

ASSESSMENT OF THE
POTENTIAL FOR
PALAEOENVIRONMENTAL
STUDY IN FLAXLEY VALLEY,
FOREST OF DEAN,
GLOUCESTERSHIRE

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Contents

1. Summary	1
2. Introduction and archaeological background.....	1
2.1 Project parameters	1
2.2 Aims	1
3. Pollen assessment (Katie Head).....	2
3.1 Methods	2
3.1.1 Fieldwork and sampling policy	2
3.1.2 Processing and analysis	2
3.2 Results	2
3.2.1 Radiocarbon Samples	2
3.2.2 Pollen samples	3
3.3 Discussion	4
3.4 Significance	4
3.5 Recommendations	4
4. Macrofossil assessment (Andrew Mann).....	5
4.1 Methods	5
4.1.1 Fieldwork and sampling policy	5
4.1.2 Processing and analysis	5
4.2 Results	5
4.3 Discussion of Significance	6
4.4 Recommendations	6
5. Geoarchaeological assessment (Terra Nova Ltd)	6
5.1 Aims	6
5.2 Scope of the report	6
5.3 Background	6
5.4 Method	8
5.5 Observations	8
5.6 Discussion	9
5.7 Further study.....	10
6. Overview and recommendations.....	10
7. The archive.....	12
8. Acknowledgements.....	12
9. Bibliography.....	12

Tables:

1	Radiocarbon date obtained from the base of the organic deposit
2	Pollen remains from selected contexts
3	Samples processed for assessment of macrofossil remains from Transect 1, core 4
4	Summary of macrofossil remains from Transect 1, core 4
5	Plant macrofossil remains from Transect 1, core 4

Figures:

1	Location of site
2	Coring locations
3	Stratigraphy of transects
4	View looking east across site, with position of palaeochannel, transects, and boreholes
5	Core 3 from transect 1

Appendices

1	The geoarchaeology of deposits at Flaxley Valley, Forest of Dean (Terra Nova)
2	Radiocarbon dating report

Assessment of the potential for palaeoenvironmental study in Flaxley Valley, Forest of Dean, Gloucestershire

Katie Head, Andrew Mann and Terra Nova Ltd

1. Summary

Analysis of pollen samples from an evaluation in Flaxley Valley, in the Forest of Dean was undertaken on behalf of the Archaeology Service, of Gloucestershire County Council. Two transects were selected across the course of a former stream, from which nine boreholes were obtained. Up to 4m of alluvial deposits overlay river gravels, and thin colluvial deposits were noted close to the edge of the floodplain. Three samples from one intact organic deposit of Anglo-Saxon date were selected for pollen and macrofossil analysis. The analysis was undertaken in order to discover whether there was any significant vegetation change, which might be related to human activity in the valley. The pollen results demonstrated that at the base of the sequence the environment was already characterised by an open, cleared landscape of dry grassland. Progressing up through the profile the landscape became increasingly wet, indicated by increased wetland herbs and an expanding, regenerating alder and hazel woodland adjacent to the stream. Plant macrofossil remains mostly reflected the 'in situ' alder carr woodland. One radiocarbon date of 880 to 1030 cal AD (at 95% probability, or 2σ probability) was obtained from the base of the organic deposit.

2. Introduction and archaeological background

An archaeological evaluation was undertaken at Flaxley Valley, in the Forest of Dean, Gloucestershire (NGR: SO 68351558), on behalf of the *Archaeology Service, Gloucestershire County Council* (Figure 1). Situated to the west of the village of Flaxley, the site, now used as pasture land, is located on the course of a former stream and lies in an area of underlying Lower Devonian Old Red Sandstone. The archaeology of the area is dominated by post-medieval blast-furnaces and it is believed that there was also earlier smelting activity. Documentary evidence indicates that the woodland within the valley has been continuously present since the medieval period and was used for producing charcoal. In later prehistory, archaeological evidence suggests that there were areas of enclosed cultivated land within the valley.

Three samples were selected by the author for assessment, based upon the organic content of the deposits.

2.1 Project parameters

The environmental project conforms to relevant sections of *Environmental Archaeology: A guide to the theory and practice of methods, from sampling and recovery to post-excavation* (English Heritage 2002).

2.2 Aims

The aims of the evaluation were to determine the state of preservation and quantity of environmental remains recovered from the samples and information provided. This information will be used to assess the importance of the environmental remains.

More specifically the following aims have been identified:

- To identify broad vegetational changes and to investigate whether there is any evidence of agricultural activity within the pollen record, particularly during the prehistoric period.

- To identify colluvial deposits, suggestive of prehistoric activity, within the sedimentary record (see Section 5; Geoarchaeological Assessment by Terra Nova Ltd 2005).

3. **Pollen assessment (Katie Head)**

3.1 **Methods**

3.1.1 **Fieldwork and sampling policy**

A total of nine cores using a Landrover mounted Dart rig, were taken from the site following two transects across the course of a former stream (six from transect 1 and three from transect 2), (Figures 2 and 3). Samples were taken by the environmental archaeologist from deposits considered to be of high potential for the recovery of environmental remains. Three samples were selected for pollen analysis as follows:

- Transect 2: Core 2: 196cm depth, organic peaty deposit with large wood inclusions.
- Transect 2: Core 2: 185cm depth, organic peaty deposit.
- Transect 2: Core 2: 175cm depth, organic peaty deposit.

A fourth sample was submitted for standard radiocarbon dating to the University of Waikato, comprising large wood fragments from Transect 2, Core 2, at a depth of 192 – 195.5cm. All nine cores were also assessed in the field for their geoarchaeological potential (see separate report by Terra Nova Ltd 2005).

3.1.2 **Processing and analysis**

Three pollen samples were selected from Transect 2 (core 2), primarily consisting of peat at depths of 175cm, 185cm, and 196cm. There were additional organic layers but these were not considered for sampling due to the possibility of mixing, being located at the base of the core sections. 2cm³ of sediment was measured volumetrically. To remove clays, the samples were soaked for 24 hours and then boiled in Tetra-Sodium Pyrophosphate for 30mins, sieved through a 120µm mesh, washed onto a 10µm mesh, and the residue collected. The samples were then digested by Potassium Hydroxide for 20mins in a boiling water bath to dissolve any humic material. 10% Hydrochloric acid was then added in order to remove any calcium carbonate within the samples. The samples were then digested using Hydrofluoric Acid in a hot water bath for 50mins to dissolve the siliceous material. The samples were then washed and sieved onto a 10µm mesh to remove any remaining clay or silica material. The samples were also acetolysed for 2mins to break down the cellulose material. Finally the pollen pellet was stained with safranine, washed in alcohol to dehydrate the sample, and preserved in silicon oil.

Pollen grains were counted to a total of 250 land pollen grains (TLP) for assessment purposes, on a GS binocular polarising microscope at 400x magnification, and identification was aided by using the pollen reference manual by Moore, Webb, and Collinson (1991). Nomenclature for pollen follows Stace (1997) and Bennett (1994).

3.2 **Results**

3.2.1 **Radiocarbon samples**

The base of the organic deposit was sampled in order to obtain material for radiocarbon dating (Table 1). Due to the substantial quantity of large wood fragments, the sample was

dated using standard radiometric methods (Appendix 3). The wood dated to between 880 AD and 1030 AD, at 95% (2 σ) probability (University of Waikato 2005).

Table 1: Radiocarbon date obtained from the base of the organic deposit

Sample	Material	Laboratory code	$\delta^{13}\text{C}$ ‰	Radiocarbon age BP	Calibrated age (2 σ)
Transect 2: Core 2: 192 – 195.5cm depth	Wood	Wk16463	-29.1 \pm 0.2	1088 \pm 41	880 cal AD – 1030 cal AD

3.2.2 Pollen samples

Transect 2: Core 2: 196cm depth

The base of the organic deposit dates to the late Anglo-Saxon period, as a piece of wood was radiocarbon dated to between 880 cal AD and 1030 cal AD, at a depth of 192 – 195.5cm. The pollen suite from this period appeared to reflect a landscape of open grassland, with grasses (Poaceae indet) contributing 84% TLP to the assemblage (Table 2). Very few other herbs were present, the occasional buttercup (*Ranunculus acris*-type) and Brassicaceae, the former expected in grassland environments. There is the possibility that cereals (Cerealia) were present, although these were difficult to identify due to the crumpling of the pollen grains, and may only be unidentifiable grasses. If these were cereals then they were most probably cultivated elsewhere as they are not a significant component. Trees and shrubs were present, primarily consisting of hazel (*Corylus*) and alder (*Alnus*), making up 10% TLP of the assemblage. The only other significant component were the ferns (*Pteropsida* (mon) indet), most probably inhabiting the wetter areas close to the stream. The pollen suite indicates an open, dry landscape with alder and hazel colonising the stream margin.

