APPENDIX 14: ASSESSMENT OF GEO-ARCHAEOLOGY

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1. Introduction

1.1 Four monolith samples were taken through Quaternary slope deposits exposed in section midway down the present side of the Wrotham Road (A227) dry valley (Figure 4, ARC TLG 98). The aim of the monolith assessment was to describe and provisionally interpret these deposits and suggest any further work that might provide information on the sequence of Pleistocene events and environments they represent.

1.2 The monolith samples were obtained by hammering a 500mm x 50mm x 50mm tin into the cleaned section face. The sediments and stratigraphy visible in section were described and drawn by the excavators on site. The monolith location was marked on the section drawing and a level, related to Ordnance Datum was taken on the top of the tin.

2. Methodology

2.1 The sediments sampled in each tin were cleaned and described using standard sedimentary criteria. This attempts to characterise the visible properties of each deposit, in particular relating to its colour, compaction, texture, structure, bedding, inclusions clast-size and dip.

2.2 Every distinct unit was given a separate number and the nature of the contacts between each unit noted. Where several units appear to be part of the same depositional phase or event they have been grouped into a larger unit [indicated by a letter].

3. Quantifications

3.1 The results of the monolith assessment are set out in the following table:

Table 27: Assessment of Geo-Archaeology

tin	Unit	Elevation of contact & thickness of unit	Description and Contacts	Assoc. bulk samples
			The top of the monolith sequence lay about 0.30m below present ground-level, which sloped from south to north along the trench and was about 47.5m OD in the sampling location. About 0.30m of ploughsoil lay above the monolith sequence.	
		47.14	TOP OF MONOLITH SEQUENCE	
1	A1	[0.30m thick]	Dark yellowish brown 10YR4/6 slightly sandy clayey silt. Clay especially infilling root channels. Other root channels are humic filled. Soft and compact. Very occasional grit. Very occasional fine rootlets. This unit thins to the south where unit B rises close to the surface, but otherwise follows the dip of the landsurface and ploughsoil down valley. Clear contact to:	Bulk <1>
1	A2	[m thick]	Yellowish brown 10YR5/6 slightly sandy silt. Occasional fine chalk granules. Frequent carbonate flecks and threads. This unit thickens down valley (to the north) and wedges out to the south where unit B rises close to the surface.	
		c.46.80	Sharp wavy irregular contact sloping from south down to north	
2	B	[c.75m thick]	Poorly sorted angular chalk and flint rubble in clay and sand matrix. This unit was too coarse for sampling, however the lowest part of it, mainly pellety chalk with occasional angular flints and clay lenses, was sampled in the top of monolith 2.	bulk<2>
		c45.60	Sharp irregular sub-horizontal contact	
2	C	[0.10m thick]	Dark yellowish brown 10YR4/6 clayey sandy silt matrix with occasional poorly sorted sub-rounded chalk granules and sub-angular flint pebbles. Occasional fragmented bedding. Moderately compact and soft.	
		45.50	Distinct irregular contact	

tin	Unit	Elevation of contact & thickness of unit	Description and Contacts	Assoc. bulk samples
2/3	D1	[0.18m thick]	Interbedded brown 10YR5/4 sandy clay-silt; pale brown 10YR6/3 sandy silt; dark yellowish brown 10YR4/4 sandy clay-silt; and occasional white 10YR8/1 sand laminae, speckles and patches. Compact and moderately hard. Very common iron concretion nodules (1-3mm diameter) and manganese speckles. Diffuse contact to	
2/3	D2	[0.40m thick]	Predominantly brown 10YR5/4 sandy clay-silt. Similar to D1 but beds exist only as disrupted patches and an increase in white (leached) speckles and patches of fine sand towards base of unit. Possible root void with carbonate precipitations. Fewer iron concretions than D1 or D3 and those that exist are less nodular and more thread-like or speckled. Diffuse contact to:	bulk<3>
3/4	D3	[0.50m thick]	Pale brown 10YR6/3 with brown 10YR5/3 patches. Slightly clayey silty fine sand. Very frequent iron nodules 1-5mm diameter: more frequent and larger than in either D1 or D2. Frequent white 10YR8/1 speckles. No visible bedding or laminations.	bulk<3>
		44.42	BASE OF MONOLITH PROFILE	

4. Provenance

4.1 The sediments were located midway up the side of a dry valley about 250m south of the monolith samples taken at Northumberland Bottom (ARC TGW 97). These were from closer to the valley floor in the same dry valley. The present site was also about 500m west of the location of a lower palaeolithic handaxe found in solifluction deposits at about 60.30m OD (ARC TGS 97).

4.2 The sediments appear to represent four main units. Unit D may be derived from Thanet Beds and is in general a silty fine sand fining up to a sandy silt. It is characterised by frequent iron nodules and bleached patches with manganese speckles and discontinuous white sandy laminae. These are characteristics of ice segregation and waterlogging in arctic soils, where waterlogging at the surface occurs, with impeded drainage due to frozen subsoil (Fedorova & Yarilova 1972; Van Vliet-Lanoe 1985; Vepraskas et al 1994). Similar characteristics have been found in Quaternary pedosedimentary profiles (Kemp 1985; Kemp et al 1992) and it is inferred that these sediments were close to the landsurface during a period of wet periglacial climate.

