PREDICTING ARCHAEO-COLLUVIUM

ON THE

BERKSHIRE DOWNS

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Thesis submitted for the degree of
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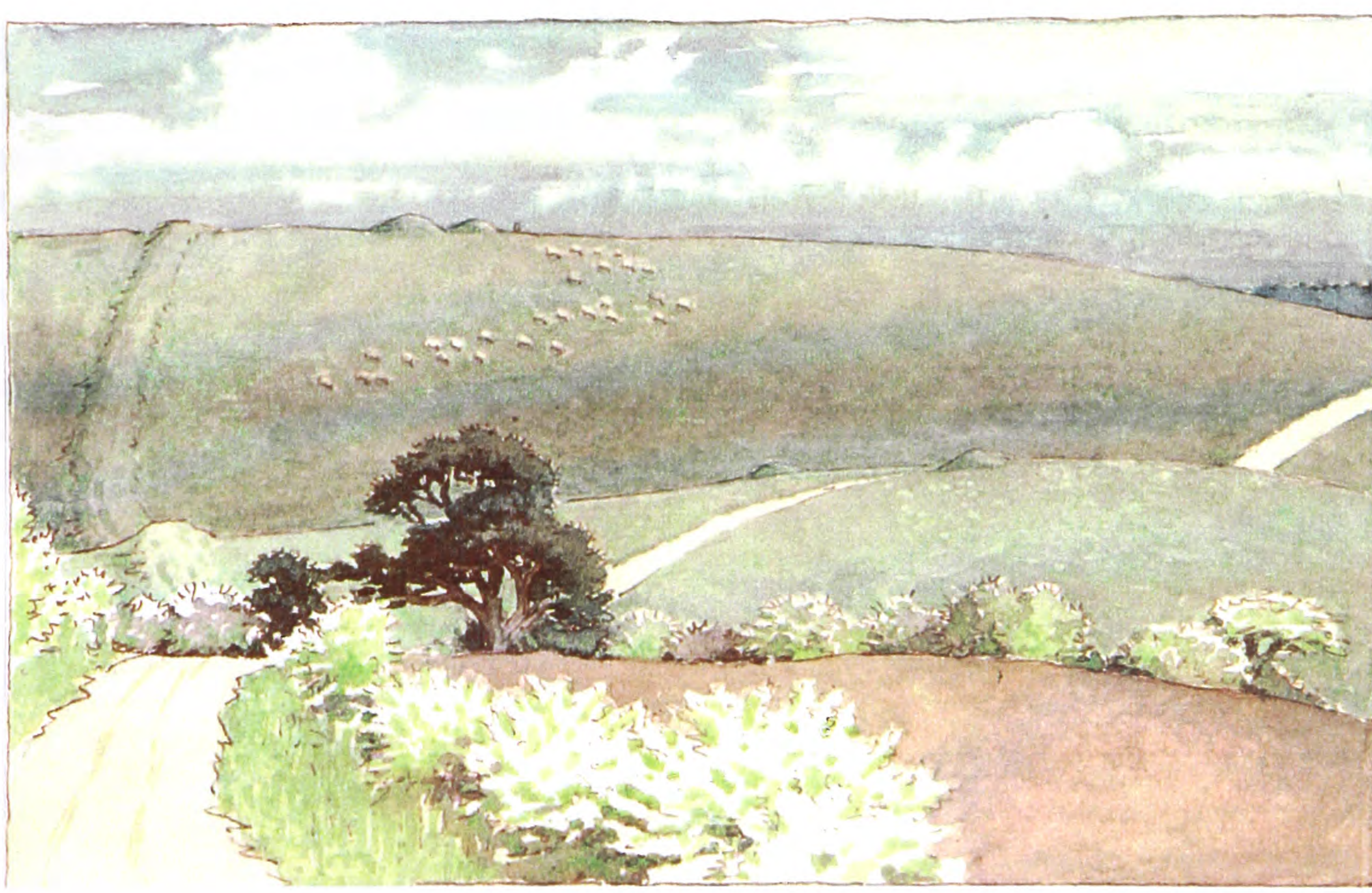
"Among the few features of agricultural England which retain an appearance but little modified by the lapse of centuries, may be reckoned the long, grassy and furzy downs, coombs and ewe leases, as they are called according to their kind, that fill a large area of certain counties in the south and south west" (*Thomas Hardy, 1888*)



The high road near Badbury Rings, ***Heywood Sumner,***
Cuckoo Hill, The Book of Gorley

Acknowledgements

Four and a half years of study would not have been possible without the support of a number of people. My parents whose encouragement was constant from near and far. My supervisors Gary Lock and John Boardman for their help and endurance. To Philip Beckett for firing an early interest in the English landscape and Bill Whitfield for hours of expert advice in the field up on the Downs. To Tyler Bell and Richard Bailey for help with computing and dating problems respectively, the Meyerstein Committee for help with field-work and travel costs and to those land-owners on the Berkshire Downs whose race-horses managed to avoid my soil pits (and there were a few) ; Jim Spence, Ben Smith, David Cox and Peter Herman for their generosity and interest. Finally to Miki who gave me the encouragement to finish before the millenium.

ABSTRACT

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A new and relatively unexplored source of archaeological and environmental information on the Chalkland are the sediments of dry valleys. From relatively recent studies these deposits have been shown to be the product of ancient land use and soil loss and a rich repository of both primary and archaeological material. There have, however, been no attempts to determine the spatial distribution of this class of ancient valley deposit – for the purpose of this project termed *archaeo-colluvium*.

The study focuses on the north-west part of the Berkshire Downs (58km^2), a landscape of both chalk and superficial drift deposits, which together with relict ancient fields, lynchets and settlement features offered a suitable area in which to develop and test a method for predicting the distribution of these deposits.

The project uses a multi-disciplinary approach which combines the traces of ancient arable (Celtic fields), some topographic parameters and assumptions about past soils, erosion regimes, and colluvial preservation in the development a GIS-based predictive model for the distribution of archaeo-colluvium within this study region.

Following the production of a map of predicted sites, archaeo-colluvium was checked in the field by an extensive auger and trench survey of the main valleys and tributaries. Dry valley sequences were assembled and dated, both for the purposes of evaluating the accuracy of the model and to draw some archaeological implications from the nature and distribution of these deposits. A synthesis of local soils, colluvium and wider archaeological observations suggested a three-stage chronology for prehistoric and Romano-British land use on the Berkshire Downs, centred around earliest arable use at Seven Barrows with later shifts to surrounding catchments of mixed chalk and clay soils.

The results of the field program were encouraging with the predictive model verified at 71% of target sites. A number of field observations were contrary to the original model, notable among these were that thicker sequences were common in landscapes of heavier soils as was evacuation of valley sediments from open chalk landscapes. This feedback allowed some modified principles to be briefly tested on three other Chalkland landscapes.

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CHAPTER ONE

INTRODUCTION

1.1 GEOMORPHOLOGY AND ARCHAEOLOGY

The role of landscape change on the archaeology of the Downland of Southern Britain has long been acknowledged. Antiquarians last century noted the presence of buried soils and old land surfaces beneath barrows and burial mounds (Greenwell 1890; Cunnington 1810-12; Pitt Rivers 1892). Soils and sediments have formed part of archaeological studies for the most part used within localised excavation work (Cornwall 1958; Shackley 1975). Recent advances however in environmental archaeology and dating methods have brought a greater emphasis on depositional contexts and on the links between soils, landscapes, and a range of environmental indicators. This has in part come with a shift in archaeological perspective over the past 20 years from the traditional focus on excavation of prominent individual sites to more regional studies which recognise the concept of "continuous" archaeological landscapes (Flannery 1976; Foley 1981).

The purpose of landscape archaeology is to develop a more complete understanding of social and economic contexts through reconstruction of past environments and of regional patterns of occupation and activity. This involves the integration of a wide range of environmental and archaeological data. The shift to a wider focus has in many cases however not been matched by a recognition of the processes which operate at this scale to bury or redistribute archaeological remains (Shennan 1985; Schiffer 1987). Many landscape studies for example place emphasis on field survey or surface collection. Unless allied with some form of geomorphic interpretation, by which surface material might be integrated with concealed yet critical subsurface material, this form of survey often misrepresents the archaeological record.

The concept of a landscape within the prevailing theoretical approach to archaeology addresses similar ideas of inter-relationship between environment and human experience, yet recognises that landscapes in archaeology are commonly viewed deterministically and within the constraints of modernist Western logic. Archaeological theorists coming to terms with the landscape suggest that consideration should be given to the symbolics of landscape perception and the role of social memory in choice of site location for example (Tilley 1994). Within this theoretical framework however it is important to recognise that ritual or social reconstructions like any physical reconstruction may be a vast underestimation of what might remain obscured as off-site archaeological material.

Concepts about the ancient settlement and land use history of the Downland have changed over the past 20 years, which challenge many of the earlier generalisations propounded about this region. The work of Renfrew (1974), Piggott and Fowler (1981), Harding (1974) and Fowler (1983) generated a number of comprehensive reviews of prehistoric land use and agriculture in which it was acknowledged that vast amounts of landscape data remained unprocessed or without interpretation. Allied with a widespread growth of computer use, information technology and analytical methods, the past two decades have seen much greater emphasis on a multi-disciplinary approach to landscape archaeology.

The results from the recent proliferation of landscape studies in Southern Britain have revealed local differences in the distribution and intensity of land use and settlement from region to region across the Downs (Sharples 1991; Gingell 1992; Barrett *et al.* 1991; Fleming 1986; Bradley and Ellison 1975; Tingle 1991; Gaffney and Tingle 1989). This has cast doubt on the traditional concepts that the Chalkland was uniform in terms of resources, settlement and development trajectories. Waton (1982) and Thorley (1981) illustrate this through a regional interpretation of pollen cores suggesting that there have been widely variable clearance histories in different parts of the Chalkland.

What has also been achieved by the proliferation of these studies (and particularly through advances in environmental archaeology), is the overturning of earlier notions that the prehistoric period was one of little landscape change (Jones 1985; Hoskins 1970). There is conflicting evidence that human activity was more intense in the Bronze Age than the Iron Age, however, a vast record of relict features such as the traces of ancient fields, boundaries and funerary monuments imply that human activity was widespread across this part of Britain in later prehistory. The impact and consequences of this activity on the landscape, on the population it supported and on the formation and subsequent redistribution of the prehistoric record have only recently been acknowledged as a prominent part of archaeological discourse.

One particular class of re-deposited soil which offers potential for revealing lost sub-surface archaeological and environmental evidence and thereby enhancing our understanding of aspects of prehistory are dry valley colluvial or "hillwash" deposits. The age of some of these deposits can be dated according to recovered artefacts to earliest agriculture. Their potential as archives of "lost " land use and archaeological material has been demonstrated by studies on the South Downs and wider Chalkland (Bell 1981a; 1983; 1986; Allen 1983; 1984a; 1984b; 1994). This corpus of research, spanning only a few years confirmed their existence and established accurate local chronological sequences of land use and activity. A general characterisation of colluvial deposits was developed which incorporated some notion of their age and spatial distribution. There were no attempts in this work however to predict their location.

It is acknowledged that these ancient deposits are widespread across the dry valleys of the Downland, having been uniquely preserved by an absence of stream action and the low level of destruction by centuries of pastoral use - a regime well reflected in Thomas Hardy's observation (above). It has been estimated that colluvial deposits might occupy up to 16% of the Downland (Allen 1991, 51). This represents a significant proportion of the landscape in which lost, *in-situ* or re-deposited archaeological and environmental material might be obscured. This has been shown in Kent by the discovery that two thirds of all Late Neolithic Beaker domestic sites in this region are concealed by colluvium (Allen 1988). It is quite feasible that elsewhere in the valleys of the Chalkland other classes of site might exist within or below these lower slope sediments.

Colluvial deposits however do not appear uniformly throughout the landscape (Bell 1992; Allen 1991; 1992). The complexity of their formation, age and preservation means that distribution is difficult to predict according to surface topography for example. It would seem a useful aid to archaeological survey to be able to predict the location of these deposits particularly if their sporadic distribution could be linked with past land use regimes. A prospect hitherto unexamined is that the colluvium might in some way directly or indirectly be linked to ancient fields and ancient landscape sensitivity of which we have widespread evidence.

This project, therefore, seeks to develop a method for locating these deposits by drawing together evidence of past land use and erosion as it survives within the modern landscape. The benefit of a focus on colluvium is that it offers a source of otherwise invisible subsurface archaeology which can greatly enhance the surface record. A specific possibility would be the prospect of dating ancient field systems.

Recent advances in both computer mapping and analysis of geographic information has great potential for incorporating aspects of spatial data and geomorphology within archaeology. Geographic Information Systems (GIS) with their capacity to store and manipulate a huge array of spatial data enables the overlay and analysis of multiple combinations of landscape and archaeological information (Allen K.M.S. *et al.* 1990; Lock and Stancic 1995). This type of approach appears ideally suited to the task of developing a model which predicts sites of ancient colluvium. By the integration of soil, landform and ancient land use patterns, a GIS based method will be developed.

A pilot study in which this approach is developed and tested will be conducted on the Berkshire Downs. The development of a predictive model will then be followed by a programme of field testing. This will involve artefact recovery and general reconstruction of sediment stratigraphy to determine (i) whether the project is effective in locating colluvium of archaeological value, (ii) whether the model is reliable given the gap of over 3,000 years which separate the processes of the past from the present landscape and (iii) whether colluvium might assist in a re-interpretation of early land use of the Berkshire Downs. The assumptions inherent in the model together with an assessment of the usefulness of GIS in this branch of geo-archaeology will form part of the evaluation of the project.

1.2 THE SOUTHERN DOWNLAND

The Berkshire Downs are a part of the Southern Downland which is perhaps the most distinctive and recognisable of English landscapes characterised as it is by rolling hills, nestled villages and a patchwork of open fields and upland dry valleys. The cultural influences on this landscape stretch over some 8,000 years and are seen in the ancient imprint of stone circles, barrows and relict boundaries. These features produce a rich palimpsest of settlement, economic and ritual activity, many of which have been lost by a modern wave of broad-scale agriculture.

A long tradition of archaeological investigation on the Downland provides a useful record of land use history from which the impact of past human action might be assembled. Despite over 200 years of archaeological attention given to this region, a number of enduring questions remain. Prominent among these are accurate dates for the field systems, from which land use phases might be developed and a curious paucity of evidence for Early Bronze Age settlement sites (Burgess 1974, 165).

According to the success of colluvial investigation in other parts of southern Britain, answers to these questions might be provided by an approach which combines both archaeology and geomorphology on the Berkshire Downs, focusing on the sediments of the dry valleys. The location by this project of sites in areas long regarded as archaeologically "blank" is an alluring prospect.

1.3 AIMS

It is the purpose of this project to extend the colluvial studies begun in the early 1980s toward the development of a predictive model for locating these deposits on a pilot area of Chalkland in Southern Britain. Ancient field traces will be used as a guide to the distribution of prehistoric land use and regimes of accelerated soil erosion. The location of colluvium, spatially determined by these traces, represents a novel linking of ancient land use and ancient colluvium as it survives in the current landscape.

The record of buried sites found through colluvial investigation in Sussex for example (Allen 1988) provides some promise that similar success might be achieved on the Berkshire Downs. In a landscape of notably poor survival of environmental and archaeological remains, a further benefit of such a regional study is the potential discovery of missing classes of this type of primary and secondary information which might be used to interpret the chronology, intensity and impact of past land use. As a pilot study, the development of a predictive model for a large part of the Berkshire Downs (58 km^2), would also be expected to have general application to similar Chalk landscapes throughout Britain.