Transect 2: Core 2: 185cm depth

Towards the middle of the sequence, the landscape became slightly more wooded as grasses decreased. It also appears that some local areas became wetter with many wetland herbs, particularly meadowsweet (*Filipendula*), but also sedge (Cyperaceae) and kingcup (*Caltha palustris*-type), encroaching. There were also occasional herbs of waste or arable land such as chamomile (*Anthemis*-type), and another possible example of a cereal (Cerealia). The arboreal component increased, still dominated by hazel (*Corylus*) and alder (*Alnus*), most probably regenerating within some open areas. Spores also retained their high values, although there was now a significant number of bracken (*Pteridium*), possibly colonising the ground beneath the regenerating woodland. Alternatively, areas of the site may have been grazed, as bracken is avoided by livestock and so will flourish in grassland.

Transect 2: Core 2: 175cm depth

Trees and shrubs continued to increase, although herbs remained the dominant feature. The species composition of herbs changed slightly, with additions of ribwort plantain (*Plantago lanceolata*), a coloniser of formerly cultivated land. There was a significant increase in spores, primarily ferns (*Pteropsida* (mon) indet), but also bracken (*Pteridium*), the former having colonised the wet woodland close to the stream.

Overall, the pollen sequence shows a transition from a cleared landscape, primarily dry grassland, to one, which became increasingly wet, with alder and hazel regenerating and expanding slightly, close to the stream edge.

3.3 **Discussion**

Although the pollen sequence dates to the Anglo-Saxon period, the results are still comparable to other alluvial sites, primarily investigated on the floodplain of the River Severn between Worcester and Tewkesbury, and the estuarine zone south of Gloucester (Brown 1982). As with the Flaxley Valley site, the four locations on the River Severn included peat deposits within the alluvial sequences, although these dated to the early Neolithic. In general, three of the four sites displayed a vegetational pattern, which developed from wet alder carr, to sedge, and finally to wet meadow or grassland. The fourth site, Longney, lies south east of Flaxley, on the River Severn floodplain (Brown 1982). The pollen sequence primarily comprised alder but also included high numbers of lime and oak. The oak was primarily from the bog oak recorded on the site itself, while lime appears to have been an important woodland component on the floodplain terraces. Only minimal numbers of lime and oak were recorded at Flaxley however, indicating a more intensively cleared landscape of Anglo-Saxon date. Lime was found to be cleared relatively early according to results from the River Severn locations (Brown 1982). Further afield, but possibly more comparable to Flaxley due to its later Roman date, was the floodplain site of Mill Street, Leominster, in Herefordshire (Head forthcoming). The pollen evidence reflected mixed alder and hazel woodland colonising the river's edge, combined with a mosaic of meadowland vegetation and drier grassland.

3.4 **Significance**

Survival of the pollen remains was good, with all samples taken from an extremely peaty organic layer of Anglo-Saxon date. Although pollen investigations have been undertaken along the River Severn, few studies have occurred in the Forest of Dean itself, and due to the wealth of archaeology in the area, the environmental evidence is of regional significance.

3.5 **Recommendations**

The following recommendations are made with regard to further work on the samples considered as part of this report:

- Further sampling for pollen of the organic layer currently under investigation, at increased resolution of 2.5cm intervals. This would provide 5 additional samples, costing £821.88 excl VAT for a total of 4 days work. Costs are broken down as follows: 2 days processing, 1.25 days counting, and 0.75 days report.
- Sampling of alluvium to determine the preservation of the pollen. The preservation of pollen analysed from the alluvium of similar sites elsewhere, such as Wellington Quarry in Herefordshire, has been good.

4. Macrofossil assessment (Andrew Mann)

4.1 Methods

4.1.1 Fieldwork and sampling policy

The environmental sampling policy was as defined in the County Archaeological Service Recording System (1995 as amended). An organic deposit from Transect 1, core 4 was selected for assessment of macrofossil plant remains (Table 3). This is contemporary with the organic deposit processed for pollen analysis from Transect 2, core 2. Processing of organic material to recover macrofossil remains from an adjacent core allows the opportunity to undertake further processing of pollen from Transect 2, core 2 if required. The single carbon date should be sufficient to date both deposits as they appear to be broadly contemporary within the same stratigraphic sequence. The second organic deposit located in the 4th core of Transect 1 was situated at a depth of 81-125cm below the ground surface.

4.1.2 Processing and analysis

This deposit was sub-sampled at increments of 5cms (where possible) and each of the samples was processed by the wash-over technique as follows. The sub-sample was broken up in a bowl of water to separate the light organic remains from the mineral fraction and heavier residue. The water, with the light organic fraction was decanted onto a 300µm sieve and the residue washed through a 1mm sieve.

The residues were fully sorted by eye and the flots were scanned using a low power EMT stereo light microscope and plant remains identified using modern reference collections maintained by the Service, and seed identification manual (Beijerinck 1947). Nomenclature for the plant remains follows the *Flora of the British Isles*, 3rd edition (Clapham, Tutin and Moore 1989).

4.2 Results

The samples were small, and hence only small quantities of plant macrofossil remains were recovered, of which only occasional seeds were identifiable to species (Tables 4 and 5). The species diversity was poor (although the seeds were well preserved) and in some samples plant macrofossils were totally absent. The organic material was predominately woody (twigs, buds and leaf fragments) and the seed remains include occasional examples of alder (*Alnus glutinosa*), holly (*Ilex aquifolium*), dock (*Rumex* sp), sloe (*Prunus spinosa*), bramble or raspberry (*Rubus fruticosus/idaeus*). These are suggestive of alder carr vegetation along the water channel, and mixed woodland beyond. The assemblages provide little indication of landscape change over time. Two coleoptera elytras were also recovered from samples 110-115cm and 115-120cm, but this again represents poor preservation (Table 4). The deposit appears visually by eye to be homogenous throughout, consisting of waterlogged wood fragments and seeds of woodland trees or shrubs, although the pollen results (Section 3) suggest some vegetation change over time. The presence of small brick or ceramic fragments (<2mm) may indicate the presence of industrial activity, although pot or ceramic material can be found widely distributed through soils around settlements and on manured agricultural soils.

4.3 **Discussion of significance**

The macrofossil plant remains largely reflect the woodland carr vegetation close to the channel which appears to have been consistently present during the period of peat formation. Although samples from an auger core are small, and larger bulk samples taken from a test pit would provide suitably large samples for analysis, these remains are less likely than the pollen results to provide information on the wider valley environment. This limits the significance of these particular remains, even if larger plant macrofossil assemblages could be recovered with an appropriate sampling strategy.

4.4 **Recommendations**

The following recommendations are made for further work.

- Further sampling of these deposits for plant macrofossils and invertebrate remains would not appear necessary as the species range of both appears to be inadequate to provide significant assemblages for paleoenvironmental reconstructions.

5. **Geoarchaeological assessment (Terra Nova Ltd)**

5.1 **Aims**

This report aimed to evaluate the geoarchaeology of a site in the Flaxley Valley in the Forest of Dean in order to clarify the origins of the deposits and help assess the archaeological potential of the site. It was concerned, in particular, to consider the potential of the deposits to contain well-preserved sequences of Holocene alluvial and colluvial deposits from which might be recovered evidence of past local land-use. Evidence of metal-smelting and working was specifically sought through magnetic susceptibility measurement.