4.3 The sub division of this unit into three sub-units may suggest either fluctuations in the climate at this time, gradual accretion of the deposit (during summer snowmelt) or it may result from the different depths of each sub-unit below the former ground level. The disturbed nature of D2 with possible evidence for rooting and fewer iron nodules and the bedded D1 above it, which has slightly finer iron concretions than D3, may indicate a fairly stable earlier arctic soil (D2+3) that was buried by faster sediment accretion (D1) perhaps as snow melt increased and the climate ameliorated.

4.4 If this is the case, unit C might be interpreted as redeposited brown-earth type soil material. This may have developed across the landscape in an intervening warm period and would therefore have been the first sediment to be eroded and redeposited downslope as climate deteriorated once again, prior to the thick solifluction deposits (unit B) accumulating. Evidence for an argillic brown earth soil developing during the Windermere interstadial has recently been observed at Heathrow Airport (Rose et al 2000).

4.5 However the increasing silt content up through unit D, together with the more distinct banding in the sediment might indicate increasingly dry conditions with loessic input and less water in the soil. In which case The cold wet environment during which unit D accumulated and probably the dry valley was cut may have immediately predated the accumulation of soliflucted deposits on the valley sides and floor.

4.6 Soil micromorphological investigation may be able to test and elaborate on these alternative interpretations.

4.7 Large scale erosion of the landscape must have occurred during the period represented by these dry valley sediments. This is illustrated by the source material of the earlier fill (unit D) being derived from Thanet Beds, which would have been far more extensive prior to the late Devensian, and the later fill (unit B) being derived largely from the chalk, indicating that by this time the Thanet Beds had been removed from the immediately surrounding landscape.

4.8 It is thought that the large scale erosion that created the dry valleys of the present landscape occurred during the late glacial period (14-10ka BP) and especially during the Loch Lomond Stadial (Younger Dryas) the cold stage immediately prior to the Holocene (11-10ka BP). The date of organic remains buried below a swathe of coombe rock eroded from the Devils Kneadingtrough, a dry valley close to Wye in Kent, and forming a fan above the Gault Clay plain is around 11-12ka BP (Preece 1994) suggesting that the dry valley must have been formed or massively re-shaped after 11ka BP. However the incision of Holywell Coombe, a dry valley near Folkstone, was probably closer to the Last Glacial Maximum (c.18-25ka BP) as it contained organic deposits dated to the early late glacial period (Preece & Bridgeland 1998).

4.9 The late glacial is thought, in Britain, to consist of a cold period, prior to 13ka BP (Oldest Dryas), followed by the Windermere Interstadial a warm period, around 13-11ka BP and finally the Loch Lomond Stadial (Younger Dryas), a cold period from 11-10ka BP (Lowe & Walker 1997). In continental Europe evidence for a very short lived cold stage, the Older Dryas is found within what is our Windermere Interstadial, separating it into the Bolling and Allerod interstadials.

4.10 Further analysis of the characteristics of, and trends within, units C and D in the present profile may therefore be able to suggest whether this dry valley was carved out during a single cold stage or whether a warm stage intervened, which would help to place it within the chronological framework of the Late Glacial. The sediments are also likely to preserve evidence with which the changing vegetation and landscape for the Late Glacial period in this area might be reconstructed. The most appropriate techniques for these purposes would be pollen and soil micromorphology.

4.11 The hand-axe found at ARC TGS 97 came from a soliflucted deposit, but was in fresh condition, which suggested it had not been transported far. The deposit was at 60.30m OD, considerably further upslope than the present soliflucted deposits. Whilst this does not necessarily mean they could not have been deposited at the same time, the soliflucted material at ARC TGS 97 was reported to have come from the north-west of the ARC TGS 97 site - an area that is today a dry valley. This implies that the soliflucted deposit in which the handaxe was found accumulated prior to the incision of the dry valley system. Its deposition was likely to have been between 25-14ka BP (URL 1997). Thus, if similar material were to have been found within the coombe rock (unit B) of the dry valley, it would be one stage further redeposited than its context upslope, and the dry valley deposits would be of little use in reconstructing the environment contemporary with the use of the handaxe (somewhere between 500-50ka BP).

4.12 Above the coombe rock the fine sediments (unit A) were calcareous and silty (and similar in these respects to some extent was unit C). This is likely to be a result of a loessic input and soil formation in this and weathered chalk material from the early Holocene onwards. The unit represents the clay enriched ‘Bt’ horizon (A1) and the carbonate precipitated ‘Cca’ horizon (A2) of an argillic brown earth type soil. These characteristics most probably developed before the recent period of agricultural activity, which has created the upper ploughsoil (not sampled).

