions up to 40cm deep which offer better soil moisture conditions for plant growth and are expected to produce differential ripening of crop and hence to be visible from air as crop marks. This deposit is finely bedded with layers of well to moderately sorted, very small to small gravels and highly calcareous coarse sand bands. The gravels are very porous and well drained.

Tentative interpretation: Apedal brown calcareous loamy soil developed over irregular bedded calcareous gravels forming level river terrace deposits largely derived from material eroded from limestone outcrops located to the West. The overlying clayey loamy soil has its origin in alluvial flood deposits probably derived from the river Welland or an extinct river. The uneven surface micro-relief of the gravel deposit may be related to cryoturbation under periglacial conditions leading to polygonal and stripped reticulate patterns.

Archaeology: No evidence of archaeological features although a double ringed ditch is clearly visible

on aerial photographs. Numerous surface scatter finds of pottery, brick, tile and glass also observed in section. Occasional fragments of charcoal.

Notes: Earthworm burrowing commonly observed throughout the profile.

Samples: No samples were collected from this trench.

TECHNICAL REPORT B3: GRAIN-SIZE ANALYSIS DATA, EXCAVATION TRENCH No. 27

Consultant: Mr. J. LEE

PARTICLE SIZE ANALYSIS

LAB. No:	MD16 (11-14cm)
LOCATION:	MARKET DEEPING 1

SIEVING RESULTS

SAMPLE Wt:	59.60			
PHI SIZE:			% TOTAL WEIGHT	% TOTAL PASSING
GRAVEL				
-5	Res Wt On 32mm Sieve:	0.00	0.00	100.00
-4	Res Wt On 16mm Sieve:	0.00	0.00	100.00
-3	Res Wt On 8mm Sieve:	0.00	0.00	100.00
-2	Res Wt On 4mm Sieve:	0.00	0.00	100.00
-1	Res Wt On 2mm Sieve:	0.00	0.00	100.00
TOTAL RETAINED:		0.00		
FINER THAN 2mm:		59.60		
SAND				
0	Res Wt On 1mm Sieve:	0.00	0.00	100.00
1	Res Wt On 500um Sieve:	0.02	0.03	99.97
2	Res Wt On 250um Sieve:	0.04	0.07	99.90
3	Res Wt On 125um Sieve:	0.04	0.07	99.83
4	Res Wt On 63um Sieve:	0.08	0.13	99.70
TOTAL RETAINED:		0.18		
WEIGHT < 4 PHI:		59.42		

SEDIGRAPH RESULTS

PHI SIZE:		RETAINED %	CORRECTED AVERAGE %	% TOTAL WEIGHT	% TOTAL PASSING
4.25	52.56um	1.20	2.33	2.32	97.38
4.50	44.19um	0.90	1.74	1.74	95.64
4.75	37.16um	0.30	0.58	0.58	95.06
5.00	31.25um	0.30	0.58	0.58	94.48
5.25	26.28um	0.70	1.36	1.35	93.13
5.50	22.10um	1.40	2.71	2.70	90.42
5.75	18.58um	2.20	4.26	4.25	86.17
6.00	15.63um	2.60	5.04	5.02	81.15
6.25	13.14um	2.70	5.23	5.22	75.93
6.50	11.05um	2.60	5.04	5.02	70.91
6.75	9.29um	2.50	4.84	4.83	66.08
7.00	7.81um	2.10	4.07	4.06	62.02
7.25	6.57um	1.90	3.68	3.67	58.35
7.50	5.52um	2.20	4.26	4.25	54.10
7.75	4.65um	2.00	3.88	3.86	50.24
8.00	3.91um	1.80	3.49	3.48	46.76
8.25	3.29um	1.90	3.68	3.67	43.09
8.50	2.76um	1.70	3.29	3.28	39.80
8.75	2.32um	1.80	3.49	3.48	36.32
9.00	1.95um	2.10	4.07	4.06	32.27
9.25	1.64um	2.00	3.88	3.86	28.40
9.50	1.38um	1.60	3.10	3.09	25.31
9.75	1.16um	1.60	3.10	3.09	22.22
10.00	0.98um	1.80	3.49	3.48	18.74
10.25	0.82um	2.20	4.26	4.25	14.49
10.50	0.69um	2.40	4.65	4.64	9.85
10.75	0.58um	2.70	5.23	5.22	4.64
11.00	0.49um	2.40	4.65	4.64	0.00
	Sum	51.60			

SIZE	% WEIGHT	CUM %
32000um	0.00	100.00
16000um	0.00	100.00
8000um	0.00	100.00
4000um	0.00	100.00
2000um	0.00	100.00
1000um	0.00	100.00
500um	0.03	99.97
250um	0.07	99.90
125um	0.07	99.83
63um	0.13	99.70
52.56um	2.32	97.38
44.19um	1.74	95.64
37.16um	0.58	95.06
31.25um	0.58	94.48
26.28um	1.35	93.13
22.10um	2.70	90.42
18.58um	4.25	86.17
15.63um	5.02	81.15
13.14um	5.22	75.93
11.05um	5.02	70.91
9.29um	4.83	66.08
7.81um	4.06	62.02
6.57um	3.67	58.35
5.52um	4.25	54.10
4.65um	3.86	50.24
3.91um	3.48	46.76
3.29um	3.67	43.09
2.76um	3.28	39.80
2.32um	3.48	36.32
1.95um	4.06	32.27
1.64um	3.86	28.40
1.38um	3.09	25.31
1.16um	3.09	22.22
0.98um	3.48	18.74
0.82um	4.25	14.49
0.69um	4.64	9.85
0.58um	5.22	4.64
0.49um	4.64	0.00

% GRAVEL:	0.00
% SAND:	0.30
% SILT:	67.43
% CLAY:	13.52
% F CLAY:	18.74

PARTICLE SIZE ANALYSIS

LAB. No:	MD15 (83-91CM)
LOCATION:	MARKET DEEPING 2

SIEVING RESULTS

SAMPLE Wt:	98.91			
PHI SIZE:			% TOTAL WEIGHT	% TOTAL PASSING
		GRAVEL		
-5	Res Wt On 32mm Sieve:	0.00	0.00	100.00
-4	Res Wt On 16mm Sieve:	0.00	0.00	100.00
-3	Res Wt On 8mm Sieve:	0.00	0.00	100.00
-2	Res Wt On 4mm Sieve:	1.35	1.36	98.64
-1	Res Wt On 2mm Sieve:	1.67	1.69	96.95
TOTAL RETAINED:		3.02		
FINER THAN 2mm:		95.89		
		SAND		
0	Res Wt On 1mm Sieve:	1.95	1.97	94.98
1	Res Wt On 500um Sieve:	3.91	3.95	91.02
2	Res Wt On 250um Sieve:	42.77	43.24	47.78
3	Res Wt On 125um Sieve:	26.31	26.60	21.18
4	Res Wt On 63um Sieve:	5.52	5.58	15.60
TOTAL RETAINED:		80.46		
WEIGHT < 4 PHI:		15.43		