A predictive method which focuses on colluvial deposits might be combined with surface survey to provide a more complete three dimensional record of settlement and land use history. The accuracy of the model will be tested in the field by a programme of shallow soil drilling and limited trenching. This will be used to evaluate the assumptions of the model and to review the landscape archaeology of the project area.

CHAPTER TWO

DRY VALLEYS, COLLUVIUM AND ARCHAEOLOGY

2.1 DRY VALLEY SEDIMENTS

2.1.1 Early research of Chalkland dry valleys

The dry valleys of the Southern Downland have long been an object of interest to geomorphologists (French 1996; Ollier and Thomasson 1957). Interest in their formation by peri-glacial processes and evolution of their characteristic asymmetric form has involved investigation of sequences of solifluction and reworked Holocene valley sediments variably described as "head" or "combe" deposits (Jarvis 1973, 6-7) . The emphasis of these studies on reconstructing broad Quaternary depositional settings meant that more recent (later Holocene) dry valley material was often overlooked.

Some early note was made of sequences of dry valley sediments in which human artefacts were recorded. The most notable of these was within eight metres of peri- and post-glacial material in a scarp dry valley at Brook in Kent (Kerney *et al.* 1964). Using mollusc and pollen evidence together with carbon dating and recovered artefacts, a chronology of prehistoric clearance and land use was developed for the uppermost two metres of the sequence. It is only in the last 20 years that this type of approach has been employed on the Southern Downland with a specifically archaeological focus to develop ideas about human activity and impact.

The focus on dry valley colluvial deposits has been recent compared with the archaeological interest in buried soils and sediments. Buried or transported soils found in pits, tree holes, ditches or beneath barrows were primarily recognised as the medium which contained sources of environmental information, notably molluscs and pollen. These were used to date and to provide evidence of past tree cover vegetation species and land use (Kerney *et al.*

1964; Weir *et al.* 1971; Evans, J., 1966; Evans, J., and Valentine 1974; Ellis 1986). The association of molluscs and human artefacts at some sites offered the possibility of developing dates and sequences of occupation, though this was often of secondary consideration in the wider use of this information to establish vegetation based reconstruction of past landscapes. The earliest examples from the Chalkland include South Street, Avebury (Fowler and Evans, J., 1967, 290) and Waylands Smithy (Atkinson 1965).

While deposits of anthropogenic soils have long been recognised on the Chalkland, conflicting views about their extent and relevance in terms of the nature of human activity and their consequent impact on the Downland pervaded archaeological debate in the 1960's. The eminent botanists Godwin (1967) and Taylor (1966) refuted the existence of widespread erosion on the chalk, suggesting on the basis of ridge and furrow features, that erosion on the Downs was a medieval phenomenon. Fowler (1983), Limbrey (1975) and Evans (1966), however, describe sequences of sediments which imply significant soil losses during prehistory.

What is certain is that all of these postulations were based on a limited range of site-specific evidence and a sparse sampling density. With an explosion over the past 15 years in archaeological landscape studies and of environmental archaeology (of which soils and sediments form a prominent subset), the resolution of archaeological and landscape data remains coarse. The time and costs involved in surveying, sampling and analysis often dictates that landscape reconstruction is the product of relatively wide extrapolation from spatially limited sources of information.

2.1.2 Archaeological implications of dry valley colluvium

It was not until the early 1980s that detailed investigation incorporating both environmental and archaeological sampling was made of colluvium within the dry valleys of the South Downs. This work revealed the importance of these soils as sources of evidence for widespread soil loss and for revealing multi-period land use and settlement evidence (Bell 1981a,1983; Allen 1983, 1984a, 1984b). At Kiln Combe in East Sussex (Fig 2), excavation of three metres of colluvium revealed 14 phases of soil deposition with evidence of occupation and land use dating from Neolithic to modern times (Bell 1983). Similar colluvial material at Itford Bottom (two metres) and Chalton (one metre) on the South Downs in Sussex revealed chronological sequences of artefacts dating to the Neolithic. At sites across the South Downs artefact concentrations of between 64 and 260 per cubic metre were found with evidence of Late Neolithic - Beaker settlements in colluvium at Strawberry Hill, Holywell Combe, and the Bourne Valley (Bell 1986; Allen 1988, 1992). The results of these investigations support the notion that in other Chalkland regions the earliest settlement sites might be found beneath sediments in valley floor locations.

Figure 2 Investigation of colluvium at Kiln Combe, East Sussex (from Bell 1983)

The fundamental conclusion from such relatively recent studies is that colluvium of human origin is widespread across the Chalk Downland. This provides a source of buried archaeology, environmental information and both primary and secondary evidence of widespread landscape change and soil loss.

Allen (1988; 1991; 1994) extended the range of colluvial investigation to over 70 sites in Southern Britain, including the Salisbury Plain, and from this record of information developed a general characterisation of the composition, processes and depositional setting of these deposits. The important conclusions from this work can be summarised as follows :

- there are substantial deposits of dry valley colluvium
- colluvium contains artefacts
- colluvium has anthropogenic origins

2.1.3 Characterisation of colluvial composition and location

From a wide range of sites across the Southern Chalkland, Allen was able to characterise archaeo-colluvium according to four main groups based on their nature and composition. These reflect a summary of survey and field investigation work which has not however been used in any spatial mapping of these deposits. The wide difference in character and composition of these deposits suggest a range of depositional settings. While this is a preliminary characterisation based on a limited number of sites different compositional sequences might be used to reconstruct different land use phases.

The four colluvial groups are :

- unsorted calcareous colluvium and unsorted weakly non-calcareous colluvium
- flint horizons
- lenses of chalk pieces
- stone-free horizons

The first group is the most common type of deposit represented in colluvial sequences as fine grained silty clays and silty loams, over one metre deep with chalky material increasing up the profile. Flint and chalk lenses may occur within them as discrete horizons. These deposits represent heavily reworked material seen both in lynchets (field boundaries caused by lower edge build-up of eroded soil) and valley floors. Weakly or non-calcareous argillic deposits derived from thicker soils and Clay with flints are apparently more localised with small source areas. The second group are flints deposited as gravel fans caused by higher energy processes such as rilling, gullying and debris flow (Stammers and Boardman 1984; Recio-Espejo *et al.* 1992). The third group is chalky colluvium which appears to have been caused by rilling. The fourth group refers to stone-free deposits which indicates either some form of pre-depositional sorting (possibly by intense cultivation) or post-depositional worm reworking or settling in water.

These main types of colluvium may occur individually or together in the same deposit indicating complex depositional conditions. It has also been observed that the particular compositional characteristics of the colluvium do not appear to correspond with any single period of prehistory. Thus the spatial and temporal differences in colluvial deposits highlight the need for caution when selecting a site as "typical". One of the objectives of this study in predicting colluvium is an evaluation of whether at certain scales the categorisation of these processes is feasible.

Allen (1992) used the dated colluvial sequences from investigation on the Southern Downland to identify phases of multi-period land use (Fig 3). A generalised sequence of environmental threshholds was proposed in which multiple stages of land use and landscape impact were suggested, from forest clearance to present day. While based on a limited number of soil sequences this provides a schematic illustration of the extent to which colluvial sequences can be used to reconstruct phases of land use history.

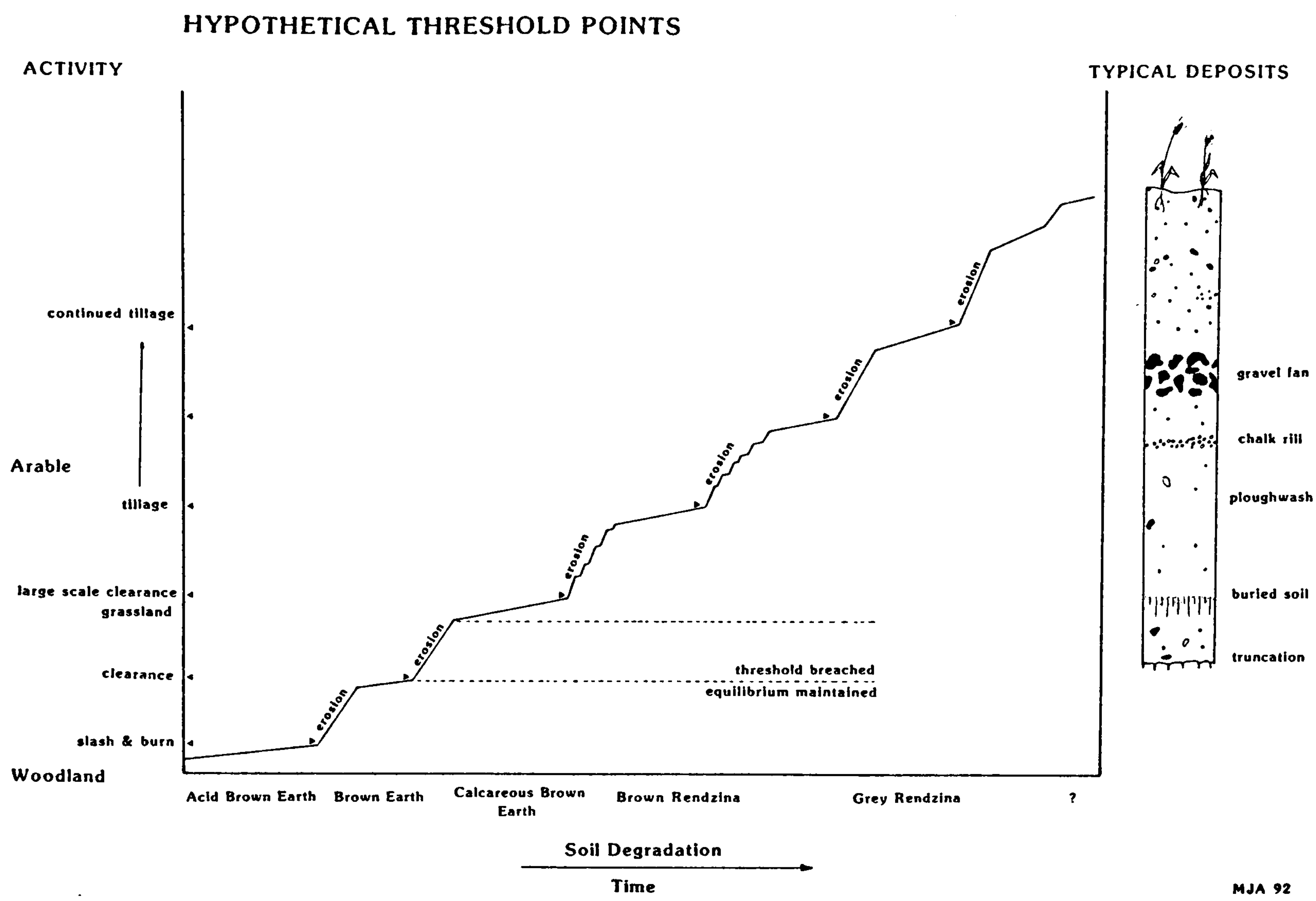


Figure 3 Hypothetical sequence of land use phases and environmental thresholds based on colluvial sequences (Allen 1992)

In addition to a general summary of colluvial composition, investigation carried out on the South Downs and the wider Chalkland has also produced a characterisation of their topographic location (Bell 1981b;1986).
Five main categories were identified ;

- alluvium edge deposits,
- positive and
- negative lynchets,
- plateau edge deposits
- dry valley fill.

While these classes of deposits represent transported soils attributed to human activity and might be regarded as colluvium in its broadest sense, dry valley fill is the most common category. The primary focus of this study will be on accumulated lower slope and dry valley deposits rather than material retained as lynchets or stranded upper slope deposits, recognising that the geomorphic distinction between dry valley and lower slope colluvium becomes particularly difficult in smaller tributary valleys.

Despite a corpus of information on colluvial deposits culminating in a summary of both its range of composition and generalised topographic location, distribution across the landscape has been thought to be sporadic and too difficult to predict (Allen 1992). Receptor sites are thought too subtle or masked, and the depth and type of deposit bears little relation to valley slope morphology.

The studies of Bell and Allen have been consolidated in a number of papers on past and present soil loss, prehistoric landscape change and off-site archaeology (Bell and Boardman 1992, Bell and Walker 1992; Allen 1988; 1991; 1992; Allen and Macphail 1987). Over the past decade colluvial surveys have been incorporated in some of the major landscape studies on the Chalkland (Sharples 1991; Cleal *et al.* 1995; Smith, R.J.C. *et al.* 1997). Following the initial flourish of research of dry valley colluvium and the inclusion of colluvial work in some landscape surveys on the Chalk, there have been no attempts to predict the distribution of these sediments, despite a landscape rich in traces of ancient land use.

2.1.4 Field prediction

The choice of sites for the investigation programme conducted by Bell and Allen on the South Downs and throughout Wessex was, by research design, subjective rather than according to strategic topographic or pedological criteria (M.Allen p.comm.). Lower slope and dry valley locations were chosen for the most part because of their proximity to known and dated archaeological sites. This provided the likelihood that sequences of datable artefacts might be recovered. At Itford Bottom in Sussex, however, colluvium was present in only one of two adjacent valleys (Bell 1983). At Stonehenge, colluvial sites were chosen in valley floor locations in the field with little reference to likely surrounding source areas, surrounding archaeological features, sites or ancient fields. Here, colluvium was notably absent despite the region's obvious rich archaeology (Richards 1990, 210-211).

2.2 A NEW DEFINITION

Colluvium has been defined as the material that is "transported across and deposited on slopes as a result of wash and mass movement processes" (Goudie 1988). Colluvium may therefore include drift and solifluction deposits tens of thousands of years old or geologically recent (Holocene) material perhaps only a few years old. Allen (1992, 37) uses the definition " material which is moved down-slope by gravity, usually lubricated by temporary flushes of water that is not in a well defined channel". While meant in an archaeological context, this definition is still imprecise with respect to processes linked with human activity.

While the age of colluvium is site-specific, the suite of material generally referred to as "colluvium" in archaeological studies (sometimes called ploughwash or hillwash) is assumed to have been formed by human action and deposited in the Holocene (Avery 1980). It is this latter class of deposits - colluvium related to human activity - which is the focus of this study. It is therefore necessary to develop a term which is accurate as well as descriptive and succinct and which distinguishes these archaeologically significant anthropogenic lower slope deposits from older geologic deposits developed under natural processes. Lang and Wagner (1995) use the term "archaeo-sediments" in dating studies of loessic sediments in Central Germany, though this too would seem too general, including as it does, any re-deposited soil or sediment found in any context from a small pit or ditch to a large valley. For the purposes of this study, colluvium, which is the product of human activity (most commonly agriculture) which includes eroded soils and sediments deposited in lower slopes or dry valleys will be referred to as "archaeo-colluvium."

2.3 COLLUVIAL MAPPING ON THE DOWNLAND

2.3.1 Soil Survey maps

There are no maps in Britain on which archaeo-colluvium is represented. Traditionally the geological and soils maps of Southern Britain, which represent regions mapped over the past 50 years, do not recognised sediments of human origin. Many of the existing geological and soil maps were compiled before much was known about the archaeological significance and distribution of these deposits in Southern Britain. In general the extent of these deposits was perceived to be small, certainly at the common one inch mapping scale, and according to conventional soil survey criteria was beyond the scope of Soil Survey work.