4.13 Unit A resembles the sediment sampled further down valley in Northumberland Bottom (ARC TGW 97). It is thinner than the Holocene deposits at ARC TGW 97 as the latter was sampled close to the valley floor and was thus in a predominantly sediment receiving location in the landscape. In contrast, the present site, midway upslope, will have lost more sediment to erosion than it will have received itself from further upslope.

4.14 Although there is no direct dating evidence for this deposit it would be valuable to compare its pollen profile with that from Northumberland bottom. Using pollen as a rough dating guide this should be able to provide more information on the pulses and environment of sediment erosion and stability within the valley catchment, and enable inferences to be made regarding the possible involvement of human activities in local landscape change.

5. Conservation

5.1 If thin sections are made of the monolith they will take up less storage space, stand a better chance of long term preservation and be amenable to a similar method of archiving to that for finds and environmental samples. As monoliths, samples are not easily stored, need to be kept in a cool to cold and dark environment and will be likely to deteriorate with time. In addition thin sections are easily available for further research and can be examined frequently without loss of information. Stored monoliths are less accessible and will gradually loose their potential for preserving information, especially as each time they are examined further cleaning will wear away the surface.

5.2 In the same way, processed sub-samples taken from the monolith will be easier to store and less likely to deteriorate than the original soil material and will provide supporting information to the thin sections.

5.3 Long term storage as a monolith sample is likely to be costly and is not an efficient use of space or archive material. After analysis, if not impregnated with resin and converted to thin sections, the sample should be discarded.

6. Comparative material

6.1 These monolith samples should be compared to those from ARC TGW 97, which were taken from the same dry valley but slightly downslope and closer to the valley floor. The ARC TGW 97 samples appear to correspond with unit A and the upper part of B of the ARC TLG 98 samples and are likely to represent the colluvial accumulation during the Holocene period.

6.2 Much geo-archaeological research has been undertaken on the slope deposits in the dry valleys of south-east England. This has focussed on identifying periods of instability (sediment accumulation) and stability (soil formation) and attempting to correlate these events with evidence for human activity (Burleigh & Kerney 1982; Bell 1983, Allen 1992).

6.3 Examination of deeply stratified colluvial profiles have shown that, as a result of accelerated soil erosion, the deep brown earth soils that developed in the early

Holocene below woodland have been removed (Bell and Boardman 1992). Where the colluvial deposits have been well dated (mostly by pottery inclusions or the burial of dated features) the periods of accelerated erosion and stability have been directly correlated with episodes of human occupation and activity upslope (Macphail *et al* 1990; Bell & Walker 1992, 193, Allen 1992).

6.4 Valley sediments have been recorded and sampled from several of the CTRL sites (assessment currently in progress). As such they record sequences and chronologies for periods of landscape stability and instability that might be compared with each other and to other evidence for human settlement and activity across the North Downs landscape.

6.5 In addition, work being undertaken by MoLAS on the A2-M2 widening scheme should provide further comparative material.

6.6 The Pleistocene deposits at the base of the profile should be compared to the evidence from ARC STP 99, in the adjacent dry valley, where thick loessic Late Glacial sediments were sampled. Comparison should also be made with other evidence from SE England and the North Downs in particular for Late Glacial climate, environment and landscape change (Kerney 1963, 1965; Preece 1994, 1998; Preece and Bridgeland 1998; Rose *et al* 2000).

7. Potential for further work

7.1 The data from the monolith samples has potential to address the following landscape zone and fieldwork aims:

- *To study the natural landscape, its geomorphology, vegetation and climate, as the context within which the archaeological evidence can be interpreted.*
- *Farming communities (2000 BC-100 BC): to consider environmental change resulting from landscape organisation and re-organisation.*

7.2 However the main potential of the samples will be to provide information about the Late Glacial environment.

7.3 This potential might best be achieved by examination of soil micromorphological thin sections and pollen analysis.

Table 1: Recommendations for further work on the monolith samples

Task	requirement
Preparation and analysis of pollen samples (*): • 12 at c. 0.40mm intervals through unit A (select 8 for analysis) • 32 at c.0.40mm intervals through units C+D (select 24 for analysis)	Geoarchaeologist + Pollen specialist
a) Impregnation of 4.monolith samples and manufacture of 9 thin sections of c.110 x 70mm • from across contacts A1/A2 contact and A2 base in monolith <1> • from B/C, C/D1 and D1/D2 contacts in monolith <2> • from D2 and D2/D3 contact in monolith <3> • from upper and lower parts of D3 in monolith <4>	Geoarchaeologist + Stirling University (Likely to take 3 months to prepare the thin sections)

b) analysis / interpretation of the depositional and post-depositional characteristics recorded in these samples (*)	Soil micromorphologist / geoarchaeologist
Integration of the pollen and micromorphological data and comparison of the sequence and chronology of events with the sites and sources outlined in section 6.	Geoarchaeologist
* It is suggested that the thin sections / pollen slides should initially be scanned to assess their potential and, if suitable the analysis should be undertaken on selected samples if necessary.	

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