SEDIGRAPH RESULTS

PHI SIZE:		RETAINED %	CORRECTED AVERAGE %	% TOTAL WEIGHT	% TOTAL PASSING
4.25	52.56um	1.60	2.01	0.31	15.29
4.50	44.19um	3.00	3.76	0.59	14.70
4.75	37.16um	5.60	7.03	1.10	13.60
5.00	31.25um	8.70	10.92	1.70	11.90
5.25	26.28um	10.60	13.30	2.07	9.83
5.50	22.10um	10.30	12.92	2.02	7.81
5.75	18.58um	8.40	10.54	1.64	6.17
6.00	15.63um	6.40	8.03	1.25	4.91
6.25	13.14um	4.80	6.02	0.94	3.97
6.50	11.05um	3.60	4.52	0.70	3.27
6.75	9.29um	2.70	3.39	0.53	2.74
7.00	7.81um	1.90	2.38	0.37	2.37
7.25	6.57um	1.50	1.88	0.29	2.07
7.50	5.52um	1.30	1.63	0.25	1.82
7.75	4.65um	1.00	1.25	0.20	1.62
8.00	3.91um	0.90	1.13	0.18	1.45
8.25	3.29um	0.90	1.13	0.18	1.27
8.50	2.76um	0.80	1.00	0.16	1.12
8.75	2.32um	0.50	0.63	0.10	1.02
9.00	1.95um	0.50	0.63	0.10	0.92
9.25	1.64um	0.80	1.00	0.16	0.76
9.50	1.38um	0.80	1.00	0.16	0.61
9.75	1.16um	0.70	0.88	0.14	0.47
10.00	0.98um	0.70	0.88	0.14	0.33
10.25	0.82um	0.60	0.75	0.12	0.22
10.50	0.69um	0.50	0.63	0.10	0.12
10.75	0.58um	0.40	0.50	0.08	0.04
11.00	0.49um	0.20	0.25	0.04	0.00
	Sum	79.70			

% GRAVEL	3.05
% SAND:	81.35
% SILT:	14.68
% CLAY:	0.59
% F CLAY:	0.33

SIZE	% WEIGHT	CUM %
32000um	0.00	100.00
16000um	0.00	100.00
8000um	0.00	100.00
4000um	1.36	98.64
2000um	1.69	96.95
1000um	1.97	94.98
500um	3.95	91.02
250um	43.24	47.78
125um	26.60	21.18
63um	5.58	15.60
52.56um	0.31	15.29
44.19um	0.59	14.70
37.16um	1.10	13.60
31.25um	1.70	11.90
26.28um	2.07	9.83
22.10um	2.02	7.81
18.58um	1.64	6.17
15.63um	1.25	4.91
13.14um	0.94	3.97
11.05um	0.70	3.27
9.29um	0.53	2.74
7.81um	0.37	2.37
6.57um	0.29	2.07
5.52um	0.25	1.82
4.65um	0.20	1.62
3.91um	0.18	1.45
3.29um	0.18	1.27
2.76um	0.16	1.12
2.32um	0.10	1.02
1.95um	0.10	0.92
1.64um	0.16	0.76
1.38um	0.16	0.61
1.16um	0.14	0.47
0.98um	0.14	0.33
0.82um	0.12	0.22
0.69um	0.10	0.12
0.58um	0.08	0.04
0.49um	0.04	0.00

PARTICLE SIZE ANALYSIS

LAB. No:	MD15 (105-109CM)
LOCATION:	MARKET DEEPING 3

SIEVING RESULTS

SAMPLE Wt:	45.28			
PHI SIZE:			% TOTAL WEIGHT	% TOTAL PASSING
		GRAVEL		
-5	Res Wt On 32mm Sieve:	0.00	0.00	100.00
-4	Res Wt On 16mm Sieve:	0.00	0.00	100.00
-3	Res Wt On 8mm Sieve:	0.00	0.00	100.00
-2	Res Wt On 4mm Sieve:	0.00	0.00	100.00
-1	Res Wt On 2mm Sieve:	0.03	0.07	99.93
TOTAL RETAINED:		0.03		
FINER THAN 2mm:		45.25		
		SAND		
0	Res Wt On 1mm Sieve:	0.12	0.27	99.67
1	Res Wt On 500um Sieve:	0.32	0.71	98.96
2	Res Wt On 250um Sieve:	3.65	8.06	90.90
3	Res Wt On 125um Sieve:	3.55	7.84	83.06
4	Res Wt On 63um Sieve:	1.73	3.82	79.24
TOTAL RETAINED:		9.37		
WEIGHT < 4 PHI:		35.88		

SEDIGRAPH RESULTS

PHI SIZE:		RETAINED %	CORRECTED AVERAGE %	% TOTAL WEIGHT	% TOTAL PASSING
4.25	52.56um	0.70	1.17	0.93	78.31
4.50	44.19um	0.20	0.34	0.27	78.04
4.75	37.16um	1.00	1.68	1.33	76.71
5.00	31.25um	2.20	3.69	2.92	73.79
5.25	26.28um	2.80	4.70	3.72	70.07
5.50	22.10um	3.20	5.37	4.25	65.81
5.75	18.58um	3.60	6.04	4.79	61.03
6.00	15.63um	3.50	5.87	4.65	56.37
6.25	13.14um	3.20	5.37	4.25	52.12
6.50	11.05um	3.10	5.20	4.12	48.00
6.75	9.29um	2.90	4.87	3.86	44.14
7.00	7.81um	2.60	4.36	3.46	40.68
7.25	6.57um	2.10	3.52	2.79	37.89
7.50	5.52um	1.80	3.02	2.39	35.50
7.75	4.65um	1.80	3.02	2.39	33.11
8.00	3.91um	1.70	2.85	2.26	30.85
8.25	3.29um	1.60	2.68	2.13	28.72
8.50	2.76um	1.60	2.68	2.13	26.59
8.75	2.32um	1.40	2.35	1.86	24.73
9.00	1.95um	1.60	2.68	2.13	22.60
9.25	1.64um	2.10	3.52	2.79	19.81
9.50	1.38um	1.90	3.19	2.53	17.28
9.75	1.16um	1.90	3.19	2.53	14.76
10.00	0.98um	2.30	3.86	3.06	11.70
10.25	0.82um	2.50	4.19	3.32	8.38
10.50	0.69um	2.20	3.69	2.92	5.45
10.75	0.58um	2.20	3.69	2.92	2.53
11.00	0.49um	1.90	3.19	2.53	0.00
	Sum	59.60			

% GRAVEL:	0.07
% SAND:	20.69
% SILT:	56.64
% CLAY:	10.90
% F CLAY:	11.70

SIZE	% WEIGHT	CUM %
32000um	0.00	100.00
16000um	0.00	100.00
8000um	0.00	100.00
4000um	0.00	100.00
2000um	0.07	99.93
1000um	0.27	99.67
500um	0.71	98.96
250um	8.06	90.90
125um	7.84	83.06
63um	3.82	79.24
52.56um	0.93	78.31
44.19um	0.27	78.04
37.16um	1.33	76.71
31.25um	2.92	73.79
26.28um	3.72	70.07
22.10um	4.25	65.81
18.58um	4.79	61.03
15.63um	4.65	56.37
13.14um	4.25	52.12
11.05um	4.12	48.00
9.29um	3.86	44.14
7.81um	3.46	40.68
6.57um	2.79	37.89
5.52um	2.39	35.50
4.65um	2.39	33.11
3.91um	2.26	30.85
3.29um	2.13	28.72
2.76um	2.13	26.59
2.32um	1.86	24.73
1.95um	2.13	22.60
1.64um	2.79	19.81
1.38um	2.53	17.28
1.16um	2.53	14.76
0.98um	3.06	11.70
0.82um	3.32	8.38
0.69um	2.92	5.45
0.58um	2.92	2.53
0.49um	2.53	0.00

PARTICLE SIZE ANALYSIS

LAB. No:	MD14 (109-117CM)
LOCATION:	MARKET DEEPING 4

SIEVING RESULTS

SAMPLE Wt:	77.88			
PHI SIZE:			% TOTAL WEIGHT	% TOTAL PASSING
GRAVEL				
-5	Res Wt On 32mm Sieve:	0.00	0.00	100.00
-4	Res Wt On 16mm Sieve:	0.00	0.00	100.00
-3	Res Wt On 8mm Sieve:	0.00	0.00	100.00
-2	Res Wt On 4mm Sieve:	0.38	0.49	99.51
-1	Res Wt On 2mm Sieve:	0.64	0.82	98.69
TOTAL RETAINED:		1.02		
FINER THAN 2mm:		76.86		
SAND				
0	Res Wt On 1mm Sieve:	0.75	0.96	97.73
1	Res Wt On 500um Sieve:	0.94	1.21	96.52
2	Res Wt On 250um Sieve:	6.77	8.69	87.83
3	Res Wt On 125um Sieve:	5.65	7.25	80.57
4	Res Wt On 63um Sieve:	3.37	4.33	76.25
TOTAL RETAINED:		17.48		
WEIGHT < 4 PHI:		59.38		