In 1980 the Soil Survey of Great Britain and Wales issued a definition of geologically recent hillwash which has been used on 1:25,000 scale Soil Survey maps across Britain since then (Avery 1980). Less than five per cent of these maps, however, extend onto the Southern Chalkland. This small proportion is represented in parts of Hampshire and Kent where recent hillwash is found at valley edges and within dry valleys (Green and Fordham 1980; Rainham 1976; Jarvis *et al.* 1984). At this point it is worth mentioning that the Soil Survey recognises these colluvial units as soil, which acknowledges the difficulty in distinguishing soil from the recent material on which it has formed particularly where deposits are shallow. They might equally be described as ancient sediments in the absence of soil profile development in many cases. Soil units which fall into this category are the Millington series (fine silty calcareous colluvium) Rowton series (silty material over non-calcareous gravel), and Dullington (fine loamy calcareous colluvium) (Staines 1991, 13).

While these soil units may be suggestive of colluvial material derived from human activity, their classification according to conventional soil survey criteria (texture and morphology), rather than on any datable criteria, introduces uncertainty about their precise age and origin. Bell (1981b) suggests that some indication of the extent of colluvium may be obtained from aerial photographs and from valley gravel and colluvial soil series mapped by the Soil Survey although he cautions that these sources "do not discriminate between Pleistocene and Post Glacial or indicate thickness". At best it appears that these soil maps provide a useful though not definitive guide to archaeo-colluvial deposits. Nevertheless these map-sheets have been used to make coarse estimates of anthropogenic soil losses across Britain (Evans R. 1990).

The Soil Survey maps which do cover large sections of Southern Chalkland are either at a scale too coarse to include more than one or two dry valley soil units (Soil Survey of South-East England, 1:250,000) or adhere to conventional descriptions of dry valley soils which predate Avery (1980) and thereby overlook any anthropogenic component. In this latter category is the Abingdon mapsheet at 1:63,360 (Jarvis M. 1973) which includes the Berkshire Downs and the Reading mapsheet at 1:63,360 (Jarvis R.A. 1968). On these maps three types of dry valley soils are recognised :

- Coombe series soils : brown calcareous soils in flinty silty drift
- Charity series soils : non-calcareous brown earths in flinty silty drift
- Winchester soils : non calcareous brown earth in clayey flinty drift

The Coombe soils have developed on dry valley peri-glacial solifluction deposits and the Winchester soils are derived from slopes carrying Clay with flints. It is conceivable that any of the valley soils might carry archaeological material mixed within the profile or mask earlier sites. The description of Charity soils on flinty silty drift covers a range of lower slope soils some of which might be worth examining for anthropogenic origins, even at this scale of mapping. Their proximity to ancient fields is an observation which is investigated further in Chapter 6. There is no suggestion in any of the profile descriptions however that these soils are derived from human action (Jarvis 1973).

2.3.2 Archaeo-colluvium in regional studies

The Maiden Castle report provides one of the few archaeological landscape studies in Britain which incorporates a map of colluvium (Fig 4)(Staines 1991). Valley soils were investigated as part of a wide soil survey and several colluvial sequences were described and interpreted in the Dorchester by-pass study (Smith R.J.C. *et al.* 1997). Figure 4 however shows colluvium which has been interpolated from Soil Survey criteria, the limitations of which have been described above. There was little work on dating of colluvium, rather broad conclusions based on observations of associated archaeological features and soil composition. Staines assigned broad dates to episodes of soil erosion, confirming widespread evidence of Bronze Age soil loss. It should be emphasised though, that the colluvial work at Maiden Castle was part of a comprehensive and detailed soil and archaeological survey which was both time consuming and reliant on extrapolation from soil survey criteria. As such, the antiquity of the valley soils may be called into question.

An extension of the Maiden Castle report on the Dorchester bypass provides a slice of landscape archaeology, in a narrow swathe through the Maiden Castle landscape project (Smith R.J.C. *et al.* 1997). Archaeological features, soils and colluvium was investigated and a synthesis was provided of environment and settlement history which added significantly to the Maiden Castle report. In one of the first attempts of its kind, a reconstruction of the prehistoric soil cover is based on buried sequences, colluvial sections, environmental data and archaeological evidence which is extrapolated across the present landscape. Such a task represents a valuable use of soil exposures, tree throw hollows and buried profiles, across a range of terrain revealed during road construction work. This type of unsystematic survey provides a glimpse of otherwise lost soil and geomorphic features. The fact that these works traverse a range of landscapes and landforms which might otherwise not attract the archaeologists attention introduces a random and often highly productive element into archaeological recovery.

The Maiden Castle survey represents an attempt to represent the spatial distribution of these deposits, although the location of sample sites and colluvial information relied on secondary map sources. Factors which might explain the sporadic distribution of these deposits were not discussed in the Maiden Castle study.

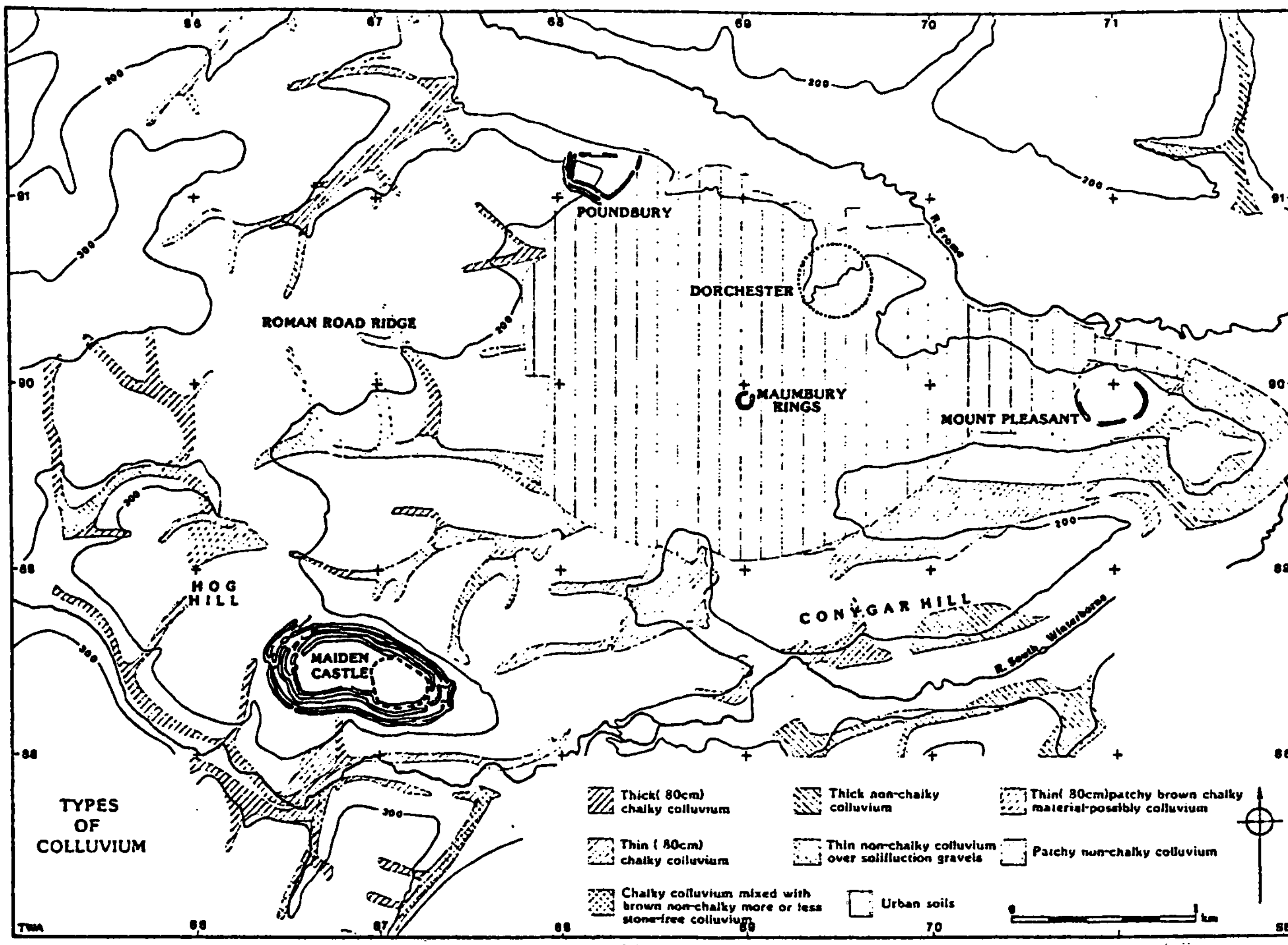


Figure 4 Colluvium in the Maiden Castle region interpreted from Soil Survey maps (Staines, 1991)

The Stonehenge Environs project included investigation of dry valley sediments, predominantly across Stonehenge Bottom, a region considered to have the highest potential for colluvial deposition (Richards 1990). The valley transects described by Martin Bell and David Cope represent the most thorough attempt to date to determine the distribution of colluvium from primary investigation within a prominent archaeological landscape (Colborne and Cope 1983; Richards 1990, 210-211). The sampling program was of reconnaissance scale and, except for one site near Coneybury Hill, proved an almost uniform absence of colluvium throughout the Stonehenge region.

A number of other landscape studies refer to dry valley soils to a lesser degree than those cited above. For the most part reference to colluvium is confined to introductory or background chapters. Colluvial sequences found during these surveys are more often used to support broad statements about phases of soil loss across the respective study regions. Few develop notions about the spatial distribution or discuss how these deposits might enhance the archaeological record.

The Marlborough Downs study (Gingell 1992), gives cursory reference to soil exhaustion as a possible cause of settlement change in this Late Bronze Age landscape but reference to erosion or colluvium is conspicuously absent in the text. Cranborne Chase (Barrett *et al.* 1991) is another large-scale landscape study which presents an encouraging summary of soil erosion and colluvial processes in the introductory chapters, but has little further reference to soils or colluvial investigation in the rest of the study. While extrapolation from soil maps or the investigation of colluvial sequences during the course of rescue projects provides useful environmental information there remains great potential for predicting archaeo-colluvial sites more systematically.

Two possible methods by which the distribution of archaeo-colluvium might be determined - Soil Survey maps and intuitive prediction are limited for different reasons. The former on the basis of a mapping criteria which does not account for the age of these sediments, the latter according to the apparent absence of surface indicators. While the localised targeting of valley floors adjacent to known archaeology offers a source of datable material, no strategic method exists for locating these potentially rich archaeological deposits at a regional scale which links their distribution to their most likely source - ancient arable fields.

2.4 STUDY OF ARCHAEO-COLLUVIUM AND ALLUVIUM OUTSIDE BRITAIN

The archaeological focus on landscape studies which incorporate investigation of sediments and transported soils has seen a growth in the investigation of large scale alluvial settings in both Britain and Europe (Brown 1987; Coles and Coles 1986; Needham and Macklin 1992; Runnels and van Andel 1987; Cherkauer 1976; Vita Finzi 1969; Butzer 1972). Often extensive depositional sequences have been used for reconstruction of regional scale ancient environments.

Archaeo-colluvium has been poorly investigated outside the Chalkland by comparison. The characteristic that colluvium can be linked with local human activity would appear to offer an advantage for accurate reconstruction, over the complex regimes of large regional alluvial environments. Nevertheless, a number of studies of ancient colluvium have been carried out outside Britain. These include Butzer (1974), Tolstoy and Fish, (1975) and Gardener (1974) in the United States, Coltorti and Dal Ri (1985), Balista and Leonardi (1985) in Italy, Kuzucuoglu *et al.* (1992) in France and Lang and Wagner (1995) in Central Germany. Lang and Wagner refer to colluvial thicknesses in excess of four metres and buried Neolithic features in the loessic landscapes of Central Southern Germany. Verhagen (1995) discusses archaeological survey and erosion modelling in Southern Spain which confirms Neolithic and Early Bronze Age settlement determined solely from lower slope and buried soils.

While these studies confirm the existence and archaeological usefulness of these sediments in landscape archaeology, as in Britain there have been no attempts to predict their location. This is in part because of the dearth of information about past soils, sediments and land use information for many regions where local colluvial sequences have been described. In many parts of the Mediterranean prediction might also be precluded because of the masking effect of frequent episodes of mass movement and landslips. When properly interpreted, terrace derived sediments which form localised colluvium can however constitute a useful source of otherwise lost artefacts and environmental information.

The relative advantage of the Chalkland of Southern Britain over many of the European settings is that a combination of the geological stability and particular hydrology of the Chalk and the continuity of pastoral land use for long periods, have uniquely preserved colluvium as "fossil" deposits of past erosion.

2.5 PRESERVATION OF COLLUVIUM

It is generally accepted that archaeo-colluvium has survived for up to 6,000 years because of a special combination of local hydrology and land use history. Absence of permanent streams and long periods of pastoral use have preserved these valley sequences throughout the Downland.

While dry valleys are topographic sites where eroded soils are preserved, certainly compared with large scale alluvial settings, selective removal and redeposition is still evident within these deposits. The Maiden Castle and Dorchester environs reports referred to in Section 2.3.2 revealed widespread evidence of truncated colluvial horizons and lost original soil profiles (Staines 1991; Smith R.J.C. *et al.* 1997).

Past surface and groundwater regimes whether affected by human activity or by climate have important implications for the formation and deposition of these deposits. While the Chalkland dry valleys are characterised by an absence of permanent streams, the truncation or removal of dry valley deposits may occur by seasonal or "lavant" streams (Bell 1986; 1992). The frequency and duration of seasonal streams will affect the degree to which dry valley colluvium is preserved or removed. While some form of water action is necessary for the transport of soil down-slope, it is the infrequent removal by these types of streams which create conditions of redistribution and sporadic preservation. Other factors include high run-off events on frozen ground, catastrophic rainfall events, as well as catchment specific factors such as variable land use history and soil conditions which lead to water table change and differential deposition. The potential for the accumulation of preserved sequences of archaeology under these conditions is a direct consequence of the particular hydrology of these parts of the Chalk landscape, acting in concert with a wide variety of catchment specific physical and land use factors. Evidence from across the Chalkland suggests that colluvium is often preserved as the product of complex processes. A benefit of a regional investigation of archaeo-colluvium is that some of these processes might become identified and better understood.

2.6 SUMMARY

The efforts of some 15 years ago, which identifed the archaeological value and provided the momentum for a focus on colluvium on the Chalkland, should not be lost. The undoubted possibilities which these deposits have to enrich our interpretation of archaeological landscapes and explain otherwise "blank" areas appears unchallenged. This is reflected in the recognition by English Heritage of colluvium as a research priority (English Heritage Draft Research Agenda 1997). The translation of this early work to a practical understanding of colluvium and to concepts of a three dimensional rather than a two dimensional archaeological record has yet to be fully realised in the field. It is hoped that this project might bridge the gap by developing a set of criteria which incorporate both ancient land use information and contemporary terrain information for locating these deposits.

From the site-specific field-work of Bell and Allen, a record of the existence, composition and topographic characterisation of these deposits exists. For a relatively small number of Downland sites (70), a record of datable anthropogenic deposits has been assembled, some of which have been used to reconstruct phases of land use. The work of the Soil Survey over the past 20 years has produced a limited number of maps on the Southern Downland which include soils which have been interpreted as archaeo-colluvium. The geo-archaeological work for the most part has been site-specific and of small scale, while the soil survey information lacks the firm chronological control necessary for the verification of the age and archaeological value of these deposits. Archaeo-colluvium therefore lies largely unidentified across vast areas of the Southern Downland.