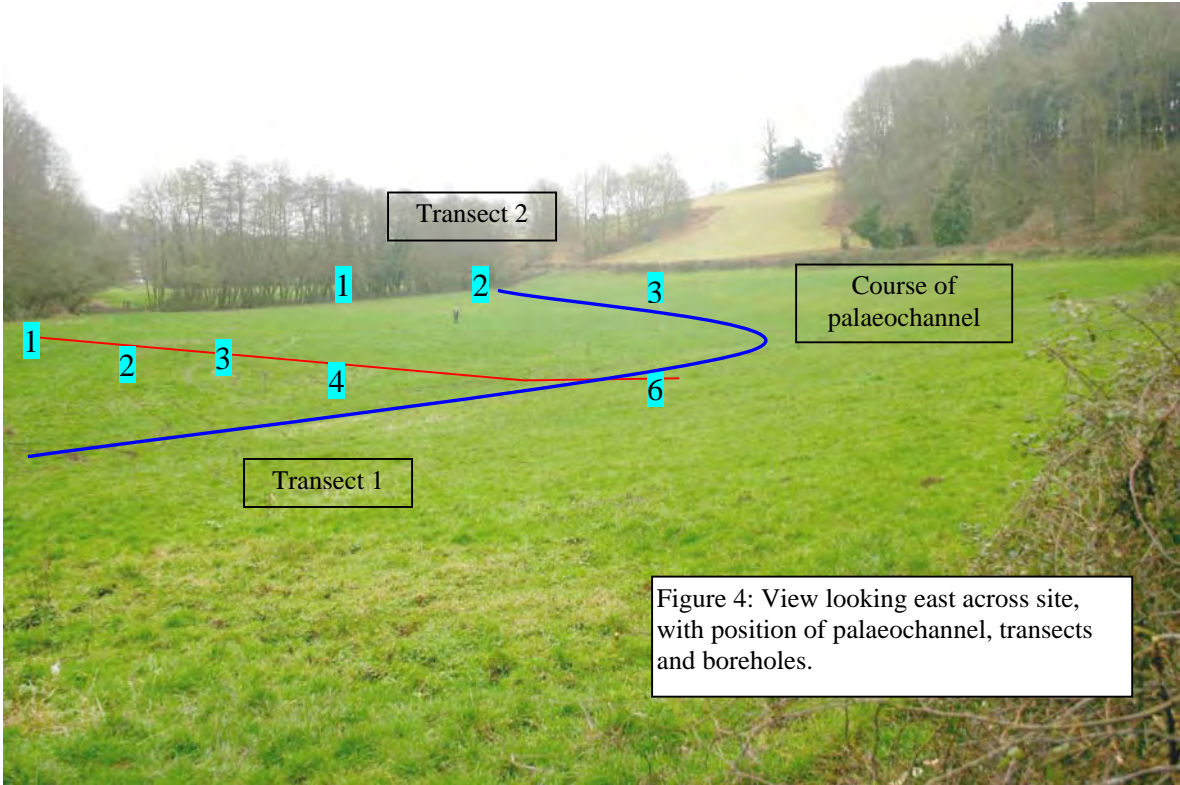
5.2 **Scope of the report**

This report is the result of a single day visit to the site to examine and record 9 cores taken across the bottom of Flaxley Valley in the Forest of Dean. The records are necessarily brief and only a small amount of preliminary analysis was carried out in the field in order to identify the potential of the deposits and construct a provisional geoarchaeological interpretation.

5.3 **Background**

Location, geology, topography, land uses, soils, hydrogeology and hydrology

The site is located at NGR SO 684 155 just to the west of the village of Flaxley and north east of the town of Cinderford. The bedrock of the area consists of Lower Devonian Old Red Sandstone (B.G.S. 1988). The site lies at the bottom of a fairly steep sided valley at about 60m OD in an area of farmland used for pasture. It is shown on the “Soil survey of England and Wales, *sheet 5 South West England* 1:250,000 map” as Typical brown earths of the Eardiston 1 formation (541c). A stream runs through the site where a high water table is maintained through groundwater recharge.



5.4 Method

The samples taken for analysis consisted of 9 cores, 6 from transect 1 and 3 from transect 2 (Figure 4). Both transects started at the valley bottom adjacent to the stream and ran south west towards the bottom of the valley side. Samples were taken using a Landrover mounted Dart rig and were split, examined and recorded on site. Magnetic susceptibility readings were taken every 5cm up the sequence using a Bartington MS2 meter and type F field coil. Sediment descriptions were logged on modified recording sheets after Hodgson (1976)

5.5 Observations

The deposits observed within the cores represented river terraces of sands and gravels overlain by silty and sandy clays with colluvial deposits at the base of the valley side.

Transect 1, Core 1

From the surface to 1.0m in depth, the deposit consisted of a medium red brown silty clay loam, becoming a medium red brown sandy clay loam with a few fragments of charcoal from 1.0 – 1.4m in depth, turning to a medium red brown loamy sand from 1.4 – 2.0m. From 3.0 – 4.0m the medium red brown sandy clay loam increased in stoniness towards the base. Magnetic susceptibility readings were all low ranging from 4 – 5 SI which was all consistent with natural background values except for the top 30cm where values ranged from 14 to over 100 SI.

Transect 1, Core 2

From the surface to 0.5m in depth the deposit consisted of a medium red brown sandy clay loam, with a few charcoal fragments observed from 0.1 – 0.5m in depth. From 0.5m – 0.9m in depth the deposits consisted of a light to medium red brown silty clay loam, this changed to a medium brown organic silty clay containing pieces of wood from 0.9m to 1.4m, which then became light to medium red brown sand and gravel increasing in stoniness towards the base of the core at 2.65m. Pieces of wood were observed between 1.0 and 1.4m in depth, magnetic susceptibility readings were 6 to 13 SI from 0 – 0.5cm in depth and 1 – 5 SI for the rest of the core and all were consistent with natural background values.

Transect 1, Core 3

From the surface to 0.6m in depth the deposit consisted of a light to medium red brown sandy clay loam, with a few fragments of charcoal observed from 0.2m – 0.6m (Figure 5). From 0.6m – 1.5m in depth the deposit consisted of a medium dark brown silty clay loam, which was very organic and contained pieces of wood from 0.6 – 1.0m. From 1.5m – 2.85m in depth the deposit consisted of a light to medium red brown sand and gravel which increased in stoniness towards the base of the core. Magnetic susceptibility readings ranged between 12 – 40 SI between 0 – 0.6m in depth with readings ranging from 1 – 5 SI below that to the base of the core.

Transect 1, Core 4

From the surface to 0.4m in depth the deposit consisted of a light to medium brown sandy clay loam, magnetic susceptibility readings ranged from 12 – 40 SI and a piece of red brick was observed at 0.35m in depth. From 0.4m – 0.7m the deposit consisted of medium brown silty clay loam. From 0.7 – 1.1m the deposit became a light red brown sand and gravel, then a medium red sandy clay from 1.1m – 1.7m, from 1.7m – 2.15m the deposit changed to a medium red brown sand and gravel, that increased in stoniness towards the base of the core, magnetic susceptibility readings ranged from 3 – 7 SI.

Transect 1, Core 5

From 0 – 0.2m in depth the deposit consisted of a medium brown silty clay loam, this turned to a light red brown sandy clay loam from 0.2 – 0.6m in depth. From 0.6m – 2.9m in depth the deposit consisted of a medium red brown sandy clay that increased in stiffness towards the base of the core. Magnetic susceptibility readings ranged from 12 – 15 SI between 0 – 0.2m in depth and between 3 – 5 SI from 0.2m in depth to the base of the core.

Transect 1, Core 6

From 0 – 0.25m in depth the deposit consisted of a medium brown sandy clay loam, this changed to a light red brown silty clay loam from 0.25m – 0.64m in depth, and then a silty clay from 0.64 – 0.75m in depth. From 0.75m – 2.9m in depth the deposit consisted of a medium red brown sandy clay which steadily increased in stiffness towards the base of the core with the colour becoming more purple from 2.25 – 2.55m in depth.

Transect 2, Core

From 0 – 0.25m in depth the deposit consisted of light medium brown sandy clay loam, with magnetic susceptibility readings of 20 – 24 SI, from 0.25 – 0.48 the deposit changed to a light medium brown sand with high magnetic susceptibility readings ranging from 51 – 124 SI.

From 0.48 – 2.48m in depth the deposit consisted of a light medium sandy clay with occasional stones and a 1cm thick sand and gravel layer at 1.0m in depth, magnetic susceptibility readings ranged from 2 – 7 SI. From 2.48 to the base of the core at 3.6m the deposit consisted of a medium red brown sand and gravel that increased in stoniness towards the base of the core, magnetic susceptibility readings ranged from 3 – 5 SI.

Transect 2, Core 2

From 0 – 0.2m in depth the deposit consisted of a medium brown sandy clay loam, containing a few fragments of charcoal, magnetic susceptibility readings ranged from 30 – 32 SI. From 0.2 – 0.25m in depth the deposit consisted of a medium yellow brown sand with magnetic susceptibility readings of 30 SI. From 0.25 – 0.4m in depth the deposit consisted of a light brown sand with some gravel, there were a few fragments of charcoal and magnetic susceptibility readings were 29 SI. From 0.4 – 1.45m the deposit consisted of a light to medium red brown silty clay with darker organic patches from 0.7 – 0.8m, and wood at 1.40m. Magnetic susceptibility readings were low and ranged from 1 – 5 SI. From 1.45 – 1.60 the deposit was a light medium grey non-humic sandy clay containing a few fine roots. From 1.60 – 3.75 the deposit was a medium red brown sandy gravel that increased in stoniness towards the base of the core.