SEDIGRAPH RESULTS

PHI SIZE:		RETAINED %	CORRECTED AVERAGE %	% TOTAL WEIGHT	% TOTAL PASSING
4.25	52.56um	0.10	0.19	0.14	76.10
4.50	44.19um	0.20	0.38	0.29	75.82
4.75	37.16um	0.30	0.56	0.43	75.39
5.00	31.25um	1.70	3.20	2.44	72.95
5.25	26.28um	3.20	6.02	4.59	68.36
5.50	22.10um	4.40	8.27	6.31	62.06
5.75	18.58um	5.20	9.77	7.45	54.60
6.00	15.63um	5.10	9.59	7.31	47.30
6.25	13.14um	4.60	8.65	6.59	40.70
6.50	11.05um	3.60	6.77	5.16	35.54
6.75	9.29um	2.70	5.08	3.87	31.67
7.00	7.81um	2.40	4.51	3.44	28.23
7.25	6.57um	2.00	3.76	2.87	25.37
7.50	5.52um	1.70	3.20	2.44	22.93
7.75	4.65um	1.50	2.82	2.15	20.78
8.00	3.91um	1.60	3.01	2.29	18.49
8.25	3.29um	1.60	3.01	2.29	16.20
8.50	2.76um	1.30	2.44	1.86	14.33
8.75	2.32um	1.00	1.88	1.43	12.90
9.00	1.95um	1.00	1.88	1.43	11.47
9.25	1.64um	1.10	2.07	1.58	9.89
9.50	1.38um	1.30	2.44	1.86	8.03
9.75	1.16um	1.30	2.44	1.86	6.16
10.00	0.98um	0.90	1.69	1.29	4.87
10.25	0.82um	0.80	1.50	1.15	3.73
10.50	0.69um	0.90	1.69	1.29	2.44
10.75	0.58um	0.80	1.50	1.15	1.29
11.00	0.49um	0.90	1.69	1.29	0.00
	Sum	53.20			

% GRAVEL	1.31
% SAND:	22.44
% SILT:	64.78
% CLAY:	6.59
% F CLAY:	4.87

SIZE	% WEIGHT	CUM %
32000um	0.00	100.00
16000um	0.00	100.00
8000um	0.00	100.00
4000um	0.49	99.51
2000um	0.82	98.69
1000um	0.96	97.73
500um	1.21	96.52
250um	8.69	87.83
125um	7.25	80.57
63um	4.33	76.25
52.56um	0.14	76.10
44.19um	0.29	75.82
37.16um	0.43	75.39
31.25um	2.44	72.95
26.28um	4.59	68.36
22.10um	6.31	62.06
18.58um	7.45	54.60
15.63um	7.31	47.30
13.14um	6.59	40.70
11.05um	5.16	35.54
9.29um	3.87	31.67
7.81um	3.44	28.23
6.57um	2.87	25.37
5.52um	2.44	22.93
4.65um	2.15	20.78
3.91um	2.29	18.49
3.29um	2.29	16.20
2.76um	1.86	14.33
2.32um	1.43	12.90
1.95um	1.43	11.47
1.64um	1.58	9.89
1.38um	1.86	8.03
1.16um	1.86	6.16
0.98um	1.29	4.87
0.82um	1.15	3.73
0.69um	1.29	2.44
0.58um	1.15	1.29
0.49um	1.29	0.00

PARTICLE SIZE ANALYSIS

LAB. No:	MD14 (122-125CM)_
LOCATION:	MARKET DEEPING 5

SIEVING RESULTS

SAMPLE Wt:	99.68			
PHI SIZE:			% TOTAL WEIGHT	% TOTAL PASSING
GRAVEL				
-5	Res Wt On 32mm Sieve:	0.00	0.00	100.00
-4	Res Wt On 16mm Sieve:	0.00	0.00	100.00
-3	Res Wt On 8mm Sieve:	0.00	0.00	100.00
-2	Res Wt On 4mm Sieve:	0.00	0.00	100.00
-1	Res Wt On 2mm Sieve:	0.00	0.00	100.00
TOTAL RETAINED:		0.00		
FINER THAN 2mm:		99.68		
SAND				
0	Res Wt On 1mm Sieve:	0.60	0.60	99.40
1	Res Wt On 500um Sieve:	1.15	1.15	98.24
2	Res Wt On 250um Sieve:	11.27	11.31	86.94
3	Res Wt On 125um Sieve:	15.27	15.32	71.62
4	Res Wt On 63um Sieve:	16.52	16.57	55.05
TOTAL RETAINED:		44.81		
WEIGHT < 4 PHI:		54.87		

SEDIGRAPH RESULTS

PHI SIZE:		RETAINED %	CORRECTED AVERAGE %	% TOTAL WEIGHT	% TOTAL PASSING
4.25	52.56um	0.20	0.31	0.17	54.88
4.50	44.19um	0.20	0.31	0.17	54.71
4.75	37.16um	1.80	2.78	1.53	53.18
5.00	31.25um	4.90	7.56	4.16	49.01
5.25	26.28um	7.70	11.88	6.54	42.47
5.50	22.10um	8.80	13.58	7.48	35.00
5.75	18.58um	8.10	12.50	6.88	28.12
6.00	15.63um	6.60	10.19	5.61	22.51
6.25	13.14um	5.40	8.33	4.59	17.92
6.50	11.05um	4.10	6.33	3.48	14.44
6.75	9.29um	2.70	4.17	2.29	12.15
7.00	7.81um	1.80	2.78	1.53	10.62
7.25	6.57um	1.50	2.31	1.27	9.34
7.50	5.52um	1.20	1.85	1.02	8.32
7.75	4.65um	1.10	1.70	0.93	7.39
8.00	3.91um	1.10	1.70	0.93	6.46
8.25	3.29um	1.20	1.85	1.02	5.44
8.50	2.76um	0.80	1.23	0.68	4.76
8.75	2.32um	0.40	0.62	0.34	4.42
9.00	1.95um	0.60	0.93	0.51	3.91
9.25	1.64um	1.00	1.54	0.85	3.06
9.50	1.38um	1.00	1.54	0.85	2.21
9.75	1.16um	0.70	1.08	0.59	1.61
10.00	0.98um	0.60	0.93	0.51	1.10
10.25	0.82um	0.50	0.77	0.42	0.68
10.50	0.69um	0.20	0.31	0.17	0.51
10.75	0.58um	0.10	0.15	0.08	0.42
11.00	0.49um	0.50	0.77	0.42	0.00
	Sum	64.80			

% GRAVEL	0.00
% SAND:	44.95
% SILT:	51.14
% CLAY:	2.80
% F CLAY:	1.10

SIZE	% WEIGHT	CUM %
32000um	0.00	100.00
16000um	0.00	100.00
8000um	0.00	100.00
4000um	0.00	100.00
2000um	0.00	100.00
1000um	0.60	99.40
500um	1.15	98.24
250um	11.31	86.94
125um	15.32	71.62
63um	16.57	55.05
52.56um	0.17	54.88
44.19um	0.17	54.71
37.16um	1.53	53.18
31.25um	4.16	49.01
26.28um	6.54	42.47
22.10um	7.48	35.00
18.58um	6.88	28.12
15.63um	5.61	22.51
13.14um	4.59	17.92
11.05um	3.48	14.44
9.29um	2.29	12.15
7.81um	1.53	10.62
6.57um	1.27	9.34
5.52um	1.02	8.32
4.65um	0.93	7.39
3.91um	0.93	6.46
3.29um	1.02	5.44
2.76um	0.68	4.76
2.32um	0.34	4.42
1.95um	0.51	3.91
1.64um	0.85	3.06
1.38um	0.85	2.21
1.16um	0.59	1.61
0.98um	0.51	1.10
0.82um	0.42	0.68
0.69um	0.17	0.51
0.58um	0.08	0.42
0.49um	0.42	0.00

TECHNICAL REPORT B4: ASSESSMENT OF EXCAVATION TRENCHES Nos. 27 and 12: PALYNOLOGY

Consultant: ***Mr. N.P. BRANCH***

Introduction

The following assessment report presents the results of a pollen-stratigraphic investigation of Trenches 12 and 27. A full account of the lithostratigraphy and criteria used in the sample selection can be obtained from Parts A and B.