The task of meeting both the spatial and chronological-archaeological criteria which the accurate location and identification of these deposits demands might be met by some form of predictive approach based on an approximation of past processes and cultivation generated erosion. The combination of geomorphic and archaeological parameters, which link past land use with the present landscape, provides a novel approach not previously attempted, and forms the basis of the model presented here.

CHAPTER THREE

PREHISTORIC SOIL LOSS AND COLLUVIATION

The existence of archaeo-colluvium has been recently proven, although the factors which influence the distribution of these deposits are clearly complex. There are well cited examples of the absence of colluvium in what appear topographically and archaeologically suitable locations and conversely the existence of these deposits in areas with little surface indication (Allen 1992; Bell 1983). A complex interplay of physical, climatic and local land use processes appears necessary for their formation and preservation.

3.1 HUMAN ACTIVITY, CLIMATE AND SOIL LOSS

Accelerated soil losses throughout the United Kingdom and Europe have been shown to be a consequence of both natural and human causes. The evidence across Southern Britain from both datable sediments and environmental data is that significant accumulation of alluvial and colluvial deposits are related to human activity (Coles and Coles 1986; Limbrey and Evans 1978; Lambrick and Robinson 1979; Bell 1992).

In Mediterranean settings, climate has been suggested as the predominant influence on landscape change on the basis of thick and contemporaneous alluvial deposits (so called Older and Younger Fill) (Vita Finzi 1969; Bintliff *et al.* 1988). These two prominent phases of alluviation have been correlated with episodes of climatic change, the latter deposits with the "Little Ice Age" of the 16th -18th Century AD (Bell 1982).

In Britain, however, the close coincidence of episodes of prehistoric clearance and agriculture with phases of sediment accumulation, suggest that human activity rather than climate is the primary causal agent (Bell 1982). The episodes of flooding and alluvial formation in the valleys of the Nene, Ouse and the Thames for example are coincident with periods of expansion of human activity in the catchments of these rivers (Lambrick 1992; Lambrick and Robinson 1979), not with periods of climatic deterioration. The final siltation of the Somerset levels also occurs during the Roman period when there is evidence of widespread human expansion in the catchments upstream (Coles and Coles 1986). The interaction of natural and human causes, however, is often complex with evidence from across Britain suggesting that although the wetter climate of Late Bronze Age Britain (800 - 600 BC) would have exacerbated flooding, soil loss and peat formation, the effect would have been much reduced in the absence of human activity (Robinson 1984, 18).

The environmental record also indicates that accelerated soil loss can be dated to periods of climatic stability such as during the Middle Bronze Age and later Iron Age. The complexity of climatic factors such as rainfall seasonality, intensity, and landscape susceptibility make generalisations difficult (Burrin and Scaife 1988, 215-216). From a brief record of climatic data, storm events have been measured which demonstrate the erosional impact of brief events on the Downland (Boardman 1993; 1996). A well documented rainfall event which caused catastrophic flooding and soil loss occurred in the Chilterns in 1945 (Oakley 1945) during which 30cm of rain fell in eight hours. Such an event is observed from less than 200 years of climatic record. The prospect exists of more severe storm events occurring at intervals of 500 or 1000 years which may leave no trace or remove or mask earlier events.

In order to provide some basis for predicting the location of archaeo-colluvium it is necessary to provide evidence for the type of land use, landscape processes, and the distribution and impact which these human activities might have had on soil losses during prehistory. We have a sporadic record of the distribution of these remnant eroded soils. A review of the prehistory of land use on the Chalkland will provide a basis for a prediction of their location, their chronology and extent.

Episodes of soil loss have been recorded under conditions of climax forest cover, but it is the particular action of tree clearance and cultivation, which accounts for most examples of accelerated soil loss (Dimbleby 1976; Boardman 1992). Examples from Australia and North America of deforestation and soil loss following settlement and cultivation last century, provide the strongest evidence and are useful analogues for the likely impact of prehistoric clearance and farming in Southern Britain (Russell and Isbell 1986; Chisholm and Dumsday 1987; Leopold 1957; Harding 1982). Butzer (1974) identified three degrees of human interference causing soil erosion :

1) Deforestation was the first impact of human activity felt in Southern Britain and had the effect of reducing rainfall interception, permitting splash erosion and accelerated soil creep and rill erosion.

2) Ploughing or severe overgrazing destroys the vegetative cover exposing bare soil to alternating rain and drought. Soil structure becomes more friable, erodible and incohesive, rendering soils susceptible to water or wind generated removal.

3) Cultivation practices such as ploughing across contour, excessive tillage and production of fine tilth, and autumn sowing, increase the susceptibility of the landscape to soil erosion.

The relative influence of wildwood clearance on soil erosion compared with cultivation is variably argued. There is evidence from cleared catchments for example that clearance of pristine natural forest is accompanied by widespread soil loss, while Boardman (p. comm) contends that losses are more significant during phases of cultivation post clearance.

3.2 EARLIEST HUMAN IMPACT AND ORIGINAL SOILS

3.2.1 Mesolithic Impact

The corpus of research of prehistoric soil loss in Britain draws on a geographically and temporally disparate record of evidence, much of which is based on site-specific investigation. Soil losses related to earliest human activities are manifest as floodplain deposits, truncated or buried soil profiles, mineral, peat horizons and colluvium (Simmons and Tooley 1981; Mercer 1981). The record of the settlement and land use history of the Southern Downland and the assembly of more recent environmental evidence, to which recent colluvial investigation has contributed, allows a loose reconstruction of the chronology of human impact in this part of Britain. Examples of soil losses from other parts of Britain also provide useful examples of the nature and extent of human impact during this period.

Before about 10,000BC when Britain was last separated from the Continent, the landscape of Southern Britain was shaped by peri-glacial solifluction and widespread erosion by melt-water after the final stages of the last Glacial period. This was followed by a period of stability when oak forest cover and warmer conditions prevailed (Cunliffe 1985). The effects of a relatively small population engaged in hunting and gathering during the post-glacial period have left few traces behind of any landscape change. The evidence for the earliest impact of human activity on the landscape of Britain exists in mineral and burnt horizons found in peat deposits which date to the Mesolithic (Evans, J., 1975; Simmons and Tooley 1991; Smith A.G. 1970). This is supported by sediment within lake floors which imply soil erosion dating to this period (Simmons and Tooley 1996).

3.2.2 Clearance of native woodland and loss of original soils

Tree clearance, particularly the removal of pristine forest cover has potentially the most significant impact on catchment hydrology, and therefore on soil stability and erosion. Examples where native forests were cleared in Australia and North America last century demonstrated up to ten fold increases in soil losses (Chisolm and Dumsday 1987; Meade 1969; Leopold, 1957). It is still argued however whether the most significant soil losses are sustained immediately post clearance or after the first arable cultivation of the landscape (Brown 1997; Favis Mortlock 1997).

The original forest soils and those of earliest agriculture across the Chalkland according to Catt (1978) were characterised by one to four metres of light, erodible loessic material. The Neolithic and the Bronze Age were periods for which there is evidence of widespread clearance of climax vegetation in Britain, and it might be expected that there would be traces of these original phases of soil disturbance. There is limited evidence of the extent of clearance in truncated soils beneath barrows and in tree throw hollows in Southern Britain (Evans, J., 1971). It is the widespread absence of original forest soils however which implies that large scale soil erosion accompanied early clearance (Bell 1986, 1992; Allen 1992).

There is certainly support for the notion that the most fundamental and widespread landscape changes in Britain are linked to human action accompanying initial wide-scale forest clearing probably in the Early Bronze Age. The elm decline which appears synchronous with the first widespread clearance during this period has been attributed to widespread tree clearing (Simmons and Tooley 1981; Evans, J., 1971; Fowler 1983) though this phenomenon has also been attributed to disease, climatic change and fodder use (Bradley 1978, 13).

There is little evidence of the first phases of forest clearance in the dry valley colluvial record. In many valley sequences such as at Kiln Combe and Chalton in Sussex and Combe Bottom and Hambledon Hill in Dorset, no trace of woodland soils were found (Bell 1992). Preece (1991) and Preece *et al.* (1995) note the presence of sequences of loessic soils on the Isle of Wight and also in colluvium at Holywell Combe. Many of the sequences studied by Bell and Allen were of Neolithic and later date and almost all were represented by environmental assemblages which indicated open environments (Allen 1992, 46). Hence both the remnant forest soils and much of the evidence of their deposition in Chalkland valleys has been lost.

There is widespread evidence that the earliest soils, which supported natural forest and earliest settlement on the Downland were derived from wind blown or loessic sediments - the product of aeolian deposition following the end of glaciation. The silt content, which is a component of present-day Downland soils provides the most significant indication of former loessic soil cover. There are few remnant deposits of primary loess in southern Britain (Catt 1978; Woolridge and Linton 1933) although sequences over 10 metres deep exist across many parts of central Europe.

The thickness and fate of the early loessic soils is the subject of wide debate. Catt (1978) estimates losses of up to four metres of loessic soils while Evans, R., (1990) suggests that soils of the Neolithic and Bronze Age were twice as thick as those of the present. Bradley (1978) suggests that much of this early soil cover was removed by the Neolithic while Allen (1988) contends it was maintained until the Late Iron Age.

A number of questions and apparent contradictions are raised by this hiatus with regard to both the scale of landscape change and the sensitivity of the original Holocene soils which cannot be fully explained. It is certainly true that Devensian peri-glacial erosion would have caused the removal of some of the loessic cover although it is the subject of speculation whether the remaining cover was lost shortly after tree removal or more gradually during Neolithic farming. It is presumed that Neolithic farmers were attracted to these light and productive soils, only to exhaust and erode them together with much of the evidence for land use of the period (Bell 1992).

A clue is given by Bell (1981b) in the South Downs and also in east Kent (Godwin 1962) where the colluvial evidence for some of the longest and most intense occupation lies in areas now occupied by Clay with flints. What is implied in these areas is that the present pattern of heavy soils was preceded by an earlier and productive loessic soil cover. The silty soils of early prehistory would have eroded severely with exposure of a loose and incoherent surface, once clay eluviation had removed the soil structure (Limbrey 1975, 23). This blanket of silt across the Downland would have borne little resemblance to the present pattern of soils developed as they are on Chalk, Clay with flints and superficial deposits.

Reconstruction, at least of these earliest of agricultural landscapes, based on medieval or modern patterns therefore cannot be sustained (Barrett *et al.* 1991, 16-17). Just how much of the loessic cover remained after tree removal is the subject of speculation as is the proportion of cleared land given to grazing or cropping on these early soils. With the removal of the loess, a distinction between rendzina soils developed on the Chalk and acid brown earths formed on superficial deposits presenting new and variable management problems.

If we accept that across most of the Chalkland, the evidence of the impact of human activity during clearance is unavailable because of the gap in both original and re-deposited forest soils, then it is the period following clearance which is characterised by an open landscape and a wider record of soil and archaeological evidence on which this project predominantly focuses. With grazing being less destructive in general than the action of ploughing and tillage, it can be maintained that our record of the prehistory of soil loss in Southern Britain is therefore closely allied to the history of cultivation.

3.3 AGRICULTURAL EXPANSION AND SOIL LOSS

3.3.1 Neolithic farming

Earliest evidence for agriculture in Britain exists in Northern and Eastern Ireland, the English Lake District and parts of Southern Britain (Mercer 1981). Agriculture appears to have been introduced by groups crossing from Europe in the mid 4th millenium BC (Fowler 1983). With gradual and patchy forest clearance and the first appearance of cultivation during the Neolithic, brought about by the cross Channel import of domesticated sheep, cattle and cereal crops, an expanded range of evidence for human impact appears in the archaeological record (Cunliffe 1985).

The indication from monumental earthworks, henges and long barrows imply a substantial population on the Downland during the Neolithic. Although pollen survives poorly in chalk settings, samples from soils preserved beneath Neolithic monuments suggest that large parts of southern Britain were cleared during this period. Soil degradation in the form of nutrient decline and erosion also appear coincident with these changes although any serious impact is still expected to have been localised (Simmons and Tooley 1981).

The earliest evidence of Neolithic cropping on the Chalk Downland is available from grain impressions, burnt seeds and ard marks (Mercer 1981; Helbaek 1952; Richards 1990). Farming of this period is well attested at Avebury, the Stonehenge region and at Cranborne Chase (Fowler and Evans 1967; Richards 1990; Barrett *et al.* 1991). The presence of ard marks scored into chalk bedrock however implies that the cultivated soils at the time of scoring were not very deep. Experimental work (Reynolds 1979) suggests that ancient ards penetrated the ploughsoil to a depth of up to 30cm. The presence of Neolithic ard marks therefore implies that cultivation at this time was on soils which had already been considerably thinned. This provides strong circumstantial evidence that farming had been conducted in these areas well before the ards began to leave their marks. Colluvium throughout the Downland preserves pottery and artefacts from this period which were presumably the refuse of arable fields (Fenton 1981). It is also expected that an increase in the impact of agriculture is likely to have accompanied the ox drawn scratch plough in the 3rd millenium BC (Fowler 1971).

Popular concepts about the impact of Neolithic farming and land use pressure have been revised by Thomas (1992), who supports the idea of mobile farming and limited cultivation during this period. He suggests that almost all carbonised assemblages in Britain are dominated by wild species (Thomas 1992, 181) and that the absence of settlement evidence implies more transitory social patterns. He goes on further to refer to an absence of developed and fixed Neolithic agricultural landscapes supported by a complete lack of major timber framed buildings, no wider evidence of permanence, nor problems of over population or soil decline. The changes to fixed arable landscapes, he asserts, occur later around 1500-1100 BC, when walled field systems and domestic structures become widespread. A further rebuff to concepts of fixed agriculture in the Neolithic comes from the work on bone collagen and diet by Richards, M. (1996). In a study of Neolithic burials he contends that cereal in the diet was far out-weighed by meat, indirectly measured as a function of bone collagen.

Although the loss of the earliest loessic soils has been discussed above, it may be prudent to recognise the possibility that evidence for the earliest agriculture and settlement might also have been lost, a plausible reason for the absence of Neolithic evidence on the Chalkland which Thomas does not consider.

If the loss of the loessic soils was caused predominantly by Neolithic farming it poses a fundamental question. How would a regime of mixed and low impact agriculture have caused such large scale and widespread erosion ? One possibility is that most of the loessic soils were stripped by peri-glacial processes before any human interference. If this soil cover were further eroded during forest clearance then the earliest farmers would have been presented with a very patchy and remnant loessic soil cover, certainly less than the several metres suggested by Catt (1978) (Brown A. p. comm).

Loessic landscapes in central Europe also appear to have been susceptible to large erosion episodes during prehistory (Lang and Wagner 1995). High erosion rates measured for present day loessic soils provide contemporary evidence of the erodibility of these silty soils (Bollinne 1978). A further and more plausible possibility is that these soil losses are a consequence of a longer period of use. Incremental soil loss, punctuated by periodic catastrophic events, over 2,500 years of sporadic farming on light soils during the Neolithic may have amounted to greater net losses than 500 years of more intensive farming on the more stable soils which this activity left behind during later prehistory.

The cause of the loss of the loessic soils, whether they were originally thick or extensive or whether they were predominantly eroded with early clearance or subsequent farming, remains the subject of speculation. It is sufficient to assume that the landscape with which we are dealing (after the Neolithic and at the onset of widespread arable expansion) is one which has yielded significantly more archaeological and environmental evidence than any earlier period. It is this resource which is drawn upon in this investigation of ancient erosion and the distribution of colluvium. Unexplained gaps and a bias in favour of what remains is a familiar problem which must be reconciled in archaeology. In this case we can acknowledge several possible scenarios for landscape change during first clearance and earliest agriculture but ultimately are left with a reconstruction based on evidence which appears later in the record of prehistoric land use and landscape change.