Transect 2, Core 3

From 0 – 0.2m the deposit consisted of a medium brown sandy clay loam with magnetic susceptibility readings of 10 – 12 SI. From 0.2 – 1.6m in depth the deposits consisted of a medium red brown silty clay loam, containing large stones at 0.55, 0.85, 1.05 and 1.5m, and a light grey sandy band at 1.55m. Magnetic susceptibility readings were all low with values of 2 – 3 SI which are consistent with natural background values. From 1.6 – 3.35m the deposit consisted of a medium red brown sandy clay that increased in stiffness towards the base of the core where the deposit became solid. There were light grey bands at 1.7m and 1.85m and magnetic susceptibility readings were all low ranging from 2 – 5 SI.

Discussion

The samples examined within the cores represent a sequence of natural deposits consisting of the weathered Devonian Old Red Sandstone bedrock surface overlain by sands and gravels deposited in the late Devensian glacial period. This in turn was overlain by Holocene alluvial silty sands and clays above which a sandy clay loam topsoil had formed. A palaeochannel ran

along the edge of the flood plain on the western side of the site and is probably a former course of the stream that now runs through the valley to the west of the site.

The sands and gravels had been laid down in a high energy fluvioglacial environment, and had then been incised by further fluvial action to form river terraces. With a drop in energy during the early Holocene, silty sands and clays were deposited on top of the sands and gravels, with thin colluvial deposits forming at the bottom of the valley side on the edge of the floodplain before the slopes became stabilised by vegetation. Organic deposits were observed in cores 2 and 3, but these were some distance from the palaeochannel and were probably waterlogged deposits within the sands and gravels. No significant organic deposits were observed in cores 4 and 5 which were positioned over the course of the palaeochannel.

5.7 Further study

Although little was found in the form of organic deposits that may have contained palaeoenvironmental evidence, the Holocene alluvium is relatively thick and there may be better sequences nearby – especially to the south and east where the valley widens and lower-energy deposits may survive. An extensive, but rapid, geophysical survey may be an efficient way to identify where these may lie. We note, however, that the low and uniform magnetic susceptibility readings do not suggest that significant amounts of metal smelting or working debris has been redeposited in these alluvia. More detailed geochemical analysis, designed to detect associated minor metal smelting by-products, might be worthwhile and there is sufficient depth of alluvium to suggest that such evidence may be well preserved.

This is an interesting and potentially valuable sampling location, which could provide much information on the development of land use in the area. Future work on this and similar sites may prove to be more productive in locating more substantial organic deposits if the focus of work was lower down the valley where a lower energy environment would favour the build up and preservation of such organic deposits.

6. Overview

Augering was undertaken along two transects across the line of what was thought to be a palaeochannel in order to maximise the potential to recover organic material for dating and environmental remains. This revealed well-preserved peaty deposits sandwiched between up to 4m of alluvium and thin colluvium deposits at the bottom of the valley side on the edge of the floodplain. The most substantial and intact organic deposit lay outside of the palaeochannel and was dated at its base to between 880 AD and 1030 AD, at 95% (2σ) probability (Appendix 3). Pollen was well preserved and demonstrated a change in environment from relatively open at the base to more woody (mostly alder carr and hazel) and wet towards the top. Macrofossil plant remains reflected mostly the *in situ* woodland carr vegetation.

The change in the valley environment from the late Anglo-Saxon, possibly into the early medieval period is of interest as there is little knowledge about both human activity and the environment for the late Saxon period. There is, however, some knowledge of changes which may have affected the valley environment which could be contemporary with the upper parts of the organic deposit. The founding of a Royal Forest sometime between 1066 and 1086 (within which Flaxley valley was situated), and subsequently the foundation of Flaxley Abbey in 1151, were two substantial changes which occurred (Jon Hoyle pers comm). The foundation of a Royal Forest may have resulted in some regeneration of woodland, while activities commonly associated with abbey estates, such as the creation of fish ponds or mill ponds, are likely to have affected local river drainage.

The Forest of Dean is well known for its Iron Ore smelting, but little is known for the late Saxon period, although villagers at Alvington near Flaxley are mentioned in Domesday as paying rent in “blossoms of iron” (Jon Hoyle pers comm). The magnetic susceptibility results

for the geoarchaeological assessment did not suggest any substantial metal smelting or working activity, but it is possible that minor smelting activities may not have been detected. Such activities (either the development or abandonment of) may have resulted in a change in the valley environment contemporary during the period discussed.

It has been demonstrated that the area sampled as part of this assessment can provide information on environmental change for the late Saxon into the medieval period. However, it is likely that deeper deposits of earlier date survive further east where the valley widens.

7. Overall recommendations

The following recommendations are made for further work:

Further analysis of the deposits sampled along auger transects 1 and 2 discussed above

- Further sampling and analysis of the pollen profile from the organic deposit dated to the late Saxon period in order to clarify the vegetation changes discussed in section 3 – Katie Head 4 days work, totalling **£821.88** excl VAT
- A further radiocarbon date towards the top of the organic deposit to clarify the date range of deposition (laboratory as advised by English Heritage).
- Assessment of pollen survival from non-organic alluvial deposits. Pollen has been successfully recovered from alluvial clays, although the provenance of pollen from these deposits is somewhat uncertain as it may derive from areas widespread in the river catchment area. However broad changes in environment may emerge as data accumulates, providing the clay sequence can be dated. Initial assessment would involve 3 samples (3.25 days work by Katie Head - **£667.78** excl VAT).

Further survey in the Flaxley valley

- Rapid geophysical survey in other areas of the valley, particularly south and east of the present assessment site where the valley widens. Archaeological projects on a larger landscape scale, for example on larger river valleys more frequently use geophysical, aerial photographs and remote sensing data to understand the physical environment and to direct palaeoenvironmental work. In these circumstances, in a small river valley, a rapid electromagnetic conductivity survey is thought to be the most appropriate. This would outline the depth of Holocene deposits and identify any palaeochannels present. Areas of potential for further sampling could then be targeted. However, there is some concern (David Jordan pers comm.) that the deposits may be somewhat mixed, judging on the appearance of deposits assessed to date. Electromagnetic conductivity survey and report (Terra Nova) - **£1800** excl VAT
- Further geochemical testing to test for the presence of minor metal working or smelting debris was considered at the assessment stage. However, further discussion with relevant specialists suggest that this may not be appropriate as iron working or smelting is unlikely to provide a sufficiently distinct signal using geochemical testing.
- A further auger profile may appropriate, south and east of the present assessment site should the geophysical survey results prove positive. A contingency of between **£3,500 to £5,500** excl VAT is recommended. The minimum and maximum figure would allow for one to two auger transects in order to assess (at a similar level to this report), the nature of the sediments and environmental potential of one to two palaeochannel or peat deposits.

Other work

- Synthesis of results, liaison with specialists – 2 days work – Liz Pearson **£410.94** excl VAT

8. **The archive**

The archive consists of:

- 3 Pollen record sheets
- 3 Pollen slides
- 8 Flot records AS21
- 1 Box flots and sorted remains from flots and residues

9. **Acknowledgements**

The Service would like to thank the following for their kind assistance in the successful conclusion of this project: Jon Hoyle of the Archaeology Service, Gloucestershire County Council, and to Derek Hurst of the Historic Environment and Archaeology Service, Worcestershire County Council for editing this report. The pollen and plant macrofossil analyses were undertaken by Katie Head and Andrew Mann respectively of the Historic Environment and Archaeology Service, Worcestershire County Council. The geoarchaeology analysis was undertaken by Terra Nova Ltd

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Table 2: Pollen remains from selected contexts

Context: Transect 2: Core 2	175cm	185cm	196cm
Trees			
<i>Betula</i>		2	1
<i>Quercus</i>	4	5	
<i>Tilia</i>		4	
<i>Alnus</i>	23	11	12
<i>Fraxinus</i>	2		
Shrubs			
<i>Corylus</i>	21	20	14
<i>Salix</i>	2	2	2
<i>Hedera</i>	1		1
Heaths			
<i>Calluna vulgaris</i>	1		
Herbs			
Poaceae	170	167	211
Cerealia		1	5
Cyperaceae	1	3	
<i>Ranunculus acris</i> -type		3	1
<i>Caltha palustris</i> -type	3	2	
Caryophyllaceae		1	
<i>Rumex acetosa</i>		1	
Brassicaceae			3
Rosaceae	3	3	
<i>Filipendula</i>	3	19	
Apiaceae	2	1	
<i>Plantago lanceolata</i>	2		
<i>Serratula</i> -type	1		
<i>Taraxacum officinale</i>	1	4	
<i>Anthemis</i>	1	9	
TOTAL LAND POLLEN	241	258	250
Spores			
<i>Equisetum</i>	2		
<i>Polypodium</i>	1		1
<i>Sphagnum</i>	1		
<i>Pteridium</i>	15	12	
<i>Pteropsida</i> (mon) indet	84	27	39

Table 3: Samples processed for assessment of macrofossil remains from Transect 1, core4