The objectives of the assessment were twofold: (i) To comment on the state of preservation and concentration of the pollen grains and spores identified from each sample; (ii) To provide a general interpretation of the vegetation changes observed.

In total twenty nine pollen samples were analysed from Trench 27 and seven from Trench 12.

Laboratory Methodology

The pollen samples were prepared using a combination of the standard procedures outlined in Moore *et al* (1991) and the application of a heavy liquid separation method recently developed at Royal Holloway, Geography Department. The procedure may be summarised as follows:

(a) Deflocculation of 1ml. samples in 1% Sodium pyrophosphate
(b) Sieving through a 125µ mesh
(c) Separation of mineral fraction from the organic fraction using Sodium polytungstate (specific gravity 2.0g/cm^3)
(d) Mounting the pollen on microscope slides in glycerol jelly

Each stage of the procedure was preceded and followed by washing in distilled water. Quality assurance is maintained by (i) periodic checking of residues, (ii) assembling sample batches from various depths to test for systematic laboratory effects.

Assessment Procedure

1. Identifications

Pollen grains and spores were identified using the Royal Holloway (University of London) pollen type collection and the following sources of keys and photographs: Erdtman, (1952); Faegri and Iversen, (1989); Moore *et al*, (1991); Reille, (1992). Plant nomenclature follows the *Flora Europaea* as summarised by Stace (1992).

2. Pollen grains and spores identified

The pollen grains and spores listed in ***Table B4-1*** represent the principal types identified during the assessment. Although no attempt was made to list the types in order of frequency, since an assessment provides only an indication of the principal pollen types, where a taxon is clearly the most dominant in the assemblage this has been indicated.

3. *Pollen concentration*

Pollen concentrations were estimated during the assessment of each pollen sample using the exotic marker technique of Benninghof (1962). The exotic marker used is *Lycopodium* sp. Used in conjunction with pollen preservation analysis (2.4, below) the concentration assessment may be used to evaluate the potential of sediments for pollen-stratigraphic studies.

4. *Pollen deterioration*

During the assessment of each pollen sample, a subjective but systematic analysis was made of the type and general intensity of pollen deterioration. Taken with the pollen concentration assessment, the preservation data assists in evaluating the stratigraphic and palaeoecological integrity of the samples.

Results and Interpretation

Trench 27

The pollen preservation and concentration throughout the stratigraphic sequence was extremely good. This implies that the pollen-stratigraphic record at Trench 27 provides a true and accurate record of vegetation changes.

The principal pollen types listed in ***Table B4-1*** indicates a sequence of vegetation changes mirrored by changes in the lithostratigraphy. The diverse range of pollen types in the basal alluvial sediments and the presence of pre-Quaternary spores suggests, however, that some redeposition of sediments and mixing of pollen assemblages has probably occurred. Nevertheless, broad vegetation communities within the study area can be ascertained from the assemblages identified:

Dryland Communities - includes *Dryopteris* type, *Plantago lanceolata*, *Corylus* type, *Chenopodium* type, *Pinus*, *Tilia*, *Artemisia*.

Wetland Communities - includes *Typha latifolia*, *Polypodium*, *Alnus*.

The presence of scalariform perforation plates in pollen samples from 98cm indicates the local colonisation of woodland. This is verified by an increase in the diversity and concentration of arboreal pollen types, and in particular the extremely high values of *Alnus* pollen ('clumping' of *Alnus* pollen grains was observed in all samples from 90cm). The colonisation of *Alnus* and the formation of peat indicates significant changes in the local hydrology resulting in the expansion of wetland plant communities. This transition may be comparable to changes observed on other parts of the Lincolnshire fens during the middle to late Holocene (from approximately 5000 years BP; Scaife, 1992). There is no clear evidence, however, within the pollen assemblages identified, to suggest that the peat unit can be equated with either the pre-Roman or post-Medieval episodes of wetland expansion.

The transition to alluvial sediments at the top of the stratigraphic sequence resulted in an increase in the diversity of the pollen types representing both wetland and dryland vegetation communities. The depositional environment was, therefore, comparable to the lowermost units identified in Trench 27.

Recommendations for Trench 27

(i) Further detailed pollen-stratigraphic analyses of the lithostratigraphic units identified will provide the basis for a comparitive study and possible correlation with other sites along the fen margin. This study would help elucidate the nature of the vegetation communities colonising the fen edge during the middle to late Holocene and enhance our database of information regarding anthropogenic activity in the study area.

(ii) Submission of suitable samples for radiocarbon dating from the upper and lower contacts of the peat unit. Further investigation of the area may also reveal other datable deposits allowing possible correlation of the landscape features.

Trench 12

The absence of pollen in most of samples suggested that no further analysis of this trench was necessary.

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Table B4-1: Pollen Identifications - Results

Trench 27

Sample Depth (cm below surface)	Principal Pollen Types Identified	Pollen Concentration	Pollen Deterioration
36-37	Dryopteris type (dominant), Typha latifolia, Alnus, Apiaceae, Corylus type, Quercus, Betula, Galium type. Microscopic charcoal present.	High	Medium
40-41	Chenopodium type, Dryopteris type, Apiaceae, Caryophyllacea, Sparganium type, Cirsium type, Corylus type, Hedera, Fraxinus, Typha latifolia, Ranunculus type, Pteridium, Alnus.	High	Medium
44-45	Alnus, Apiaceae, Typha latifolia, Dryopteris type, Corylus type, Quercus, Betula, Galium type, Rumex, Caryophyllaceae. Microscopic charcoal present.	High	Medium
48-49	Alnus, Apiaceae, Typha latifolia, Dryopteris type, Corylus type, Quercus, Betula, Galium type, Rumex. Microscopic charcoal present.	High	Medium
49-50	Alnus (dominant), Poaceae, Quercus, Pinus, Corylus type, Dryopteris type, Acer.	High	Low
53-54	Alnus (dominant), Betula, Polypodium, Fraxinus, Corylus type, Dryopteris type, Quercus.	High	Low
57-58	Alnus (dominant), Betula, Corylus type, Quercus. Scalariform perforation plates present.	High	Medium
61-62	Alnus (dominant), Corylus type, Quercus, Poaceae, Cyperaceae, Ulmus, Hedera.	High	Low
65-66	Alnus (dominant), Polypodium, Ulmus, Chenopodium type, Caryophyllaceae, Quercus, Betula, Ranunculus type, Pinus, Fraxinus, Poaceae, Dryopteris type, Hedera, Corylus type,	High	Low