3.3.2 Bronze Age Intensification

Whether or not farming communities were firmly established across many parts of Britain by 3000 BC, and in spite of questions about the fate of the earliest soils, it is the popular notion that the impact on soil loss would not have been widespread before this period (Simmons and Tooley 1981; Woodell 1985; Limbrey 1975). The conventional model contends that the expansion of agricultural activity and the almost complete exploitation of the Southern Downland occurred during the Bronze Age (Fowler 1983; Hingley and Miles 1984, 75; Mercer 1981). This is supported by a proliferation of archaeological and environmental evidence, particularly by the widespread appearance of field boundaries - so called "Celtic Fields" which date to this period, from tillage and cereal processing implements and burnt seed and pollen. Thomas (1992) concurs, suggesting that the real change in fixed settlement and arable economy occurred in the mid second millenium BC when field systems and domestic structures became widespread. Most significant is the fact that the earliest colluvium in many parts of Southern Britain date to this period (Bell 1982).

3.3.3 Iron Age adaptation

Extensive thinning of soils and abandonment to pasture in many regions of the Chalkland occurred in the Late Bronze Age and is implied by the appearance of large linear or ranch boundaries (Robinson 1984; Bowen 1975). The effects of sustained agricultural pressure on much of the Downland were being experienced during this period coincident with evidence of deterioration in climate between 1000 and 600BC in Southern Britain. Episodes of flooding, siltation and abandonment linked to climatic deterioration during this period are recorded at Farmoor and Mingies Ditch in the Upper Thames Valley and in the Severn and Avon catchments implying increased runoff and soil loss following arable development of upstream catchments (Lambrick and Robinson 1979; Shotton 1978). The alluvial record from the valley and lowland regions complements the colluvial record on the Downland of the impact of human activity during this period. Cunliffe attributes the movement of settlement from uplands to valleys in Devonshire during the Iron Age to wetter conditions (Cunliffe 1978).

Social and economic stress manifest in the construction of fortified hillforts was also a feature of this period brought about by population expansion and land use pressures which might plausibly be attributed in many regions to soil decline (Cunliffe 1984). During the Iron Age, as a consequence of earlier exploitation of arable chalkland, and exacerbated by the impact of climate change, less land appears to have been farmed though more intensively. Arable landscapes which flourished in the Mid and Late Bronze Age, such as the Marlborough Downs, the South Downs and the Stonehenge region were in decline toward the end of the Bronze Age (Gingell 1992; Drewett 1982; Richards 1990). There is also evidence that during this period marginal landscapes of heavier soils and forested areas were cleared adjacent to areas of abandoned chalk soils.

3.3.4 Roman intensification

The transition to the Roman period is seen as one of arable intensification of a landscape which had already been partitioned, managed and in some parts exhausted. There is widespead evidence that Romano-British agriculture adapted and managed many pre-existing agricultural systems (Palmer 1984). The introduction of iron ploughs and tillage techniques also opened up abandoned areas or landscapes of marginal soils, particularly Clay with flints and heavy soils of the lowland valleys. While evidence exists in the alluvial record of flooding and siltation of lowlands in the Thames Valley and the Somerset levels linked to Roman activity (Lambrick and Robinson 1979; Coles and Coles 1986), there is little evidence for exceptional colluviation for the Mid and late Roman period (Bell 1982). This implies that much of the arable landscape had shifted to pastoral use by this time.

3.3.5 Summary

Under this continuity of land use, the impact on the thickness and productivity of Downland soils through later prehistory and into the Romano-British period is likely to have been widespread. Colluvial profiles bearing Bronze and Iron Age pottery in many parts of the Downland show basal non calcareous silty horizons beneath flints and calcareous material.- inverted profiles which show that successive thinning of original loessic soil cover preceded the incorporation of chalky material, as soils were thinned to bedrock (Bell 1986, 1992; Allen 1986). This chronology of human activity and landscape impact is in part supported by the loosely dated and widespread layout of ancient fields many of which imply arable origins in the Early Bronze Age (discussed in more detail in Chapter 4) with later Roman re-use and expansion.

Period		Climate	Human activity and landscape impact
8000BC	Late glacial	Very rapid warming	Minimal human impact
8000-3500BC	Mesolithic	Dry - Increasing wetness	Hunting, gathering, initial clearances, burning.
3500- 2500BC	Neolithic	Very warm humid	Patchy clearance, first agriculture
2500-750BC	Bronze Age	Cooling, wetter	Widespread clearance and full agricultural development. Land allotment.
750BC-40AD	Iron Age	Warmer	Effects of soil loss. Succession of intensification and abandonment.
40AD-410AD	Romano-British	Becoming cooler	Rapid population growth, Intensification Exploitation of valleys and wetlands.

Table 1. Chronology of land use history and climate, late Glacial to Romano-British period in Britain (adapted from Fowler 1983).

3.4 REGIONAL VARIATION IN ARCHAEOLOGICAL LANDSCAPES ON THE DOWNLAND

The poor understanding of regional variation in late prehistoric landscape change is another priority identified by English Heritage in their recent research agenda (English Heritage Research Agenda 1997, p44). With the assimilation and comparison now possible between an increasing corpus of archaeological landscape studies on the Downs it is clear that the simple model for the spread and intensification of agriculture across Southern Britain in prehistory, summarised above (Table 1), is being redefined. The long held convention, which is summarised in the previous section, suggests that the Bronze Age was the period when the first pressure was exerted on the landscape through clearance (accelerated by the introduction of bronze axes), arable expansion, increased sheep numbers and almost complete utilisation of the landscape. This is most prominently manifest in the layout of ancient fields. The Late Bronze Age - Iron Age was a period of great social and economic change with shifts in settlement and social order variously attributed to population pressure, soil and climate decline as well as external influences such as immigration (Cunliffe 1978).

According to Simmons (1981, 29) and Robinson (1984) the Iron Age represented the period of heaviest impact of prehistoric activity on the environment. Fowler (1983) suggests that before 1000 BC the land remained in "good heart" with no pedological degradation.

While this is supported by evidence in some regions, it is likely that the extent and severity of change initiated during the Late Bronze Age may not have had impact in some areas until much later in the Iron Age. The later response to land use pressures or lag effects may have been due to local adaptation, physical or hydrologic variation or ritual factors and are certain to have occurred across different parts of Southern Britain. The expansion of land use and arable in the Late Bronze Age is refuted by Bradley *et al.* (1994, 139) on the Salisbury Plain for example, where settlements and field systems of this period are absent. Bradley in fact compares the Salisbury Plain with the Berkshire Downs where there are Middle Bronze Age linear boundaries with little other material dating from this period.

According to Bradley (1978, 41,123), the colluvial record suggests that erosion is largely an Iron Age phenomenon. There are however numerous Bronze Age and Neolithic sequences which support a much earlier date (Bell 1983; Allen 1992). Both arguments find support from different regions on the Chalkland. In the Bronze Age when clearing of climax vegetation would have exposed a light and erodible landscape, soil loss is likely to have been severe. It may have been equally severe in the later Iron Age, when a wetter climate and degraded soils were widespread following long periods of use (Robinson 1984). Erosion in the Iron Age has also been attributed to land management changes such as a shift to winter wheat for example (Boardman 1992; Allen 1992).

The colluvial record is not extensive enough, however, to support one scenario over the other. Bell for example demonstrated in the archaeological evidence from eroded soils at twenty sites throughout Britain, a wide difference in the age of soil deposition and erosional phases (Bell 1982, 137). The pollen record shows similar wide variation across the Chalkland in both the period during which original clearance took place and subsequent land use changes. In the southern part of the Berkshire Downs for example, clearance was not until late prehistory compared with the intensive utilisation of the north-western part of this region. The South Downs show later clearance and more spatial variation while Dorset and Wiltshire seem to have been preferentially exploited for long periods (Waton 1982).

As more is revealed about the prehistoric environment and land use history within these sub-regions, it is clear that wide regional and chronological differences exist which appear to more accurately characterise the land use history of the Downland. This is in contradiction to earlier ideas that the Chalkland was a landscape of uniform physical character and a broadly shared land use, settlement and development trajectory.

The reason for the development and abandonment of landscapes reflects variation in local resources, social dynamics and ritual factors. Reasons which include predictable changes and unpredictable human vagaries, adoption or resistance of new methods, local land management practices, immigration, under-exploitation of landscapes for ritual reasons in addition to environmental and local climatic variation threaten any simple generalisations about the landscape of the past. The environmental record on which many of the settlement models have been proposed is also commonly characterised by localised or point source information which cautions against wide extrapolation or generalised development models. Table 2 illustrates this, showing peak agricultural development and decline for six archaeological landscapes in Southern Britain.

Landscape Study	**Period of Agricultural Intensification**	**Author**
Marlborough Downs	Late Bronze Age	Gingell (1992)
Danebury Environs	Late Iron Age	Cunliffe (1991)
Berkshire Downs	Romano-British	Bowden *et al.* 1991; Bradley and Ellison 1975
Stonehenge Environs	Bronze Age (no IA arable)	Richards (1990)
Maiden Castle/Dorchester	Late Bronze Age (no IA arable)	Sharples (1991)
Bullock Down	Late Bronze Age	Drewett (1982)

Table 2. Archaeological landscapes on the Chalkland and periods of maximum arable extent.

The Marlborough Downs saw the abandonment of fields and upland cultivation toward the end of the Late Bronze Age when settlement became focused on lowland sites (Gingell 1992, 156). In the landscape surrounding the Danebury hillfort, however, there was long continuity of land use into the Late Iron Age and through to the Romano-British re-use of fields. The abandonment of the hillfort in about 100 BC is suggested to have been a consequence of agricultural decline (Cunliffe and Miles 1984). The Stonehenge region also experiences an curious Iron Age hiatus represented by an absence of pottery of this period (Richards 1990). On the South Downs clearance was not until the Bronze Age with agriculture flourishing throughout the Bronze and Iron Age (Drewett 1982).

Regional soil variation may provide a simplified answer to the onset and continuity of agricultural use in different regions. The observation that Danebury is surrounded by calcareous soils while Maiden Castle is surrounded by less productive Clay with flints may account for the longer land use history at the former. In the face of limited and localised records of environmental and archaeological data, of poor preservation of the earliest soils and settlement features on the Chalk, the prehistoric history of the Downland appears characterised more by local rather than regional development forces. Further landscape studies and increased sampling density, particularly within valley sites where earliest evidence might be preserved, will further serve to consolidate ideas about the archaeology and land use history of this region.

3.5 PAST AND PRESENT PROCESSES OF DOWNLAND EROSION

While variable chronologies of agricultural development and landscape impact characterise the Downland, it is possible to review agricultural regimes and practices in prehistory in order to define the processes by which erosion and colluvial deposition occurred. It is also possible to compare soil erosion processes on present Downland settings as possible analogues for prehistoric erosion processes.

3.5.1 Past arable management and soil erosion

The cultivation and land management practices of prehistoric farmers, while confined to small fields would still have caused erosion especially on a landscape of light loessic soils. Under human traction or by oxen it is suggested that field size was small to accommodate the daily work-load of a ploughing team. Using wooden or stone ards, later replaced by iron, rough tillage methods both broke and inverted soil to depths of 30cm, a mechanism on sloping ground which effectively shifted soil down-slope to the field edges. The thickness of extant field lynchets across Southern Britain implies the shift of large volumes of soil to the field edge against some form of stone or brush boundary fence. There are examples from the practices of present-day Chalkland farmers who redistribute soil accumulated as lynchets back onto fields. The long-term consequences of these management practices are the promotion of successively finer, less cohesive and more erodible soils.

The fields ascribed Bronze Age dates are commonly broadly oblong in shape, about 0.2ha in size with approximate dimensions of 60m x 40m (Fowler 1983). Moffat (1988) found that fields in his Hampshire study were somewhat larger (0.5 - 0.6 ha) while Cunliffe prefers 0.4ha (Cunliffe 1978). The larger and more elongated fields ascribed to Roman cultivation support the notion of greater erosion during this period. Evans, R., (1980) in a survey of modern erosion, noted the absence of erosion in fields of less than 50m and little soil loss on fields up to 100m long.

It has been suggested that ancient fields were established to counter erosion (Bradley 1978; Bell 1983). Allen (1996, 267) in the Dorchester bypass report identified sections of fields (within larger field blocks) which he interpreted to have been created in response to valley side erosion with the consequent formation of lynchets. Moffat (1988, 21) however makes the observation that in many parts of the Downland the alignment of fields oblique to contours appears counter to any soil conservation function.

While it might be suggested that a landscape of fields would help to retain soil on hillslopes as is clearly evident by the formation field lynchets, the susceptibility to soil loss of a cultivated landscape partitioned by small fields, would still exceed that of a pastoral regime. Even if soil rarely breached the lynchets, accelerated soil movement would still be possible down track-ways, between fields and especially during periods of decline or abandonment (Morgan 1992). Measurement of soil losses on or around a landscape of ancient field boundaries (1-2ha) was undertaken in the winter of 1990-91 and was found to be minimal (Boardman 1992, 14). Results from such experiments should be interpreted with caution though as such fossilised landscapes with current soils and stabilised grassy boundaries may bear little resemblance to those in use during prehistory.

A prominent factor in prehistoric soil losses also appears linked to a shift to autumn sowing (Boardman 1992). The exposure of fallow fields to winter rainfall increases the susceptibility of soils to erosion, though losses were probably mitigated by weed cover, a factor about which little is known. Evans, R.(1990) nevertheless suggests that erosion of fallow land may have been considerable.

3.5.2 Manuring

A critical source of material by which both field systems and colluvial sequences are dated are fragments of pottery spread on fields through manuring. These provide evidence both of widespread arable practice and critical support for the age and extent of ancient agricultural activity across the Downland. The weight of archaeological evidence from Britain and Netherlands supported by ethnographic examples supports the widespread use of manuring to promote soil fertility (Megaw 1961). Of relevance to any study of soil erosion and colluvial formation is the conclusion that manuring introduces domestic refuse such as pottery sherds onto arable fields (Fowler 1983; Fenton 1981, 210-15). These have been found to survive as surface material or transported down-slope and forming datable sequences within colluvial deposits. The large volume of sherds in some parts of Downland Britain allow no other conclusion for their appearance in the colluvial record.

The surface or subsurface density of sherds among tracts of fields or within valley deposits might be used to imply the distribution and intensity of arable from district to district (Gaffney and Tingle 1989). The paucity of surface sherds on the high Downland, where settlements and water are scarce may reflect less arable use compared with lower Chalkland where mixed farming and greater settlement density was prevalent.

The presumption that manuring is responsible for widespread distribution of surface pottery however, is challenged by Bradley (*et al.* 1995, 31-3), who suggests that much of the manured pottery from his study of Salisbury Plain, which is assumed to be from ancient fields, is probably residual material from ploughed settlements. He bases this assertion on the large quantity of burnt flint and pottery, which he suggests is too large to attribute to manuring alone.

3.5.2 Present soil erosion

The distribution and rates of soil loss across prehistoric southern Britain are characterised by a lack of firm land use chronologies. A useful measure of past land use and its impact can be found in examples of current soil loss processes on the Downland (present day analogues).