Sample	Context type	Description	Period	Sample vol	Vol processed	Res assessed	Flot assessed
81-86cm	Layer	Organic	SAX-MED?	200mls/190g	200mls/190g	Y	200mls
86-91cm	Layer	Organic	SAX-MED?	250mls/231g	250mls/231g	Y	150mls
91-96cm	Layer	Organic	SAX-MED?	190mls/134g	190mls/134g	Y	80mls
96-100cm	Layer	Organic	SAX-MED?	180mls/76g	180mls/76g	Y	50mls
100-105cm	Layer	Organic	SAX-MED?	200mls/192g	200mls/192g	Y	50mls
105-110cm	Layer	Organic	SAX-MED?	200mls/207g	200mls/207g	Y	100mls
110-115cm	Layer	Organic	SAX-MED?	200mls/180g	200mls/180g	Y	50mls
115-120cm	Layer	Organic	SAX-MED?	200mls/203g	200mls/203g	Y	40mls
120-125cm	Layer	Organic	SAX-MED?	240mls/300g	240mls/300g	Y	40mls

Table 4: summary of macrofossil remains from Transect 1, core 4

Context	Sample	insect	charcoal	waterlogged plant	other
Organic Layer	081-086cm			+	Wood
Organic Layer	086-091cm	+	+	+	Wood
Organic Layer	091-096cm			+	Wood
Organic Layer	096-100cm			+	Wood
Organic Layer	100-105cm			+	Wood
Organic Layer	105-110cm			+	Wood
Organic Layer	110-115cm	+		+	Wood
Organic Layer	115-120cm	+		+	Wood
Organic Layer	120-125cm				Wood

Key:

Quantity
+= 1 - 10
++ = 11- 50
+++ = 51 -100
++++ = 101+

Table 5: Plant macrofossil remains from Transect 1: core 4

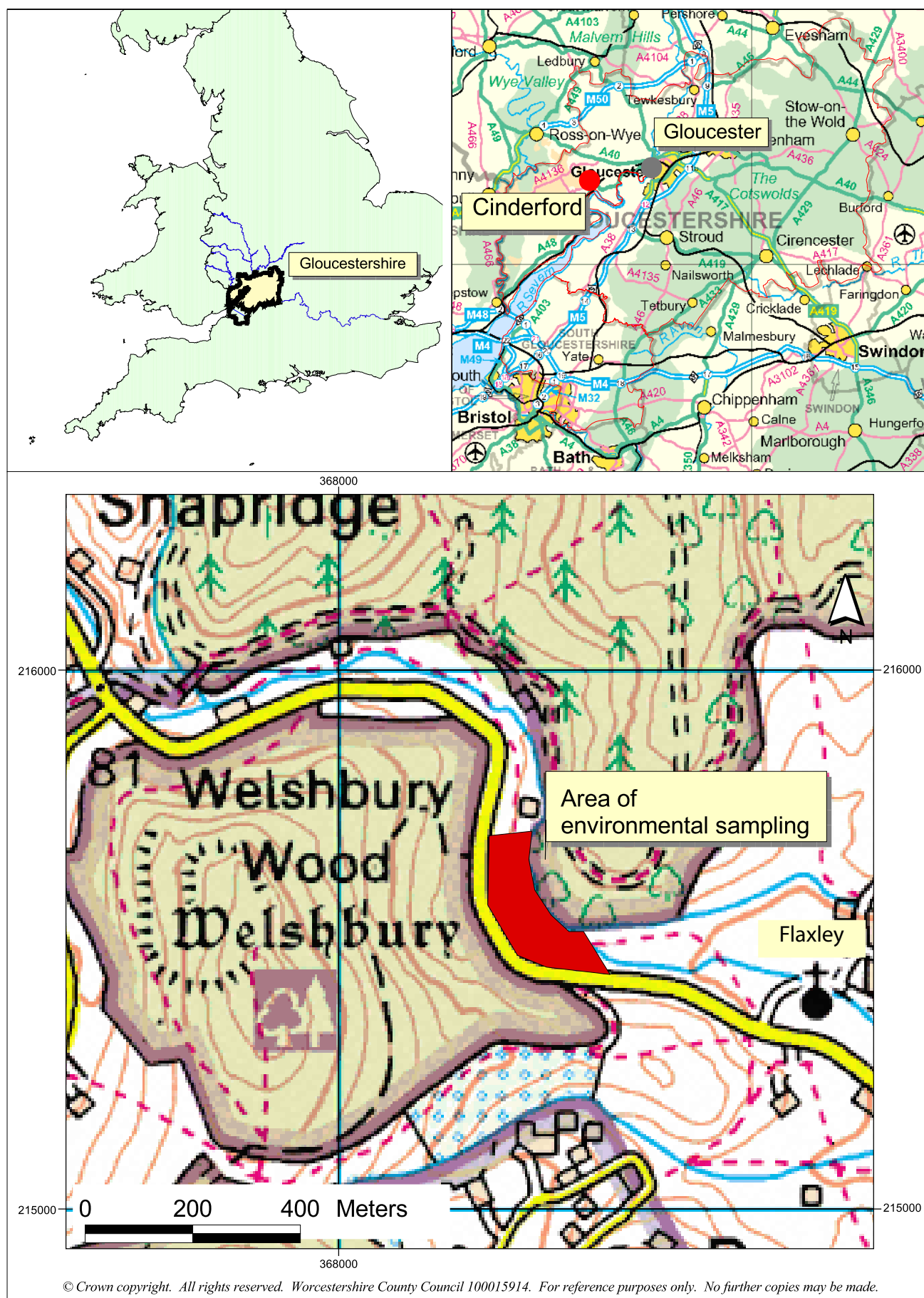
Latin name	Family	Common name	Habitat	081-086cm	086-091cm	091-096cm	096-100cm	100-105cm	105-110cm	110-115cm	115-120cm	120-125cm
<i>Waterlogged plant remains</i>												
<i>Ranunculus acris/repens/bulbosus</i>	Ranunculaceae	buttercup	CD								+	
<i>Ranunculus</i> sbgen <i>Batrachium</i>	Ranunculaceae	crowfoot	E							+		
<i>Ilex aquifolium</i>	Aquifoliaceae	holly	C				+					
<i>Rubus fruticosus</i> agg	Rosaceae	blackberry/bramble	CD			+		+	+			
<i>Prunus spinosa</i>	Rosaceae	sloe	C			+						
<i>Rumex</i> sp	Polygonaceae	dock	ABCD		+							
<i>Alnus glutinosa</i>	Betulaceae	alder	CE		+	+	+	+	+	+	+	
unidentified twig/bud fragments	unidentified			+++	+++	+++	+++	+++	+++	+++	+++	+++
unidentified wood fragments	unidentified			+++	+++	+++	+++	+++	+++	+++	+++	+++

Key:

Category of remains	Quantity
A= cultivated ground	+ = 1 - 10
B= disturbed ground	++ = 11- 50
C= woodlands, hedgerows, scrub etc	+++ = 51 -100
D = grasslands, meadows and heathland	++++ = 101+
E = aquatic/wet habitats	
F = cultivar	