	Filipendula.		
69-70	Alnus (dominant), Quercus, Cyperaceae, Dryopteris type, Corylus type, Betula, Equisetum, Fraxinus, Ranunculus type, Ulmus, Polypodium, Oenanthe type. Scalariform perforation plates present.	High	Low
73-74	Alnus (dominant), Quercus, Corylus type, Chenopodium type, Dryopteris type, Erica type, Poaceae, Betula, Polypodium, Fraxinus, Cyperaceae, Tilia, Pterdium, Succisa. Scalariform perforation plates present.	High	Low
77-78	Alnus (dominant), Cyperaceae, Corylus type, Ulmus, Betula, Sinapis type, Quercus. Scalariform perforation plates present.	High	Low
81-82	Alnus (dominant), Cyperaceae, Ranunculus type, Poaceae, Sparganium type, Pteridium, Stellaria type, Pre-Quaternary spores. Scalariform perforation plates present.	High	Medium
89-90	Alnus (dominant), Pteridium, Sparganium type, Centaurea scabiosa, Quercus, Filipendula, Corylus type, Dryopteris type, Trifolium type. Scalariform perforation plates present.	High	Medium
93-94	Alnus, Poaceae, Quercus, Typha latifolia, Betula, Apiaceae, Sinapis type, Corylus type.	High	Medium
97-98	Poaceae, Chenopodium type, Quercus, Alnus, Lactuceae, Betula, Dryopteris type, Lotus type, Corylus type, Pinus, Pre-Quaternary spores. Scalariform perforation plates present.	Medium	Medium
101-102	Quercus, Chenopodium type, Apiaceae, Rumex, Corylus type, Dryopteris type.	Medium	Medium
105-106	Pteridium, Chenopodium type, Tilia, Sinapis type, Artemisia, Caryophyllaceae, Lactuceae, Cyperaceae, Pre-Quaternary spores.	Medium	Medium
107-108	Pteridium, Typha latifolia, Chenopodium type, Lactuceae, Poaceae, Corylus type, Alnus, Quercus, Rhinanthus type, Polypodium.	High	Medium/Low

115-116	Plantago lanceolata, Dryopteris type, Corylus type, Cyperaceae, Chenopodium type, Typha latifolia, Polypodium, Pteridium, Pinus.	High	Medium/Low
123-124	No pollen. Microscopic charcoal present.		
131-132	No pollen. Microscopic charcoal present.		

Trench 12

Sample Depth (cm below surface)	Main Pollen Types Identified	Pollen Concentration	Pollen Deterioration
30-31	Pinus. Microscopic charcoal present.	Low	High
38-39	No pollen. Microscopic charcoal present.		
46-47	Sinapis type. Microscopic charcoal present.	Low	High
54-55	No pollen. Microscopic charcoal present.		
62-63	No pollen. Microscopic charcoal present.		
70-71	No pollen. Microscopic charcoal present.		
88-89	No pollen. Microscopic charcoal present.		

Table B4-2 Glossary of nomenclature - pollen types

Scientific Name:	*Common Name:*
Acer	Maple or Sycamore
Alnus	Alder
Apiaceae	Carrot Family
Artemisia	Mugwort
Betula	Birch
Caryophyllaceae	Campion family
Centaurea scabiosa	Greater Knapweed
Chenopodium type	eg. Fat Hen
Cirsium type	eg. Thistle
Corylus type	Hazel or Bog Myrtle
Cyperaceae	Sedge Family
Dryopteris type	Male Fern
Equisetum	Horsetail
Erica type	eg. Cross-Leaved Heath
Filipendula	Meadowsweet
Fraxinus	Ash
Galium type	Bedstraw Family
Hedera	Ivy
Lotus type	eg. Common Birdsfoot-Trefoil
Oenanthe type	eg. Water Dropwort
Pinus	Pine
Plantago lanceolata	Ribwort Plantain
Poaceae	Grass Family
Polypodium	Polypody fern
Pteridium	Bracken fern
Quercus	Oak
Ranunculus type	Buttercup
Rhinanthus type	eg. Yellow Rattle
Rumex	Docks and Sorrels
Sinapis type	eg. Charlock
Sparganiun type	eg. Branched Bur-Reed
Stellaria type	eg. Chickweed
Succisa	Devils. Bit Scabious
Tilia	Lime
Trifolium type	Clover
Typha latifolia	Bulrush
Ulmus	Elm

TECHNICAL REPORT B5: ASSESSMENT OF EXCAVATION TRENCH No. 27: PLANT MACROFOSSIL CONTENT

Consultant: ***Mr. C. SHELDRICK***

1. Introduction

Four bulk sediment samples from Market Deeping were investigated, MD17 through to MD20 obtained from the Trench 27 sediment profile. Macroscopic plant remains (> 250 μm) were recovered from each sample using the standard palaeoecological technique for the extraction of plant macrofossils desribed by Wasylikowa (1986). A representative sample of between 150 cm^3 and 250 cm^3 of the retained material was then examined under a low-power stereo-microscope (at X15 to X45 magnifications). All potentially identifiable plant material was removed for further analysis. These were then identified to the lowest possible taxonomic level by comparison with modern and fossil reference material. The nomenclature of UK native taxa follows that of Kent (1992) and for non-native European taxa that of the *Flora Europaea* (Tutin *et al.*, 1993, 2nd ed.). The abundance of the different macrofossil types is of little or no diagnostic value in an assessment study of this nature. The following discussion of the plant macrofossil data has therefore been based upon presence data alone.

The plant macrofossil types listed as "unknown" are all potentially identifiable to the species level. This can however be an extremely time-consuming process, and has therefore not been undertaken during the assessment phase.

Where very large (> 2 cm) or large (5mm - 2 cm) wood fragments are present, identification by light and/or scanning electron microscopy is possible. This has not been undertaken at this stage, however, because of the preliminary nature of the study.

2. Sample MD17

Macrofossil types recovered: Cyperaceae leaves
Chara oospores
Ceratophyllum leaves

Other notes: Macrofossils are generally rare and in poor condition. Evidence of both mechanical damage and chemical oxidation. Occasional large (5mm - 2cm) wood fragments. Moss filaments common. Very occasional small

(< 1 mm) carbonised/charred fragments.

The sample consisted mainly of a coarse sand, with frequent iron-rich concretions, often associated with what appeared to be old root channels. It is possible that the iron from these, along with the occasional pyrite nodules found in these sediments, are derived from the basal Jurassic oolite found in the region. Minerogenic sediments of this nature, with a significant coarse-grained component, do not promote good macrofossil preservation. Organic material contained in such coarse sediments is prone to mechanical degradation and chemical oxidation.

The macrofossils recovered show a bias toward the aquatic environments, as is often the case with water-logged material. The recovered types are indicative of very slow-moving mesotrophic to eutrophic open waters with a pH ca. 6. Many of the wood fragments recovered showed signs of river washing. This, along with the grain size of the host sediments, may indicate seasonal peak in flow rates.

3. Sample MD18

Macrofossil types recovered: *Potentilla palustris* (L.) Scop.
Carex L. (Tristigmatae)
Rubus L. sp.
Three unknown seed types

Other notes: Macrofossils generally infrequent and in a poor condition. Very occasional small (< 5 mm) wood fragments. Very occasional small (< 1 mm) carbonised/charred fragments.

This sample was very similar to MD17, consisting mainly of a coarse sand matrix with abundant iron-rich concretions. In several cases these had formed around plant material, rendering it unidentifiable.

In contrast to sample MD17, there are no fully aquatic plants represented, suggesting perhaps that the flow rate of the water was too high for the local growth of aquatic macrophytes. *Potentilla palustris* and *Carex* are indicative of wet, perhaps seasonally-flooded ground. Little can be inferred from the presence of briars, given their very cosmopolitan nature, though they may suggest the local presence of woodland.

4. Sample MD19

Macrofossil types recovered:

Corylus avellana L.
Betula pubescens L.
Alnus Miller sp.
Thalictrum L.
Ranunculus subgen. *Batrachium* (DC) Gray
Rubus L.
Carex L.
Schoenoplectus cf. *lacustris* (L.) Palla
Potamogeton L. (small)
Cenococcum sclerotia
Four unknown seed types
One unknown bud type
One unknown budscale type.

Other notes: Macrofossils generally abundant and well preserved. Very large (> 2 cm) and large (5 mm - 2 cm) wood fragments extremely numerous, many twigs still retaining bark. Small (< 1 mm) carbonised/charred fragments present, but very infrequent.