The renewal of accelerated soil erosion on the southern Downland is a relatively recent phenomenon, linked closely to the expansion and intensification of cereal cropping both during and since the Second World War (Morgan 1986). Grain shortages during the war and the more recent demand for cereal production under European Economic Community quotas has brought about the change from a predominantly stable pastoral landscape of fields and hedgerows into one of vast open fields. The change in the agricultural regime and the landscape character of the Downs has for the first time in up to 1500 years, exposed the soils to the erosive action of wind and water.

The growing concern in Britain over the past 30 years has been reflected in an increasing research emphasis on soil erosion (Kirkby and Morgan 1980; Allen 1991, 39-57; Boardman 1992). In a temperate, green and pleasant land the concept of widespread soil erosion is not a widely held perception, neither is the problem addressed by a national soil conservation strategy. Nevertheless the speed and magnitude of the shift from pastoral to arable land use particularly on a landscape which had already (though perhaps two millenia earlier) been degraded, shares some parallels with the imposition and impact of agricultural regimes 150 years ago in some of the New World landscapes of North America and Australia (Bell 1982).

In some catchments on the Chalk, soil loss rates have reached 200m^3/ha/yr under cropping, and episodes of flooding and siltation have not only affected arable land but spread to neighbouring residential areas (Boardman *et al.* 1996). In spite of the problems associated with comparison of soil processes over such long time periods, the recent research of soil loss on the South Downs has identified a range of contemporary soil erosion processes by which ancient depositional processes and land use regimes might be understood (Boardman 1992).

As stated above, soils on the present Downland are stony and more stable than those of early prehistory. Fields today are larger and mechanised tillage and cropping frequency present a more open and intensified regime of cultivation than the small fields, rough tillage and weed cover typical of prehistoric agriculture. Nevertheless, it is a basic principal of soil movement that fine grained materials are likely to be deposited frequently, while coarser material is deposited less often and in more concentrated locations. Soils most at risk are those where clay content, which provides cohesiveness properties, falls below 35% (Evans, R. 1992). The soils of the Downland are predominantly coarse silts (up to 60% silt), which are also deficient in the structural and binding properties provided by organic matter. The chalk soils have less than 4% organic matter under arable, making them more likely to slake and crust with consequent increase in impermeability and runoff (Evans, R. 1992, 61; Allen 1992).

Frequent smaller scale movement of fine soil material occurs naturally but is increased greatly by human activity especially agriculture. Processes involved include rainsplash, hillwash, soil creep, biota resorting, sheetwash and rilling. Higher energy events of perhaps one in ten year frequency create larger rills and gullies, gravel fans and the deposition of coarser material. Boardman (1992) suggests that rilling or small scale translocation of hillslope sediment, sheetwash and gullying are the main forms of down-slope sediment transport on cultivated hillslopes of the present South Downs. Large-scale mass soil movement is generally discounted in these landscapes although Boardman contends that it is impossible to discern smaller pulsed from incremental soil movement. Allen (1992) has identified three-dimensional sequences of colluvium which imply both rilling and gravel fan deposits within prehistoric colluvium.

In the absence of detailed records of prehistoric climate it would be imprudent to completely rule out the dramatic effects of 100 or even 1000 year storm events. While debate will continue about the relative rates of current and prehistoric soil erosion, the results of a relatively short programme of Downland erosion research provide some contemporary measures of soil erodibility which might be incorporated in a colluvial predictive model.

3.5.3 Comparison of past and present processes

The comparison between present day soil erosion on the Downland and that of prehistory must take account of several fundamental differences in both landscape and land management practices. Some of these are summarised in Table 3.

Arable characteristics	**Present**	**Past**
Field size	5-30ha	1-2ha
Slope angle	Up to 25 degrees	Fields <5 degrees
Land use	Winter cereals	Mixed arable/grazing fallow
Mechanisation	Compaction, wheeled rolling. Fine tilth, power harrow	No
Weeds	Weed free	Weeds
Soils	Silty and stoney	Silty

Table 3 Past and present cultivation practice (from Bell and Boardman 1992)

The impact of certain cropping practices from the present or past would counter-balance each other. Whether the lighter soils of prehistory would have suffered more erosion than the more stable soils of the present Downland, which are clearly under a different and mechanised regime of cultivation is arguable. Opinion appears divided about whether the overall extent and severity of soil losses were greater in prehistory or the present day. Boardman (1992) suggests that current rates are higher, while Evans, R., (1990) suggests that rates were higher in the past due to widespread fallowing.

It is also important to consider the scale and duration of arable practice on the Downland soils throughout the prehistoric period. It is conceivable that some regions within this part of Britain were farmed at varying degrees of intensity for nearly 4,000 years before the Roman period. The evidence of multiple episodes of soil use and erosion, deposition and removal may have been lost over such a long period. The research of present-day processes, by contrast draws on less than 50 years of information and therefore represents a brief temporal snapshot with respect to environmental change and climatic events.

A useful comparison between rates of erosion throughout prehistory and those of the present day has been incorporated in a computer simulation model of soil losses on the South Downs (Favis-Mortlock *et al.* 1997). Using approximations of past soil profiles, land use regimes and climatic history, Favis- Mortlock *et al.* estimate soil loss rates over a 7,000 year period. The model is based on evidence for higher soil losses under arable regimes and the simulation produces estimates of soil losses and soil thinning up to the present day, which are comparable with the present soil depths on the South Downs (see section 5.2 and Fig 12 for more detail). A prominent conclusion was that the rates of prehistoric soil losses between the Neolithic and Iron Age far exceed those of modern agriculture on the Downs.

Comparison between present and past erosion is a complex task. The variability of causal agents like climate, growing season, rainfall intensity, storm events and a range of human and environmental changes for which we have no data would seem to preclude any meaningful comparisons. In examining past soil losses, a relatively brief, yet dramatic episode of soil erosion may have lasting environmental effects, such as landscape abandonment, without leaving much evidence of the cause. The introduction of rabbits, for example, to an agricultural landscape may cause vegetation decline and widespread soil loss in the space of 20 years (Bintliff 1988). This type of causal variability creates a complex record of deposition and stratigraphy with temporal differences in episodes of soil loss across a period of up to seven millenia.

The evidence from the distant past and recent soils research, however, provides a useful corpus of research about soil erosion processes under a range of regimes. It would seem worthwhile for example, to attempt to evaluate the extent to which land bounded by ancient field boundaries might be used to locate archaeo-colluvium, before dismissing the prediction of these sites as too temporally and spatially complex.

The task of meeting both the spatial and chronological/archaeological criteria which the accurate location and identification of these deposits demand can perhaps be met by some form of predictive approach based on an approximation of past processes related to cultivation-generated erosion. The combination of geomorphic and archaeological parameters, which link past land use with the present landscape, has not previously been attempted and forms the basis of the model presented here.

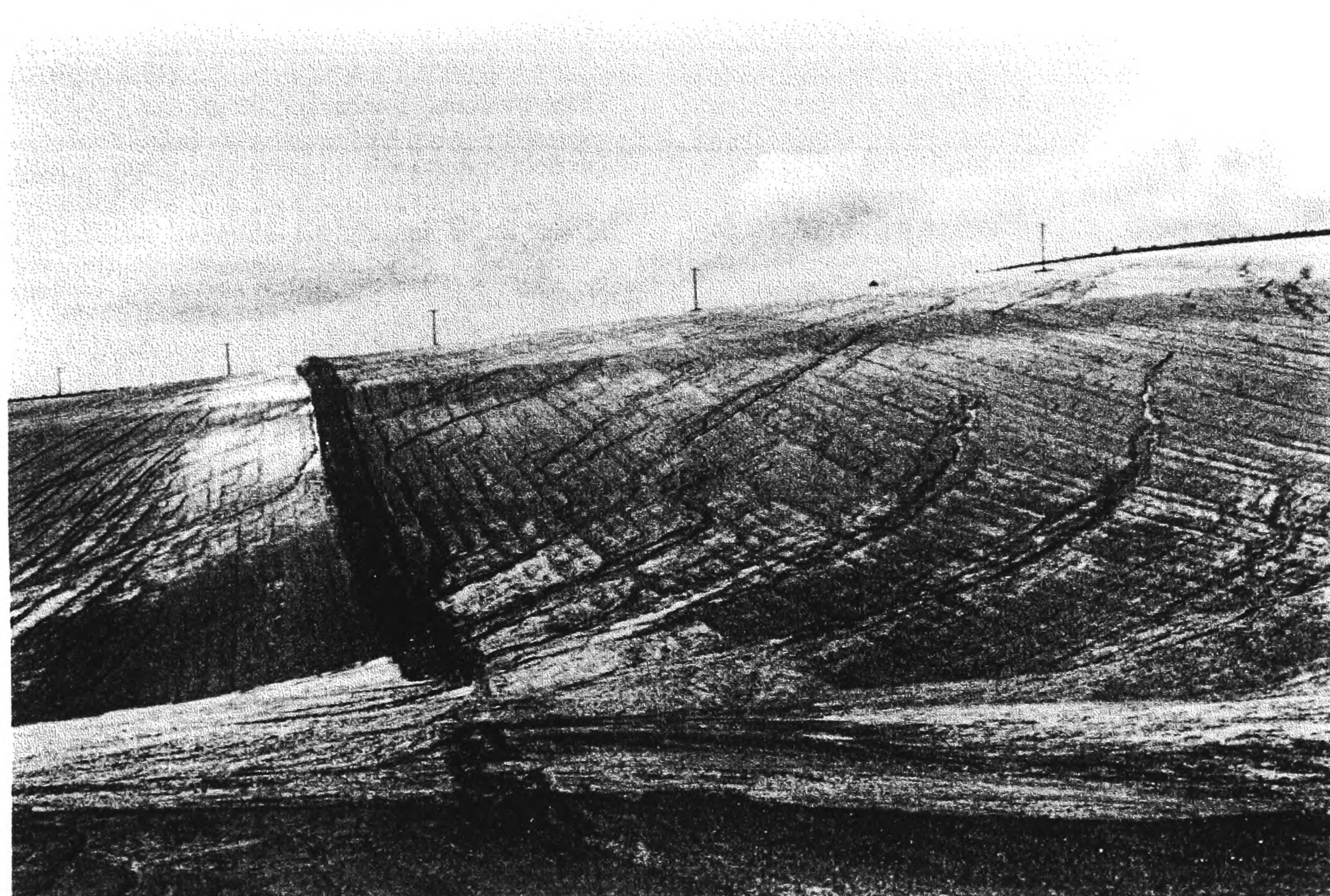


Figure 5 Modern soil erosion on the Chalkland (Boardman 1992)

CHAPTER 4

PILOT STUDY : THE BERKSHIRE DOWNS

4.1 INTRODUCTION

The trial of a model which predicts archaeo-colluvium will be centred on the north-western part of the Berkshire Downs. The project area occupies some 58km^2 on the dip-slope between Lambourn and the prominent Chalk escarpment which overlooks the Vale of the White Horse. Situated at the northern edge of the Southern Downland, the landscape offers an area large enough to represent some of the variability of this distinct physiographic and archaeological landscape yet is sufficiently small enough to allow localised field checking and investigation. It is one of the aims of the project that soils and sediments might be investigated across a range of sites at sufficient scale to draw some conclusions about colluvial distribution and land use history.

The Berkshire Downs has a rich record of prehistoric archaeology, most notably the Uffington White Horse, Waylands Smithy long barrow, the Bronze Age cemetery at Lambourn and the Ridgeway. Four prehistoric hillforts overlook the Vale of the White Horse along an eight kilometre segment of this ancient track-way. The landscape also bears traces of linear ditches and field systems, which reflect multiple phases of ancient land use and land division (Bradley and Richards 1978).

Apart from references to the absence of ploughwash in the Lambourn Valley (Harding 1974; Bradley and Ellison 1975; Bell 1982; Hall 1975), and a few references to buried soils (Piggot and Piggott 1940; Atkinson 1965; Richards 1986; Jarvis 1973) there has been no investigation of colluvium on the Berkshire Downs. The traces of prehistoric cultivation manifest in swathes of ancient fields however, provide an indication that sediments caused by ancient erosion ought to be present throughout the landscape. If colluvium exists on the Berkshire Downs, it holds great potential as an archive of both settlement and land use information.

Evidence from the Mesolithic exists across Southern Britain but there is scant evidence from this period on the Berkshire Downs (Gaffney and Tingle 1989). There is also a paucity of Neolithic and Early Bronze Age settlement sites in the project area, a gap in evidence which is common to the wider Chalkland, notably on the Salisbury Plain and Cranborne Chase. Settlement remains of this age are more frequent in the lower landscapes of the Thames and Kennet Valleys (Bradley *et al.* 1994, 138). Loss of sites of this age, especially on the upland parts of the Chalkland would seem most likely due to plough damage and/or chemical weathering. It is well documented for example that prehistoric features on Chalkland suffer severe truncation due to dissolution (Atkinson 1957; Schiffer 1987). In the absence of evidence, the questions as to whether these gaps are real or a product of erosion might be addressed by investigation of off-site sediments like colluvium. In fact, in severely degraded and truncated landscapes, colluvium might provide the only source of early prehistoric archaeology.

The large tracts of ancient fields suggest elements of both prehistoric and Romano-British activity though their extent and intensity of use at different periods has been variably argued (Bradley and Ellison 1975; Bowden *et al.* 1991). The Berkshire Downs therefore provide a landscape with considerable potential for investigating the nature and extent of colluvial deposits. If colluvium exists on the Berkshire Downs it might help to answer questions about the date of the fields and their use and provide an insight into the missing elements of earliest or later prehistoric land use.

4.2 THE PHYSICAL SETTING

4.2.1 Location

The pilot area is in the upper reaches of the Lambourn valley with the township of Lambourn to the south. It occupies 58 km^2 of rolling dry uplands bounded to the north by the Ridgeway track between the towns of Wantage and Ashbury (Fig 6). This landscape, more recently associated with racehorse training, and gallops, has a long history of agriculture with the present towns largely established in Saxon times. Over the past 50 years the Berkshire Downs have been transformed from an open pastoral landscape into one of large arable fields, threatening the survival of traces of ancient land use which had been relatively undisturbed for centuries.