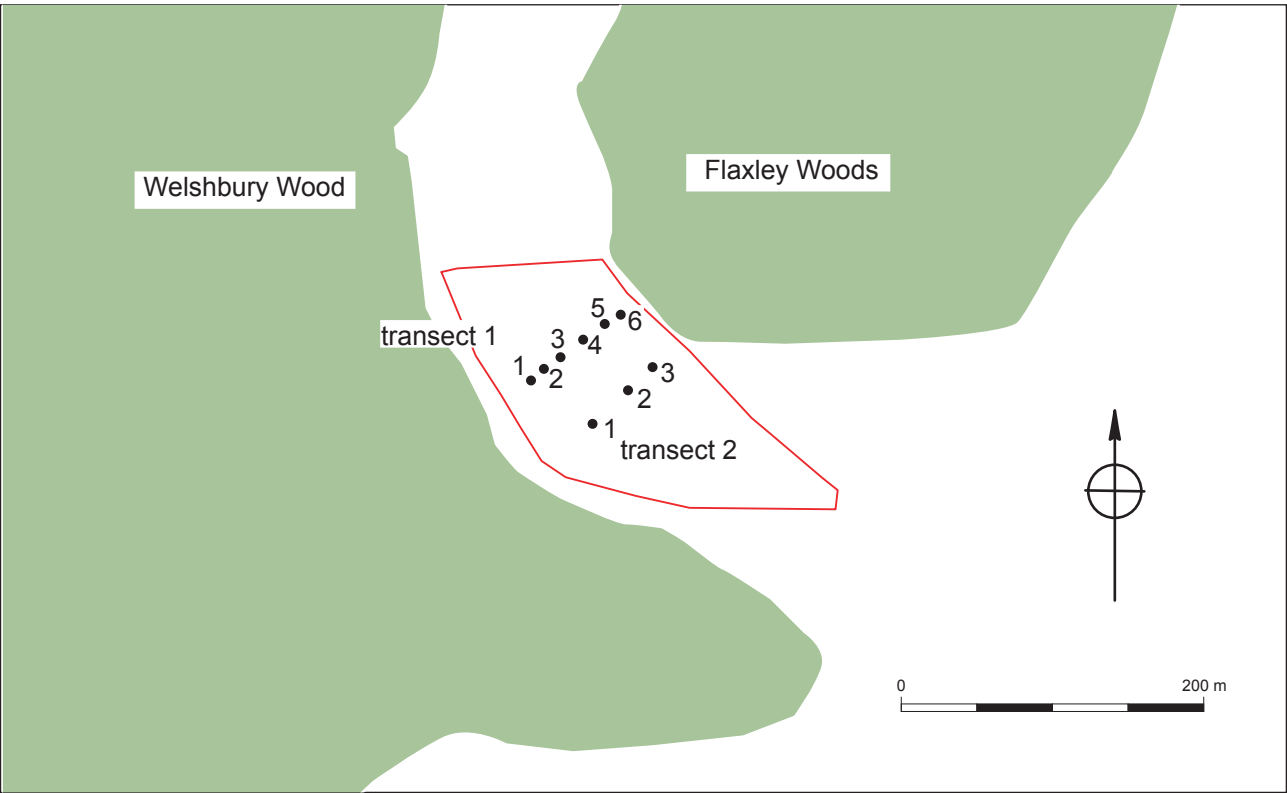
Appendix 1: The geoarchaeology of deposits at Flaxley Valley, Forest of Dean (Terra Nova)

Appendix 2: Radiocarbon dating report (University of Waikato, New Zealand)



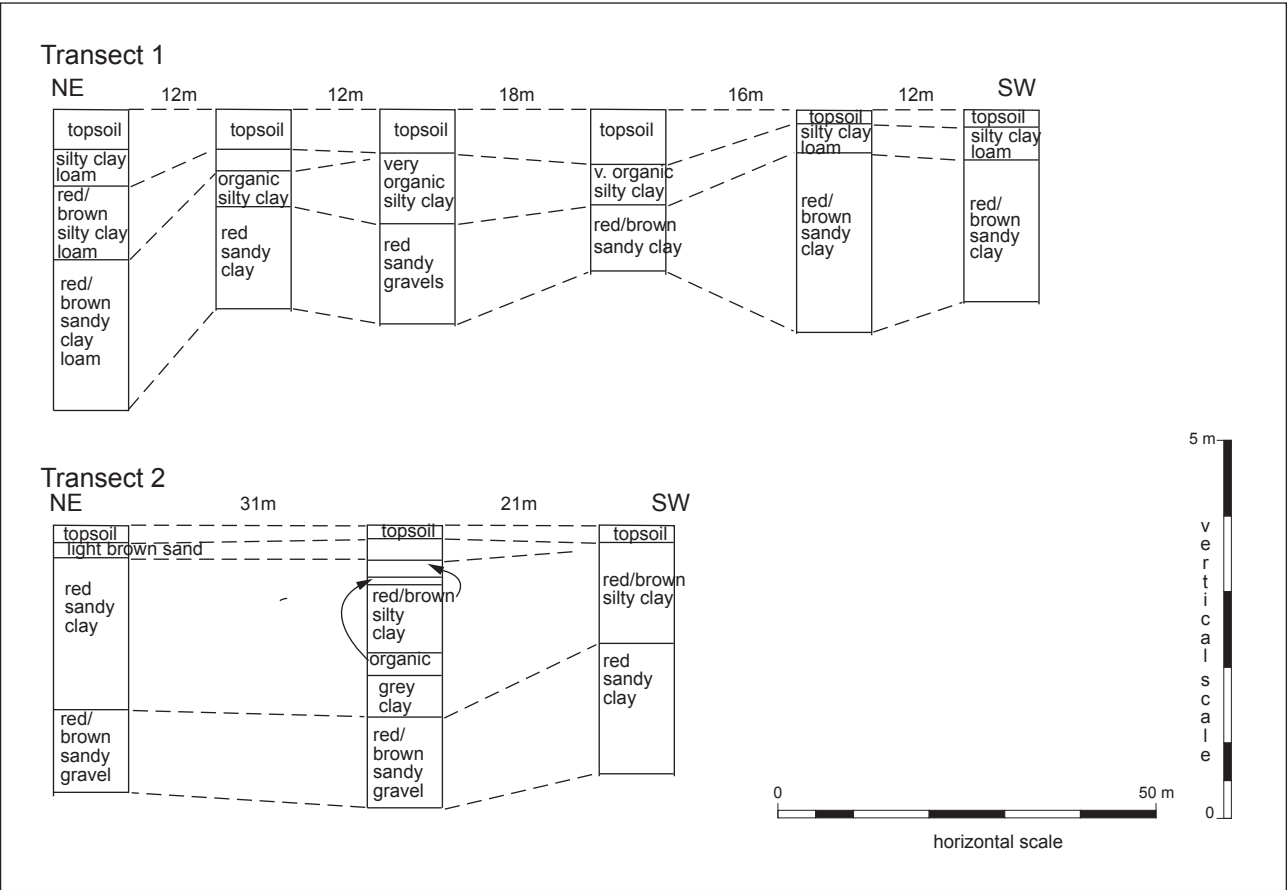
Location of site

Figure 1



Core locations

Figure 2



Stratigraphy of transects

Figure 3



TERRA NOVA

The Geoarchaeology of Deposits
at Flaxley Valley, Forest of Dean
20th January 2005



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The Geoarchaeology of Deposits at Flaxley Valley, Forest of Dean 20th January 2005

Summary

A geoarchaeological study was carried out in order to clarify the origins of deposits at Flaxley Valley in the Forest of Dean. Nine cores were taken at the site along two transects, containing a sequence of natural deposits. The Old Red Devonian Sandstone was overlain by late-glacial sands and gravels then early Holocene silty sands and clays above which a sandy clay loam topsoil had formed.

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Table of Contents

Text

Aims	1
Scope of Report.....	1
Background	2
Method	3
Observations	5
Discussion	8
Further Study	9
Bibliography	10

Figures

Figure 1: View of site looking east and core 3 from transect 1	4
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Appendices

Appendix 1: The Meaning of Magnetic Susceptibility	xi
Appendix 2: Sample Descriptions	xii

Aims

This report aimed to evaluate the geoarchaeology of a site in the Flaxley Valley in the Forest of Dean in order to clarify the origins of the deposits and help assess the archaeological potential of the site. It was concerned, in particular, to consider the potential of the deposits to contain well-preserved sequences of Holocene alluvial and colluvial deposits from which might be recovered evidence of past local land-use. Evidence of metal-smelting and working was specifically sought through magnetic susceptibility measurement.

Scope of Report

This report is the result of a single day visit to the site to examine and record 9 cores taken across the bottom of Flaxley Valley in the Forest of Dean. The records are necessarily brief and only a small amount of preliminary analysis was carried out in the field in order to identify the potential of the deposits and construct a provisional geoarchaeological interpretation.



Background

Location

The site is located at NGR SO 684 155 just to the west of the village of Flaxley and north east of the town of Cinderford.

Geology

The bedrock of the area consists of Lower Devonian Old Red Sandstone (B.G.S. 1988).

Topography

The site lies at the bottom of a fairly steep sided valley at about 60m OD

Land Use

The site lies in an area of farmland used for pasture.

Soils

The site is shown on the “Soil survey of England and Wales, *sheet 5 South West England* 1:250,000 map” as Typical brown earths of the Eardiston 1 formation (541c)

Hydrogeology and Hydrology

The site lies at the bottom of a fairly steep sided valley through which a stream runs, where a high water table is maintained through groundwater recharge.