The terrestrial macrofossil assemblage recovered from this sample suggests a wet but not flooded lowland wood on mature soils. One of the havel nuts recovered from this sample showed the characteristic signs of predation by woodmouse.

The aquatic macrofossil assemblage is poorer than might have been expected. It is not clear why the aquatic assemblage is so poor. Further investigation of these sediments at a finer stratigraphic interval (ca. 1 cm increments) might help to clarify the issue. It is likely that the sclerotia of the soil fungus *Cenococcum* entered the system from the surrounding soils during slumping of stream banks as there is no evidence of widespread soil instability. The presence of twigs retaining bark indicates that such material has not been transported over great distances. Such in situ deposition of plant material suggests very slow-flowing waters and a relatively rapid sediment accumulation rate. Under these conditions, the macrofossil flora can often be very large, yielding a great deal of detailed information about the local environment.

5. Sample MD20

Plant macrofossil types recovered: *Salix* L. sp.
Heracleum cf. sphondylium L.
Potamogeton L. (small)
Two unknown seed types
Two unknown leaf types

Other notes: Macrofossils generally frequent and moderately well preserved. Very numerous very large (> 2cm) , large (5 mm - 1 cm) and small (< 5 mm) wood fragments. Occasional twigs retaining bark. Occasional small carbonised/charred fragments. Numerous iron-rich concretions.

The drop in macrofossil concentration and diversity seen in this sample relative to MD19 may be due to a reduction in the preservation of macrofossils or a change in the environment. The very low number of macrofossil types recovered from this zone makes it very difficult to answer this question conclusively. However, the re-appearance of iron-rich concretions suggests the influx of material derived from the Juraasic oolite which occurs in the vicinity. This would only occur with increased erosive activity, either of the rocks directly, or, as is more likely, of the soils formed upon them.

6. Summary

Samples MD17 and MD18 suggest a relatively slow-flowing stream with regular, perhaps seasonal, periods of spate. The assemblage recovered from MD19 is much more diverse, with conclusive evidence for the first time for the local presence of woodland. The assemblage suggests a lower water flow rate and greater rate of sediment accumulation by comparison with samples 17 and 18. The data from MD20 are poor by comparison with 19, but generally support the overall impression that a floodplain of a generally slow-flowing stream, with isolated pools, characterised the locality throughout the period represented by the samples

7. References

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Table B5-1: Plant macrofossil records from samples MD17 to MD20, Trench 27, Market Deeping

Frequency represented by: - very rare ++ occasional ++++ frequent
+ present +++ common +++++ abundant

	Plant macrofossil type	Number/frequency
Sample MD17	*Chara* oospores	1
	Polytrichum sp. leaf tip	1
	Cyperaceae (vegetative)	++
	Ceratophyllum L. (vegetative)	++
	small carbonised/charred fragments	+
	large wood fragments	++
Sample MD18	*Potentilla* palustris (L.) Scop.	1
	Carex L. (Tristigmatae)	1
	Rubus L. sp.	14
	Three unknown seed types	6 individuals
	Small wood fragments	+
	small carbonised/charred fragments	-
Sample MD19	*Corylus avellana* L.	2
	Betula pubescens L.	2
	Alnus Miller sp.	4
	Thalictrum L.	1
	Ranunculus subg. *Batrachium* (DC.) Gray	1
	Rubus L.	1
	Carex L. (Distigmatae)	1
	Schoenoplectus cf. lacustris (L.) Palla.	1
	Cenococcum sclerotia	1
	four unknown seed types	5 (total)
	one unknown bud type	1
	one unknown budscale type	1
	very large wood fragments	+++++
	large wood fragments	+++++
	small wood fragments	++++
	small carbonised/charred fragments	-

Sample MD20	*Salix* L. sp. leaf	1
	Heracleum cf. sphodyllum L.	1
	Potamogeton L. (small)	2
	Poytrichum leaf tip	2
	two unknown seed types	2 (total)
	two unknown leaf types	3 (total)
	very large wood fragments	+++++
	large wood fragments	++++
	small wood fragments	+++++
	small carbonised/charred fragments	+

Table B5-2: Glossary of plant names

LATIN NAMES	*COMMON NAMES*
Salix L.	willow
Heracleum sphondyllum L.	cow parsnip, hogweed
Potamogeton L.	pondweed
Polytrichum	moss - no common name
Corylus avellana L.	hazel, cob-nut
Betula pubescens L.	downy birch
Alnus Miller	alder
Thalictrum L.	meadow rue
Ranunculus subg. *Batrachium* (DC.) Gray	water crowfoot
Ceratophyllum L.	Hornfoot
Rubus L.	blackberry
Cyperaceae	sedge family (e.g. cotton-grass)
Carex L. (Distigmatae)	sedge (2-sided fruits)
Carex L. (Tristigmatae)	sedge (3-sided fruits)
Schoenoplectus cf. lacustris (L.) Palla.	Bulrush
Potentilla palustris (L.) Scop.	marsh cinquefoil
Chara oospores	fruiting bodies of stonewort
Cenococcum	a soil fungus - no common name.

TECHNICAL REPORT B6: ASSESSMENT OF EXCAVATION TRENCH No. 27: FOSSIL INSECTS (Coleoptera)

Consultant: Mr. A. WALKLING

1. Introduction

Four bulk samples (MD17 to MD20) from Market Deeping were analysed for coleopteran (beetle) remains. The coleopteran remains were extracted from the sediment using standard flotation techniques. Subsamples were taken from the bulk material, disaggregated in warm water and washed through a 150 µm mesh. The residue collected in the sieve was then washed in kerosene. The kerosene absorbs onto the chitin of the insect cuticle, causing the sub-fossils to float in water. This enables the insect remains to be selected and abstracted from the matrix organic detritus. The insect-laden floating fraction was poured through a 150 µm mesh. sieve, washed in detergent to remove the kerosene and stored in alcohol. Sorting and identification of the beetle remains was carried out under a low power, binocular stereo- microscope at magnifications of X40 to X80.

The majority of the fossil remains were well preserved (i.e. still strongly sclerotized) although heavily fragmented. In several instances, elytra (wing-cases) and metasternal plates still fused together were found, suggesting that these fossils had undergone relatively little transporation before being deposited. In addition, the delicate nature of these joined parts of the exoskeleton would not have survived any reworking and hence they are considered to represent a fauna contemporary with sedimentation.

The major components of the beetle exoskeleton were represented in the bulk samples, including legs, mandibles, metasternal plates and the more diagnostic elytra, heads and pronota (thoraces).

The provisional taxa identifications listed in the following section are Coleoptera unless otherwise stated.

2. Results

Sample MD17:	No chitinous remains (vegetation detritus only)
Sample MD18:	*Cercyon* sp. Aleocharinae indet. *Staphylinidae* indet.
Sample MD19:	*Bembidion* sp. Carabidae indet.

Gyrinus cf. natator
Helophorus spp.
Ochthebius spp.
Hydrophilidae indet.
Staphylinidae indet.
Dryops sp.
Aphodius spp.
Plateumaris spp.
Chrysomelidae indet.
Curculionidae indet.

Sample MD20:
Bembidion spp.
Pterostichus nigrita (Payk.)
Carabidae indet.
Gyrinus cf. natator
Colymbetes spp.
Agabus arcticus (Payk.)
Helophorus spp.
Ochthebius minimis F.
Ochthebius bicolon Germ.
Ochthebius spp.
Cercyon sp.
Hydrophilidae indet.
Staphylinidae indet.
Dryops sp.
Aphodius spp.
Plateumaris spp.
Chrysomelidae indet. (many)
Curculionidae indet. (many)

Interpretation

Samples 17 and 18 contained little or no coleopteran remains, while samples 19 and 20 both yielded relatively large faunas (in excess of 100 specimens, representing approximately 20 species).