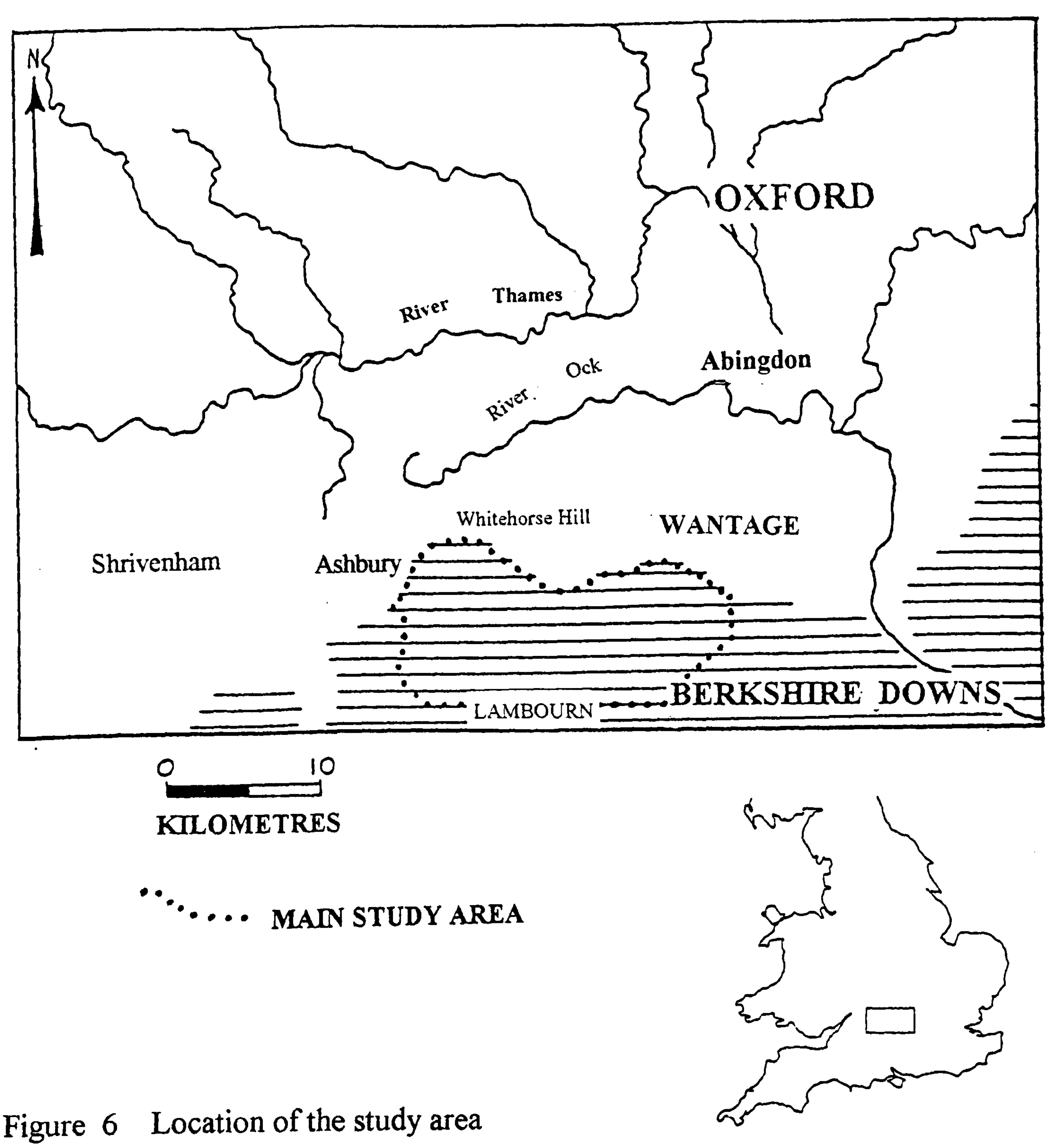


Figure 6 Location of the study area

4.2.2 Geology and topography

The Berkshire Downs lie at the northern limit of the Southern Chalkland where uniform limestone dips gently to the south-south east. The Chalk terminates at a prominent north facing scarp which reaches 244m above sea level before sweeping down to the Vale of the White Horse and the Thames gravel to the north. Drift deposits of residual sands and clays which include Clay with flints, exist as cappings and superficial surfaces (Jarvis 1973) (Fig 7). The rolling landscape is characterised by a series of asymmetric dry valleys with steeper west-facing slopes.

A series of prominent ridge-lines trend from north to south separating a landscape of more open valleys to the west from a more dissected landscape to the centre and east of the region. The Berkshire Downs lie less than 150km south of the last glacial extent and are largely a product of Tertiary incision and Pleistocene peri-glacial processes. The gentle form of many of the Chalkland valleys is a product both of the homogeneity of the chalk and the freeze-thaw weathering and scouring action of melt-water and fluvial erosion. Characteristic of the Upper Chalk is a high degree of permeability and lack of permanent flowing streams.

Much of the landscape of the project area is gently sloping though some of the shorter west-facing slopes may exceed 20 degrees. The formation of these dry valleys has generated considerable debate among geomorphologists. Foremost among the explanations is that valley asymmetry is the result of differential processes of solar radiation and greater freeze-thaw on the west-facing slopes (French 1996; Ollier and Thomasson 1957; Kennedy and Melton 1972). The Middle and Upper formations of the Cretaceous Chalk which form the Berkshire Downs are composed of uniform limestone (fine calcium carbonate) with few impurities. Tabular and nodular flints are found along bedding planes throughout the Upper Chalk (Jarvis 1973), which commonly persist as residual features through much younger units.

Two primary divisions occur within the category of superficial or drift deposits on the Berkshire Downs. Clay with flints is the more common, and refers to heavy clay deposits and unworn flints in close contact with the chalk surface. The second of these, plateau deposits, however, represent a mix of material resulting from peri-glacial mixing and re-sorting of chalk and loess material over several cycles. Among these are Tertiary Reading beds, which though almost negligible in extent in the project area, are reddish sands and sandy clays existing as residual units or filling solution holes.

The thickness of the veneer of the Clay with flints deposits was the main criteria for identifying superficial deposits which are represented on geological maps. Clay with flints and plateau deposits are represented on Drift maps wherever they exceed a thickness of one metre (Jarvis 1973). On the Drift map of the Berkshire Downs, the Clay with flints extend intermittently across much of the project area (Geol. Survey 1971). According to the soils maps however, soils derived from Clay with flints only occupy hillcrests in the eastern half of the Berkshire Downs (Jarvis 1973). As thin and remnant deposits are of special relevance it was decided to represent the maximum extent of the Clay with flints - shown in Figure 7.

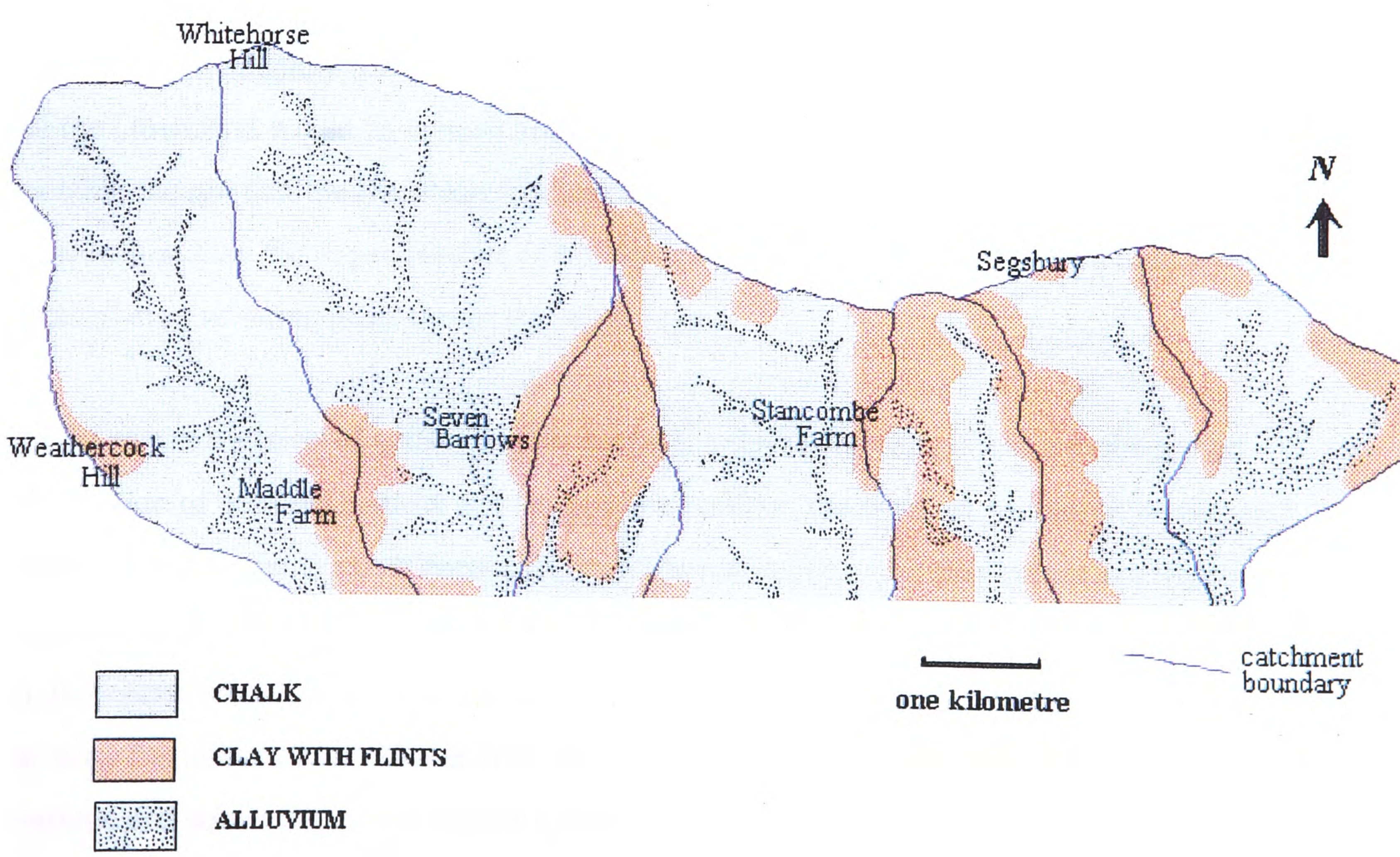


Figure 7 Main geological units on the Berkshire Downs

4.2.3 Hydrology

Surface hydrology and groundwater conditions not only influence settlement location but also the processes of soil movement and erosion by which archaeological material may be preserved or redistributed. The dry valleys of the Southern Downland are so called because of the absence of permanent streams. These conditions exist because of the high permeability and rapid drainage of the underlying chalk. Rainfall infiltrates into the soil and flows quickly through the bedrock, sometimes discharging in seasonal streams for a few months. Though dew ponds have been constructed to store water and some wells feature in lower areas (Ashbee 1963), more permanent water sources lie some distance from the Chalk uplands at springlines near the base of large escarpments for example.

The regime of a distant water supply would have had widespread implications for domestic and agricultural life on the upper Downland in prehistory. The siting of most of the Bronze and Iron Age hillforts in the upper reaches of these landscapes meant inevitable dependence on a distant water supply and the agricultural landscape of these regions would have been suitable predominantly for sheep and cropping. A model of how the watered and drier parts of the Downland would have been used in prehistory is shown in Cunliffe (1984, 476). It is notable though that the Danebury landscape to which this model refers is considerably lower in elevation than the upper reaches of the Berkshire Downs, a feature which would have exacerbated watering problems in the project area.

In the recent tradition of archaeological landscape studies there has been a focus on the interaction of both the cultural and the physical setting. The work of geomorphologists and archaeologists over the past decade has brought recognition that past human activity and its remains exist and are influenced by a landscape which is dynamic and changing. The change in the character and thickness of soils across the Downland, in response to 6,000 years of activity has already been discussed in Chapter 3. Far less attention however has been paid to surface and subsurface water regimes, their response to climate and land use, and the effect which these changes may have had on past environments, settlement shifts and archaeological preservation.

Some of the references to water-tables in prehistory include Wymer (1966) who suggests that the linear configuration of the Lambourn cemetery was a consequence of ritual burial following a retreating springline. Bradley (1978) also refers to Neolithic wells and water-table fluctuation and Kerney *et al.* (1964) who discuss springline change as an influence on formation of peri-glacial dry valley sediments at Brook in Kent.

4.2.4 Land use and water-table change

It has been suggested that water-tables in prehistory were much higher than those of today (Macdonald and Kenyon 1961). The present depth to water-table across most of the upland Berkshire Downs is 40-100m with large springs discharging at the base of the escarpment and smaller springs flowing in the lower landscape near Lambourn. It is interesting to speculate that a vertical extrapolation by 15m of the elevation of the current water-table at Lambourn (a not unreasonable rise given local chalk aquifer conditions), would place areas such as the Seven Barrows cemetery and Maddle Farm - sites of prehistoric and Roman activity - at the source of permanent water. This would have wide implications for the land use of these valleys, presenting the possibility that settlements and stock might have been watered in regions which at other periods of prehistory would have been dry. Large parts of the upper landscape would however, still have remained well above any permanent water sources. It is hard to imagine that the hillforts along the Ridgeway for example would not have drawn their water from the high yielding springs at the base of the scarp near Woolstone or Letcombe Regis rather than more distant sources on the dipslope to the south.

The clearing of the climax vegetation of the Berkshire Downs would have had the effect of raising water-tables (Allen 1992, 48; Holstener-Jorgenson 1967; Limbrey and Evans 1978, 23). The reduced transpiration of replacement grassland and the resultant net increased deep percolation would have allowed greater groundwater recharge with consequent advance of springlines. With subsequent periods of regeneration, as has been suggested on the Berkshire Downs during the Bronze Age (Bradley and Ellison 1975) springs would have retreated accordingly. The amount of advance or retreat is a function of local recharge and aquifer storage conditions, however, it is well known at Lambourn that a spring rises sporadically below Seven Barrows.

The process of water-table fluctuation as a consequence of changes in land use has had significant impact in drier environments in both Eastern European and New World settings, where wide-scale tree clearing has resulted in water-table rises, mobilisation of regolith salts and severe land and stream salinity problems (Szabo 1996; Williamson 1990). These observations once again provide evidence that during prehistory human activity and land use rather than climate may have been responsible for changes in both surface and subsurface hydrology. Groundwater change has received less attention however than landscape change in archaeological literature.

While it is not suggested that problems such as salinity occurred in prehistoric Britain, it is certain that settlement and land use conditions in lowland areas would have fluctuated according to water-table changes (Bell 1992, 27). A small shift in what is often a fine balance between climate, effective rainfall, soil moisture regimes, land cover and land management may be sufficient to bring about water-table change. To illustrate this - on the glacial plains of Montana in the North American wheat belt, water-table levels and soil salinity risk is managed biannually by rotating cereal crops, which cause water-table rises, with deep rooted lucerne which cause them to recede (Brown M. 1984). The fundamental implications to past landscapes and particularly soil deposition is that land use and vegetation cover influence hydrologic regimes and should be acknowledged in any reconstruction of past landscapes.

The evidence for this type of process on the Chalkland of Britain comes from limited work on pasture and crop transpiration rates and recharge measurements in the Pang catchment, south of the Berkshire Downs. Deep percolation was measured to be three times as high for grass cover than forest cover for example. Winter wheat was shown to allow 20% more deep percolation to water-tables than grassland (Finch *et al.* 1999). Water-tables therefore would have been at different heights during periods of clearance, pasture or cultivation. During the wetter climate of the Late Bronze Age (Section 3.3.2), lowland areas would have been subject to frequent spring fed inundation and dry valleys more subject to both increased accumulation, but also removal of colluvium. While perhaps less an influence in the upper parts of the Berkshire Downs, water-table changes may affect areas lower in the valley near Lambourn for example, a region noted for its absence of colluvium.

Soil type and thickness also play a role in regulating water-table fluctuations. It is possible to speculate that the thick loessic soils of prehistory would assist in lowering water-tables by providing greater rainfall storage capacity than the thinner soils of later prehistory. The simulation of soil cover, land cover (forest, crop or pasture cover) water-table levels and climate is possible by a number of water balance models which estimate deep percolation (Ragab *et al.* 1997). While beyond the scope of this project, such a modelling exercise would be possible for prehistoric Downland settings similar to that developed by (Favis-Mortlock *et al.* 1997) for soil loss over the same time period

4.2.5 Water-table change and colluvial preservation

Of direct relevance to valley erosion and preservation of valley sediments is the impact of hydrologic regimes and water-table change on colluvial preservation. During early prehistory when soils were thicker and the landscape largely forested, water-tables would have been lower than after periods of clearance and soil thinning in the Neolithic. The fluvial loss of valley deposits would have been common under these conditions. In the Late Bronze Age when agricultural activity spread rapidly across Southern Britain (Robinson 1984), rates of erosion would have produced colluvial material, but in the wetter conditions higher water-tables would have caused evacuation of valley sediments.