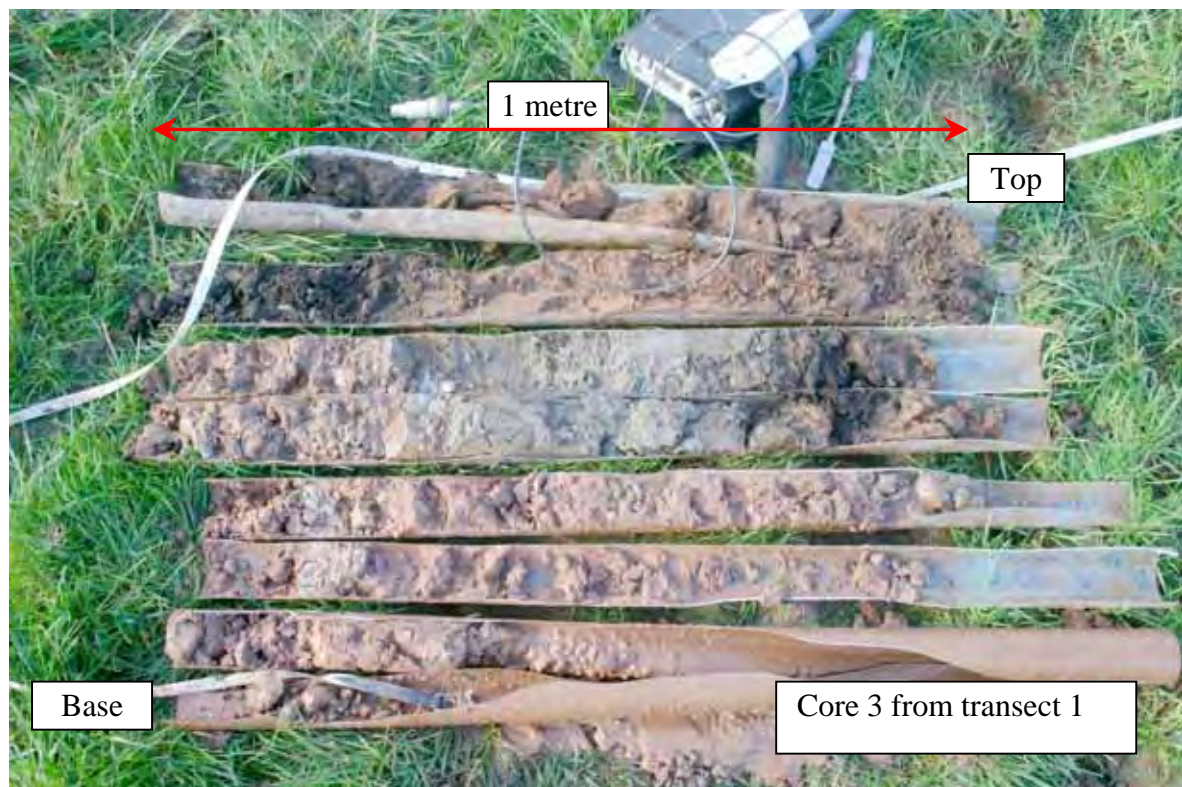
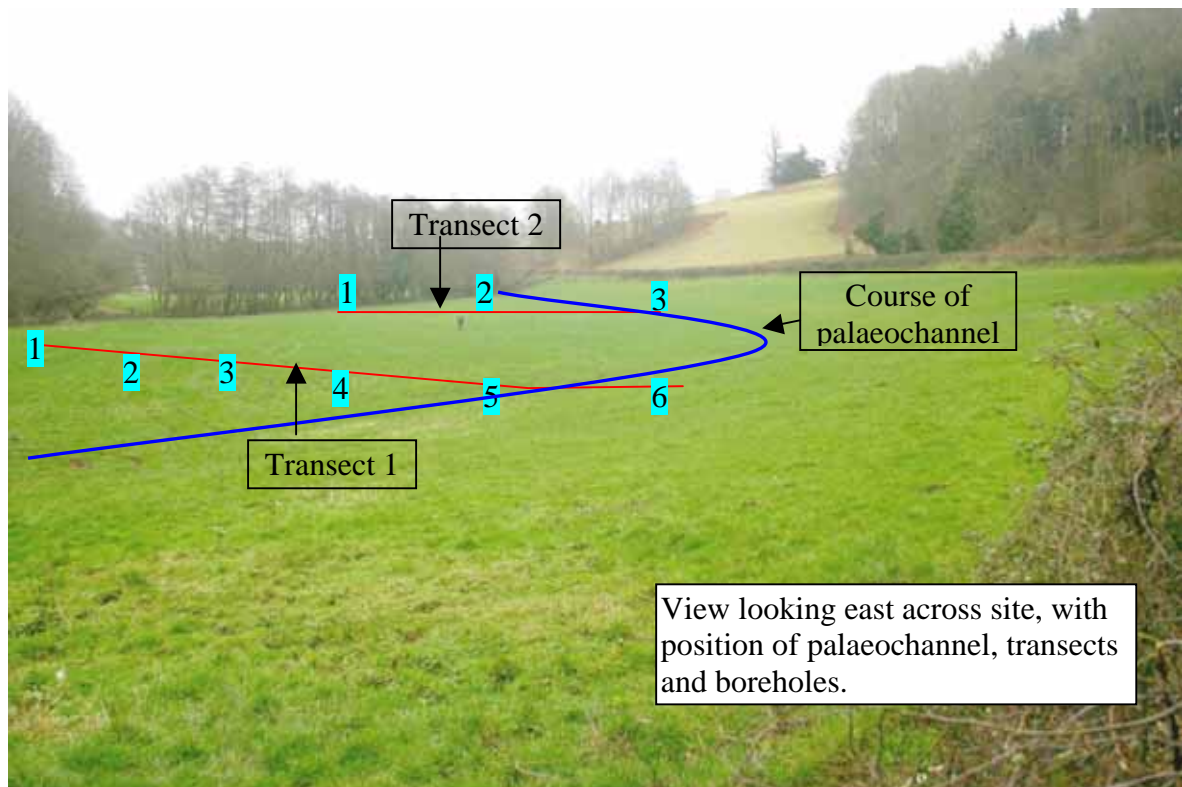
Method

The samples taken for analysis consisted of 9 cores, 6 from transect 1 and 3 from transect 2. Both transects started at the valley bottom adjacent to the stream and ran south west towards the bottom of the valley side.

Samples were taken using a Landrover mounted Dart rig and were split, examined and recorded on site.

Magnetic susceptibility readings were taken every 5cm up the sequence using a Bartington MS2 meter and type F field coil. Sediment descriptions were logged on modified recording sheets after Hodgson (1976)





Observations

The deposits observed within the cores represented river terraces of sands and gravels overlain by silty and sandy clays with colluvial deposits at the base of the valley side.

Transect 1, Core 1

From the surface to 1.0m in depth, the deposit consisted of a medium red brown silty clay loam, becoming a medium red brown sandy clay loam with a few fragments of charcoal from 1.0 – 1.4m in depth, turning to a medium red brown loamy sand from 1.4 – 2.0m. From 3.0 – 4.0m the medium red brown sandy clay loam increased in stoniness towards the base. Magnetic susceptibility readings were all low ranging from 4 – 5 SI which was all consistent with natural background values except for the top 30cm where values ranged from 14 to over 100 SI.

Transect 1, Core 2

From the surface to 0.5m in depth the deposit consisted of a medium red brown sandy clay loam, with a few charcoal fragments observed from 0.1 – 0.5m in depth. From 0.5m – 0.9m in depth the deposits consisted of a light to medium red brown silty clay loam, this changed to a medium brown organic silty clay containing pieces of wood from 0.9m to 1.4m, which then became light to medium red brown sand and gravel increasing in stoniness towards the base of the core at 2.65m. Pieces of wood were observed between 1.0 and 1.4m in depth, magnetic susceptibility readings were 6 to 13 SI from 0 – 0.5cm in depth and 1 – 5 SI for the rest of the core and all were consistent with natural background values.

Transect 1, Core 3

From the surface to 0.6m in depth the deposit consisted of a light to medium red brown sandy clay loam, with a few fragments of charcoal observed from 0.2m – 0.6m. From 0.6m – 1.5m in depth the deposit consisted of a medium dark brown silty clay loam, which was very organic and contained pieces of wood from 0.6 – 1.0m. From 1.5m – 2.85m in depth the deposit consisted of a light to medium red brown sand and gravel which increased in stoniness towards the base of the core. Magnetic susceptibility readings ranged between 12 – 40 SI between 0 – 0.6m in depth with readings ranging from 1 – 5 SI below that to the base of the core.



Transect 1, Core 4

From the surface to 0.4m in depth the deposit consisted of a light to medium brown sandy clay loam, magnetic susceptibility readings ranged from 12 – 40 SI and a piece of red brick was observed at 0.35m in depth. From 0.4m – 0.7m the deposit consisted of medium brown silty clay loam. From 0.7 – 1.1m the deposit became a light red brown sand and gravel, then a medium red sandy clay from 1.1m – 1.7m, from 1.7m – 2.15m the deposit changed to a medium red brown sand and gravel, that increased in stoniness towards the base of the core, magnetic susceptibility readings ranged from 3 – 7 SI.