The faunas of MD17 and MD18 are probably taxonomically sparse for three reasons: (i) the deposition of the coarse sands and gravels which comprise MD 17 ("inorganic green clay") and MD18 ("inorganic blue clay") may have resulted in the destruction of beetle remains; (ii) coarse-grained deposits are prone to oxidation and hence degradation of the chitin of beetle exoskeletons; and (iii) (the more likely cause) there were too few beetles in the area to yield significant quantities of sub-fossil material. There is an insufficient amount of raw faunal data to warrant any further analysis of MD17 and MD18.

The riparian and aquatic environment dominate the fossil assemblage of MD19 and MD20. The abundance of fossil *Dryops* spp. in these samples strongly indicates the presence of flowing water, a suggestion supported by the occurrence of *Ochthebius bicolon* which is found in the vegetated edges of slowly flowing streams and rivers and is probably only accidentally found in stagnant water (Lindroth, 1985). The occurrence of *Gyrinus* spp. (whirlygig beetles), carniverous species which hunt for insects trapped by the water surface tension, suggest a stagnant or slow-flowing water surface with no floating vegetation, while conversely the water beetle *Ochthebius minimus* is usually very abundant only in shallow water with vegetation. In addition, specimens from the family Staphylinidae, and *Cercyon* spp. and *Aphodius* spp. are characteristically abundant under heaps of decaying plant refuse or the dung of herbivores. These two sets of contrasting ecological requirements (i.e. vegetation-rich and vegetation-poor niches) within the riparian habitat suggest that the bettle assemblage is a mixed fauna derived from a mosaic of micro-habitats along the edge of a water body, which in the more sluggish parts may have collected large amounts of decaying vegetation. Staning-water taxa include Helophorus sp., broadly indicative of stagnant pools of water, and the species Agabus arcticus, found commonly in *Sphagnum* pools and the mossy edges of lakes (Zaitsev, 1953). The ground beetle *Pterostichus nigrita* is confined to wet habitats, usually occurring in the shore zone of large ponds, lakes or rivers, and being most abundant in eutrophic fens (Lindroth, 1985).

TECHNICAL REPORT B7: ASSESSMENT OF EXCAVATION TRENCHES Nos. 3 and 27: FOSSIL MOLLUSCAN REMAINS

Consultant: Ms. S. DIXON

Introduction

Thirteen samples were analysed for molluscan remains (samples MD17-MD20; Samples A-G and 6-7, see table for full description). Two sizes of samples were processed. First, MD17-MD20 consisted of bulk samples, where approximately 3kg of sediment was used. Secondly, A-G and 6-7 consisted of smaller samples of approximately 1kg.

Laboratory Methods

(i) The samples were soaked in water overnight

(ii) The samples were sieved through a 0.15 mm (MD17-MD20) or 0.3mm mesh sizes (sample A-G and 6-7)
(iii) The sample residues were dried at 40°C

Identifications were made using modern specimens from the reference collection at Royal Holloway and Kerney and Cameron (1979).

Results

The results of the analysis indicate that the concentration of mollusca were generally low, with numbers of individuals in 10's (a medium concentration would be 100's and a high concentration 1000's). The number in brackets after the mollusc species indicates the total number of individuals found in each sample. Levels of preservation were estimated by looking at the surface of the shell under high magnification and examining the degree of fragmentation.

Interpretation

MDBP96 (G) 165

This sample contained the largest number of individuals. However, the total number of species was restricted to only five species. The freshwater component of the species show evidence for a calcium rich shallow water body with little water movement, a ditch or mire which frequently dries out and has abundant vegetation. *L. truncatula* (Muller) is not a true aquatic and is commonly found living on mud at the edges of streams. It does not tolerate peaty ground, and prefers shallow water bodies such as ditches, mires and puddles (Okeland, 1969). *P. planorbis* (Linne, 1758) is a specialist species requiring vegetation and fairly shallow hard water (Boycott, 1936). It is commonly found in small water bodies with little water movement. *L. peregra* (Muller) is a generalist ubiquitous species and therefore does not provide additional information. However, since it is a poor competitor with other species, the low diversity of mollusc assemblage would have favoured its colonisation. The land component is restricted to only one species, *V. pulchella* (Muller, 1774). This species is found at present in calcareous habitats, usually wetter places, such as moist meadows and marshes. This species was probably living on the waters edge and became mixed with the freshwater molluscs. All species present in this horizon are found in the British Isles today.

MDBP96 (F) 164

This unit contained the same assemblage as (G). The constancy of the assemblage

suggests that the local environment was stable.

MDBP96 (E) 164

This unit has a restricted mollusc assemblage with only three species present. The freshwater component shows evidence of a drying out shallow water, with minimal competition and hard water. *A. leucostoma* (Mi. 1813) is a specialist slum species and is frequently found in stagnant drying ponds (Boycott, 1936) in uncompetitive shallow water. This is similar to *L. truncatula* which prefers a semi-terrestrial habitat. The sample indicates a similar freshwater environment to the previous samples. The land component is common to a variety of habitats, such as moist places, woods, hedgerows, amongst rocks and human disturbed habitats. It may indicate the presence locally of a moist substrate with woodland and possible human disturbance.

MDBP96 (C) and (D)

The mollusc assemblage in these samples indicates the same local environmental conditions as the previous samples.

Summary of the mollusc evidence from samples A-G

Evidence was found for a calcareous shallow water body with little water movement eg. a ditch, which frequently dried out and had abundant vegetation. The land molluscs show evidence of the local environmental conditions and indicate areas of moist meadows, woodland and the possibility of human disturbance. It is suggested that the mollusc assemblage remained the same throughout the sedimen tary sequence and that the local environmental conditions were therefore stable.

Conclusions

The column samples have a restricted assemblage with only a few number of individuals and species. However, due to the specialist nature of the molluscs present, valuable information has been ascertained with regard to the local environmental conditions. It is recommended that any additional analyses should be carried out on sample sizes of 3-4 kg so that a more complete record can be recovered.

Table B7-1: Results

Sample	Number	Depth	Initial Weight	Concentration	Mollusca Identified	Preservation
MDBP96	(A) 158	-20cm	1kg	No Mollusca		
MDBP96	(B) 161	-20cm	1.2kg	No Mollusca		
MDBP96	(C) 186		1kg	Low Total (10)	Lymnaea truncatula (1) Lymnaea stagnalis (1) Anisus leucostoma (1) Vallonia pulchella (1) Aegopinella nitidula (5) Vallonia sp. (1)	Average
MDBP96	(D) 164		0.6kg	Low Total (17)	Lymnaea peregra (1) A. leucostoma (1) V. pulchella (3) A. nitidula (12)	Average
MDBP96	(E) 164		1kg	Low Total (13)	L. peregra (6) A. Lecostoma (2) A. nitidula (5)	Average
MDBP96	(F) 164		1kg	Low Total (20)	L. peregra (15) Planorbis planorbis (1) L. truncatula (1) V. pulchella (1) Vallonia juvenile (2)	Average
MDBP96	(G) 165		1kg	Low Total (31)	L. peregra (22) P. planorbis (3) L. truncatula (1) Pupilla spp. (1) V. pulchella (1) Vallonia spp. (3)	poor/ average large no. of fragments with in the residue were unidentifiable

MDBP96	TR23 (6)	1kg	No Mollusca
MDBP96	TR23 (7)	1kg	No Mollusca
MD17			No Mollusca
MD18			No Mollusca
MD19			No Mollusca
MD20			No Mollusca

TECHNICAL REPORT B8: ASSESSMENT OF SOILS

Consultant: Dr. H.C.M. Keeley

1. Introduction

The soils adjacent to the River Welland and at the northeastern end of the Bypass route, where it approaches the A16, have been mapped by the Soil Survey as Fladbury 1 Association (Hodge et al., 1984). These are deep, clayey alluvial soils comprising the Fladbury (pelo-alluvial gley soils), Thames (pelo-calcareous alluvial gley soils) and Wyre (pelogleyic brown calcareous alluvial soils) series. The main stretch of the route in between is mapped as the Badsey 2 Association, composed mainly of fine loamy soils over calcareous gravel. Most of these soils belong to the well-drained Badsey series (typical brown calcareous earths) but the occasionally waterlogged Ickford series (gleyic brown calcareous earths) and the seasonally waterlogged Kelmscot series (calcaro-cambic gley soils) reflect the influence of high grounwater levels.