Transect 1, Core 5

From 0 – 0.2m in depth the deposit consisted of a medium brown silty clay loam, this turned to a light red brown sandy clay loam from 0.2 – 0.6m in depth. From 0.6m – 2.9m in depth the deposit consisted of a medium red brown sandy clay that increased in stiffness towards the base of the core. Magnetic susceptibility readings ranged from 12 – 15 SI between 0 – 0.2m in depth and between 3 – 5 SI from 0.2m in depth to the base of the core.

Transect 1, Core 6

From 0 – 0.25m in depth the deposit consisted of a medium brown sandy clay loam, this changed to a light red brown silty clay loam from 0.25m – 0.64m in depth, and then a silty clay from 0.64 – 0.75m in depth. From 0.75m – 2.9m in depth the deposit consisted of a medium red brown sandy clay which steadily increased in stiffness towards the base of the core with the colour becoming more purple from 2.25 – 2.55m in depth.

Transect 2, Core

From 0 – 0.25m in depth the deposit consisted of light medium brown sandy clay loam, with magnetic susceptibility readings of 20 – 24 SI, from 0.25 – 0.48 the deposit changed to a light medium brown sand with high magnetic susceptibility readings ranging from 51 – 124 SI.



From 0.48 – 2.48m in depth the deposit consisted of a light medium sandy clay with occasional stones and a 1cm thick sand and gravel layer at 1.0m in depth, magnetic susceptibility readings ranged from 2 – 7 SI. From 2.48 to the base of the core at 3.6m the deposit consisted of a medium red brown sand and gravel that increased in stoniness towards the base of the core, magnetic susceptibility readings ranged from 3 - 5 SI.

Transect 2, Core 2

From 0 – 0.2m in depth the deposit consisted of a medium brown sandy clay loam, containing a few fragments of charcoal, magnetic susceptibility readings ranged from 30 – 32 SI. From 0.2 – 0.25m in depth the deposit consisted of a medium yellow brown sand with magnetic susceptibility readings of 30 SI. From 0.25 – 0.4m in depth the deposit consisted of a light brown sand with some gravel, there were a few fragments of charcoal and magnetic susceptibility readings were 29 SI. From 0.4 – 1.45m the deposit consisted of a light to medium red brown silty clay with darker organic patches from 0.7 – 0.8m, and wood at 1.40m. Magnetic susceptibility readings were low and ranged from 1 – 5 SI. From 1.45 – 1.60 the deposit was a light medium grey non-humic sandy clay containing a few a few fine roots. From 1.60 – 3.75 the deposit was a medium red brown sandy gravel that increased in stoniness towards the base of the core.

Transect 2, Core 3

From 0 – 0.2m the deposit consisted of a medium brown sandy clay loam with magnetic susceptibility readings of 10 – 12 SI. From 0.2 – 1.6m in depth the deposits consisted of a medium red brown silty clay loam, containing large stones at 0.55, 0.85, 1.05 and 1.5m, and a light grey sandy band at 1.55m. Magnetic susceptibility readings were all low with values of 2 – 3 SI which are consistent with natural background values. From 1.6 – 3.35m the deposit consisted of a medium red brown sandy clay that increased in stiffness towards the base of the core where the deposit became solid. There were light grey bands at 1.7m and 1.85m and magnetic susceptibility readings were all low ranging from 2 – 5 SI.



Discussion

The samples examined within the cores represent a sequence of natural deposits consisting of the weathered Devonian Old Red Sandstone bedrock surface overlain by sands and gravels deposited in the late Devensian glacial period. This in turn was overlain by Holocene alluvial silty sands and clays above which a sandy clay loam topsoil had formed. A palaeochannel ran along the edge of the flood plain on the western side of the site and is probably a former course of the stream that now runs through the valley to the west of the site.

The sands and gravels had been laid down in a high energy fluvio-glacial environment, and had then been incised by further fluvial action to form river terraces. With a drop in energy during the early Holocene, silty sands and clays were deposited on top of the sands and gravels, with thin colluvial deposits forming at the bottom of the valley side on the edge of the floodplain before the slopes became stabilised by vegetation. Organic deposits were observed in cores 2 and 3, but these were some distance from the palaeochannel and were probably waterlogged deposits within the sands and gravels. No significant organic deposits were observed in cores 4 and 5 which were positioned over the course of the palaeochannel.



Further Study

Although little was found in the form of organic deposits that may have contained palaeoenvironmental evidence, the Holocene alluvium is relatively thick and there may be better sequences nearby – especially to the south and east where the valley widens and lower-energy deposits may survive. An extensive, but rapid, geophysical survey may be an efficient way to identify where these may lie. We note, however, that the low and uniform magnetic susceptibility readings do not suggest that significant amounts of metal smelting or working debris has been redeposited in these alluvia. More detailed geochemical analysis, designed to detect associated minor metal smelting by-products, might be worthwhile and there is sufficient depth of alluvium to suggest that such evidence may be well-preserved.

This is an interesting and potentially valuable sampling location, which could provide much information on the development of land use in the area. Future work on this and similar sites may prove to be more productive in locating more substantial organic deposits if the focus of work was lower down the valley where a lower energy environment would favour the build up and preservation of such organic deposits.



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Appendix 1: The Meaning of Magnetic Susceptibility

Magnetic susceptibility (χ) is a measure of the degree to which a material will become magnetised in the presence of an external magnetic field. The magnetic susceptibility of many natural soils increases slightly towards the surface. This is the Le Borgne effect (Le Borgne, 1955) and is probably caused by slight changes in magnetic mineralogy caused by the greater availability of oxygen at the surface.

Burnt soil material, domestic debris and ceramics typically have high magnetic susceptibilities. Ferrous metals have susceptibilities which are even higher. The degree to which an archaeological or natural deposit is contaminated with these materials can be determined by measuring its susceptibility, either in the field, using a small, portable detector, or under more controlled conditions in the laboratory.

Laboratory instruments also allow us to calculate the frequency dependence (fd) of the susceptibility. This is a measure of the percentage difference between the susceptibility of a sample to magnetic fields which are alternated at two different frequencies, 0.465 and 4.65 KHz – known as low frequency (lf) and high frequency (hf). respectively. Samples containing magnetic minerals of different types show different χ_{fd} values – although the interpretation of these differences is, as yet, a matter of debate. It is thought that very fine magnetic particles, derived from burning and soil formation, alter the magnetic susceptibility of samples in a way which alters with the frequency of the inducing field.

Simple studies of the relationship between particle size, particle type and susceptibility can often help us to understand how the magnetic properties of archaeological deposits arise. Such studies are easily achieved during excavation projects and may prove a valuable part of future excavation practice, especially on urban sites.

The use of magnetic susceptibility measurements is discussed in Walden, J., Oldfield, F., and Smith, J. (1999) *Environmental magnetism: a practical guide*. Quaternary Research Association, technical guide no. 6, London, pp.243.

Le Borgne, E. (1955) *Susceptibilite magnetique anormale du sol superficial*. Annales de Geophysique, **11**, 399-419.



Appendix 2: Sample Descriptions



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Radiocarbon Dating Laboratory



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New Zealand.
Fax +64 7 838 4192
Ph +64 7 838 4278
email c14@waikato.ac.nz
Head: Dr Alan Hogg

Report on Radiocarbon Age Determination for Wk-

16463

Submitter K S Head
Submitter's Code P2683/TR2/2/192-195.5cm
Site & Location Flaxley Valley, Forest of Dean, Gloucestershire, United Kingdom
Sample Material Wood
Physical Pretreatment The wood was chopped up into small splinters.
Chemical Pretreatment Sample was washed in hot 10% HCl, rinsed and treated with hot 0.5% NaOH. The NaOH insoluble fraction was treated with hot 10% HCl, filtered, rinsed and dried.

$\delta^{14}\text{C}$	-133.7 ± 4.4	‰
$\delta^{13}\text{C}$	-29.1 ± 0.2	‰
D^{14}C	-126.6 ± 4.5	‰
% Modern	87.3 ± 0.4	%
Result	1088 ± 41 BP	

Comments

8/3/05

- Result is *Conventional Age* or *% Modern* as per Stuiver and Polach, 1977, Radiocarbon 19, 355-363. This is based on the Libby half-life of 5568 yr with correction for isotopic fractionation applied. This age is normally quoted in publications and must include the appropriate error term and Wk number.
- Quoted errors are 1 standard deviation due to counting statistics multiplied by an experimentally determined Laboratory Error Multiplier of 1.
- The isotopic fractionation, $\delta^{13}\text{C}$, is expressed as ‰ wrt PDB.
- Results are reported as *% Modern* when the conventional age is younger than 200 yr BP.

Atmospheric data from Stuiver et al. (1998); OxCal v3.10 Bronk Ramsey (2005); cub r:5 sd:12 prob usp[chron]