2. The soils exposed in the excavation trenches

The soils in the trenches close to the River Welland (Trenches 1 and 2) and in the better drained adjacent section (Trenches 4 to 24, 30 and 31) conformed fairly closely to the Soil Survey map, although there was some variation in the better drained soils depending upon the proportion of alluvium within the profile. The trenches at the eastern end (Trenches 25 to 29) were more humic approaching the fen edge and included a section across a palaeochannel (Trench 27). Full descriptions of the soils in all of the trenches were made by J-L. Schwenninger and are provided in Technical Report B2.

The most archaeologically significant trenches were:

Trench 3 cut across a large Roman ditch with a fairly consistent gravelly fill overlain by alluvium which was sampled for molluscs.

Trench 9 contained the remains of a possible barrow scaling a thin layer of gravelly material which appeared to be a truncated buried soil. The barrow ditch appeared to have filled by natural silting.

Trench 11 contained a possible barrow ditch overlain by an accumulation of soil (thought

to be a headland) and a trace of the mound may have been preserved.

Trench 12 was a section through the remains of the Car Dyke bank, thought to date from the Roman period, which preserved beneath it a gravelly layer (probably a truncated buried soil) similar to that in Trench 9.

Trench 23 contained a number of pits and other features which appeared to be part of an Iron Age(?) saltern. Samples were taken for the identification of charred plant remains and these were found to contain substantial quantities of large well-preserved charcoal. However, no identifiable seeds were present (W. Carruthers, pers. comm.).

Unfortunately the palaeochannel (Trench 27) contained no archaeological remains.

3. *Assessment of value of further work*

The gravelly layers preserved beneath the barrow in Trench 9 and the Car Dyke bank in Trench 12 appear to represent the remains of a buried soil - probably part of the B horizon. The palaeosols have been recorded but, as they are clearly truncated, further work cannot be justified.

TECHNICAL REPORT B9: CHARCOAL ASSESSMENT, TRENCH 23

Consultant: Rowena Gale

1. Introduction

The excavation of two pits and a posthole produced evidence of industrial activity of unknown date but possibly dating to the Iron Age/Roman periods. Trench 23 included abundant burnt clay and fuel residues (charcoal). Bulk soil samples were collected and bagged. Five were processed and assessed for their potential to provide information on fuel resources, environmental data and suitable material for radiocarbon (C14) dating.

2. Bulk samples

The soil samples were processed by water flotation and sieving. Sieve mesh sizes included 0.5mm, 2mm and 5mm. The samples included charcoal, seeds, intrusive roots and straw (modern and noted as windblown on sample sheets). The charcoal was well preserved and fairly abundant in most samples with a useful proportion measuring >2mm in radial cross section (i.e. suitable for identification). Charcoal fragments measuring >2mm were extracted for examination. To assess the likely range of species present, fragments were selected randomly from those which, at macroscopic level, appeared to differ. These were fractured to expose transverse, tangential and radial surfaces and examined at magnifications of up to X400. The anatomical features were matched to reference material. Details are given in Table 1 of bulk sample weight, abundance of fragments, species diversity and C14 potential.

3. Results

Random sampling indicated that Samples 1 and 4 included alder, oak, ash and hazel whereas Samples 2, 3 and 5 identified hazel and/or alder. The pieces of charcoal were too fragmented to indicate whether they arose from narrow stems or wider roundwood.

4. Discussion

The abundance of burnt clay associated with the charcoal deposits strongly supports the suggestion that the charcoal represents fuel residues from industrial activity. The fuel appears to have consisted mainly of wood; there was no evidence of the use of cereal processing waste or other materials. Fuel residues from other fenland industrial sites of comparable date (eg. the

salterns at Cowbit, Middleton and Morton Fen: Lane, forthcoming) indicate that various types were used including wood, cereal waste, reeds and possibly peat. However, it should be noted that there is no evidence to suggest that the industrial processes undertaken at the site represent salt making. The differences in usage probably reflected the availability of fuel and hence the resources in the local environments.

The abundance of charcoal in the fuel deposits indicates that wood was readily available in the environment and was gathered from wetland species (alder) and woodlands characteristic of drier land which supported oak, ash and hazel. The species list may be enlarged by more detailed examination of the samples.

All the samples included material suitable for radiocarbon dating.

5. Recommendations for further work

Although only five samples of charcoal are available these consist of relatively large, well preserved fragments, present in sufficient quantity to produce significant results from further analysis. Their identification will contribute to the collective data on the environment local to the site. It will also complement environmental data from pollen analysis from the current excavation and existing records from work recently completed at Market Deeping for the Fenland Management Project.

It is therefore recommended that samples 1, 2, 3, 4 and 5 should be examined in detail and suitable fragments of material selected for C14 dating.

6. References

Lane, T.W., (Ed), forthcoming, A millennium of Saltmaking: Prehistoric and Roman Salt Production in the Fenland, Lincolnshire Archaeology and Heritage Report Series.

Table 1. Market Deeping Bypass: charcoal from Trench 23.
Taxa identified: Alnus (alder), Corylus (hazel), Fraxinus (ash) and Quercus (oak).

Sample	Context	BS weight in litres	Fragments	Species diversity	C14
1	174	20	>100	Quercus, Fraxinus, Corylus	+
2	188	20	<10	Mainly short lived eg. Corylus/Alnus	+
3	172	20	>100	Mainly short lived eg. Corylus	+
4	189	20	>100	Quercus, Alnus, Corylus	+
5	178	10	10-20	Corylus	+

TECHNICAL REPORT B10: PEAT HUMIFICATION RATIOS

Consultant: Mr. R. Hunter

1. Introduction

Humification analysis provides a rapid means of assessing the state of decomposition of detrital plant material associated with changes in hydrological conditions (e.g. aerobic or anaerobic medium) commonly related to climate change or human activity (e.g. drainage or deforestation). In palynological analysis, the degree of humification may also give an overall indication of the state of pollen preservation and the relative concentrations to be expected from specific humic levels.

2. Laboratory Methodology

Part 1 Humification Analysis

(i) Dry the samples at 80°C for 24 hours
(ii) Grind the sample using a pestle and mortar
(iii) Weigh 0.2g of sample
(iv) Add 100ml of 8% solution of Sodium Hydroxide
(v) After simmering for 1 hour transfer solution to a 200ml volumetric flask
(vi) Filter the solution (Grade 1 paper) and transfer 50ml to a 100ml volumetric flask
(vii) Analyse the solution using a Skalar SAN+ Segmented Flow Autoanalyser using a 540nm filter with a 1010nm interference filter.

Part 2 Organic Matter Content

(i) Add 1g of oven-dried sample to a weighed, dry crucible
(ii) Place in a muffle furnace at 550°C for 2 hours
(iii) After 2 hours transfer to a dessicator and allow to cool
(iv) Reweigh the sample.

3. Correction Factors

The percentage transmission reading was corrected for mineral content (established by the organic

matter determinations) and 'fading effect' of the solution (due to the time elapsed since the start of the preparation procedure and the actual analysis).

4. Results

Depth (cm)	*% Transmission*	*% Organic Matter Content*	*Corrected % Transmission*
49-50	42.17	39.00	14.34
53-54	41.28	46.00	16.88
57-58	54.01	37.00	17.87
61-62	68.84	28.28	17.17
65-66	54.96	34.23	16.58
69-70	64.44	28.28	15.93
73-74	75.02	27.55	18.15
77-78	66.81	26.17	15.26

END