In the Iron Age, as climate moderated and some land became abandoned, water-tables would have declined and colluvium of earlier periods would remain preserved in upland valleys. The Roman intensification would have caused water-table rises, again with some loss of earlier deposits. In the predominantly pastoral post-Roman and Medieval periods water-tables would again have retreated, leaving many of the valley deposits in the upper catchments free from fluvial removal. This simplified sequence of prehistoric land use change and water-table fluctuation presented here and summarised in Table 4 illustrates changing conditions of colluvial preservation throughout prehistory. Once again local catchment factors will influence conditions and rates of preservation. In many cases the only evidence of such a chronology of deposition is likely to be the sporadically distributed valley sediments themselves.

It must be emphasised that the region in which springline advance and retreat is likley to have occurred would not reach into the high Downland on the Berkshire Downs where areas above about 160m asl would have remained dry throughout prehistory. In this part of the landscape colluvium would be spared removal by spring-lines, though not the effects of periodic "lavants" or catastrophic rainfall events (section 2.5).

Period	**Vegetation, hydrology and colluvial regimes.**
Neolithic	Forested, thick soils, low water-tables, lower valley settlement, low sediment loss.
Later Bronze Age	Wetter climate, agricultural development, high water-tables, higher valley settlement, higher sediment production and removal.
Iron Age	Warmer climate, agricultural decline, lower water-table, lower valley settlement, sediment preservation
Romano-British	Agricultural intensification, higher water-tables, production and removal of colluvium
Medieval	Pastoral landscape, lower water-tables, preservation of older colluvium.

Table 4. Hypothetical water-table change with different land use and climatic regimes from prehistoric to Medieval periods.

4.3 SOILS

While the current soils of the Berkshire Downs are shallow and stony, they have replaced a much earlier covering of loess rich soil (Catt 1978). The prominent elevation of this part of the Southern Downland increases the likelihood that substantial deposits of wind blown loess may have blanketed a large part of the landscape. There are however no primary loessic deposits in the project area and very few buried soils from which a reconstruction of the ancient soil cover might be made. A reconstruction of ancient soils land use can therefore only be inferred on the basis of the current pattern of soils.

4.3.1 Present soils

The source of the soil information on the Berkshire Downs is the Abingdon (one inch to the mile) Soil Survey of England and Wales map-sheet (1971) and accompanying text (Jarvis 1973). The soils derived from the Chalk, referred to as Icknield soils, are shallow and calcareous and occur on hillcrests and upper slopes. Classed as thin calcareous rendzinas, they are commonly less than 40cm thick, grey or black in colour and slightly to extremely stony (flinty/and or chalky). The most common land use on the Icknield soils is arable with continuous cereal cropping, though shallow soil cover, stoniness and some of the steeper slopes present limitations to cropping (Jarvis 1973). The open grassy ridge tops are used for racehorse training gallops.

The soils over Clay with flint deposits, the Berkhamstead and Winchester series, are common on the elevated hillcrests on the eastern half of the study area. These are non-calcareous acid brown earth soils with flinty fine silt or fine loamy upper horizons over chalk at less than two metres. They have low erodibility though acidity and stoniness render them less attractive cropping soils than the calcareous Icknield soils. In many cases the clay soils have been avoided by cultivation and are under mixed forest or scrub.

It was mentioned in the geological description of the project area (section 4.2.2) that none of these soils appear in the western part of the project area which appears anomalous as Clay with flints exist as hill-cappings in this region on the Geological Survey Drift map.

The soils of the dry valleys are calcareous and flinty to depths of 40cm and have developed on Coombe series deposits of chalky drift. The Charity series are soils developed on decalcified drift commonly occupying the gentler east-facing slopes (Fig 8). These drift units have been attributed to peri-glacial solifluction deposits but their classification as undifferentiated deposits does not rule out their origin from more recent processes - including human activity. It is also possible that these drift units represent remnant or re-deposited loessic soils. Charity soils are silty loams over silty clays, up to 90cm deep and are generally less erodible than the Icknield soils on the slopes.

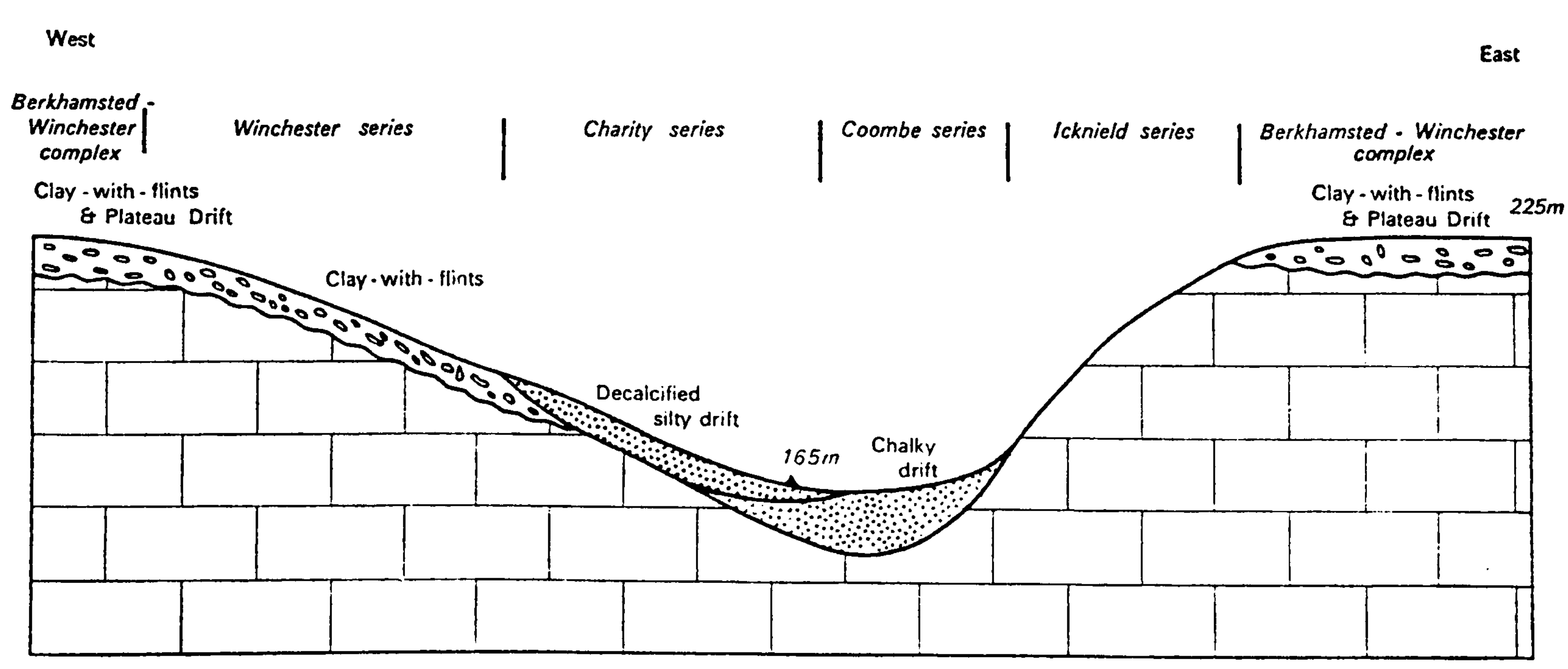


Figure 8 Valley cross-section of soils on the Berkshire Downs (Jarvis 1973)

4.3.2 Colluvium on the Berkshire Downs – previous interest

Colluvium of Holocene age has not been mapped in the study area. Jarvis (1973, 9,24) however gives passing reference to the existence of anthropogenic soils in the region. The distribution of soils on undifferentiated drift units (Charity series) on Soil Survey maps in relation to ancient fields is a coincidence which is investigated later in this thesis.

Post-glacial dry valley deposits containing artefacts have been identified in early studies at Cothill Fen to the east of the project area (Clapham and Clapham 1939) and localised hillwash of prehistoric origin has been recorded at Rams Hill (Bradley and Ellison 1975) and at Waylands Smithy (Atkinson 1965) as well as in the Maddle Farm survey (Tingle 1991, 14). The occurrence of extant lynchets, most notably near Stancombe Farm also imply localised soil movement on the Berkshire Downs during antiquity (Bowden *et al.* 1991).

These few sources of buried and re-deposited soils point towards the likelihood that archaeo-colluvium exists on the Berkshire Downs. The Lambourn Valley and Bronze Age cemetery, a common focus of archaeological interest is however often cited for its lack of hillwash (Harding 1972, 62; Bradley and Allison 1975; Gaffney and Tingle 1989). Richards (1986, 9), investigating barrows in the Lambourn Valley also comments on the depth of valley soils (<30cm) and the absence of colluvium. Bradley observed that in some parts of the Lambourn Valley, the thickness of soil in the valley is even less than on the ridges (Bradley and Ellison 1975, 181).

4.3.3 Past soils on the Berkshire Downs

There have been few investigations of palaeosols and little environmental or pedological sampling from beneath barrows or tree holes on which a reconstruction of the past soils of the Berkshire Downs might be based. Richards (1986) conducted excavations of four round barrows across the Berkshire Downs and found buried soils at two of the sites ; Lambourn and Hodcott Down. The old soil beneath both of these barrows was a silty loam, brown earth which might be presumed to be the original woodland soil, though no date or loessic origin was postulated (Macphail 1986). Artefacts and environmental evidence from these sites supported Neolithic use of these early soils. The fact that only small traces of these soils exist here implies considerable soil thinning even from earliest periods of land use.

The primary soil changes on the Southern Downland of Britain reflect a change from thick loess rich calcareous brown-earth forest soils to the present grey stony rendzinas. As a loessic fraction in the present soils of the Berkshire Downs implies earlier loessic cover, it will be assumed that a similar sequence of soil change occurred in this northern corner of the Downland. Catt's (1978) map shows loessic soils to be well represented on the prominent Berkshire uplands. The extent and thickness of these soils available to the early farmers here may however have been much less than the 1-4 metres postulated by Catt because of peri-glacial removal or soil losses associated with forest clearance (section 3.2.2). Based on the record of evidence which exists for occupation and land use on the Berkshire Downs, the present soils are a product of at least 6,000 years of human activity.

From limited information from soils and sediments on the Berkshire Downs it will be assumed that the original loessic soils were thick and productive enough to sustain early farming of the region, which evidence suggests was of Neolithic date (Richards 1986). With the gradual thinning of these soils, Clay with flints were exposed, most commonly in the east of the Berkshire Downs. Of heavier texture, the soils developed on these hill-cappings appear to have been largely avoided by later prehistoric farmers (Moffat 1988; Fowler 1983; Bradley and Richards 1978). In the present landscape these soils are often marked by woodland copses or forest cover.

With the removal of the loess, a broad division would have emerged between productive (Chalk) and poor (Clay with flint) soils, especially before the development of tools and technology to deal with the heavier soils. Richards (1986) suggests that the wider Berkshire Downs in the Late Bronze Age reflects this dual character based on the distribution of field monuments, social interaction and soil type. He identifies an arable western "Lambourn" zone on the chalk soils and a more pastoral "Beedon" zone on the clay soils of the east (discussed further in Section 4.7).

Speculation about land use linked to the earliest phases of loessic soil has been discussed in Chapter 3. The current landscape, however, bears sparse but beguiling traces of ancient land use on which a more consolidated picture of land use history might be based. The prospect for both the earlier (and presumably lost) and later prehistoric landscapes is that, in the light of the erosion and dissolution suffered by the soils and chalk surface during six millenia of human activity, colluvium may in many regions be the only record of prehistoric activity, preserved in valley floors with either primary or secondary archaeological material.

4.4 PREHISTORIC LAND USE ON THE BERKSHIRE DOWNS

The history of soil loss on the Southern Downland is tied closely to the history of human activity (Bell 1986). Any attempt to estimate past erosion patterns will therefore be closely tied to the nature and intensity of episodes of past land use. Elements of past land use such as fields and linear ditches, settlement, and environmental information allow a reconstruction of the agricultural regime from which the distribution and impact of ancient land use might be interpolated. For example, the sensitivity to erosion of prehistoric Chalk landscapes would have been higher for cultivated than for pastoral use and an arable landscape could reasonably be expected to leave behind evidence of soil loss and colluviation. A summary of the landscape archaeology of the Berkshire Downs will help to shed some light on phases of land use intensity and periods when colluviation may have occurred.

4.4.1 Archaeological studies on the Berkshire Downs

Early interest in the antiquity of the Berkshire Downs focused on excavation of barrows (Greenwell 1890; Grinsell 1936). More recent investigation of barrow sites included excavation of the Neolithic burial mound at Waylands Smithy (Atkinson 1965) and the Seven Barrows cemetery (Case 1956; Wymer 1966; Rahtz 1960, 1962). There are four hillforts along the Ridgeway within the project area, in order of size, Segsbury Camp, Uffington Castle, Hardwell Camp and Rams Hill. Rams Hill was excavated by Piggott and Piggott (1940) and Bradley and Ellison (1975) while Uffington and Segsbury have recently been excavated by Lock and Gosden (1997a and b).

There have been four major landscape studies wholly or in part focused on the Berkshire Downs. The Rams Hill report (Bradley and Ellison 1975) represents the most comprehensive source of archaeological and environmental detail for the north-west part of the Downs. The associated landscape survey added 50% more enclosures to the earlier surveys, new field boundaries, barrows and earthworks and an additional 13km of linear ditches. Richards (1978) added new survey information and reinterpreted the existing multi-period archaeology of the wider Berkshire Downs at a broad scale and for the purpose of identifying risks to archaeological preservation. Among the recommendations for protection and research of archaeological sites was that questions about the age and use of ancient fields be addressed.

The remaining two studies, the Maddle Farm survey (Gaffney and Tingle 1989) and the Vale of the White Horse survey (Tingle 1991) employed both surface collection (systematic collection of artefacts) over areas of $18km^2$ and $34km^2$ respectively with targeted excavation. Ideas about the settlement and economy of the early prehistoric and Roman landscape were proposed from these surveys though both have little to say about the later prehistoric period. This is largely because of the small recovery of prehistoric sherds from surface collection (376 and 78 sherds respectively) compared with enormous quantities of flints and Roman wares. Field walking surveys on the Chalk Downland are notable for their poor recovery of prehistoric pottery. The East Hampshire Survey, for example, recovered 89 sherds (Shennan 1985), while the East Berkshire Survey recovered just six pieces (Ford 1985). Attempts to compare surface with subsurface sherd concentration were made during the Maddle Farm survey in a attempt to validate the field survey results. The results however were neither conclusive nor did they account for lateral processes of redistribution.

4.4.2 Summary of the archaeology of the Berkshire Downs

A long tradition of archaeological interest in the study region has made possible a summary of the multi-period archaeology of the region as follows. There is widespread evidence of Mesolithic activity around the Kennett River to the south-west though this period in notably un-represented in the project area (Gaffney and Tingle 1989). The earliest environmental evidence for settlement and tree clearance for the Berkshire Downs comes from the Neolithic long barrows at Lambourn and Waylands Smithy as well as ring ditch burials at Post Down Farm in the far west of the project area (Richards 1986).

Robinson (1984) provides a useful summary of the clearance history of the Berkshire Downs. Mollusc sequences from the long barrow at Waylands Smithy suggest Neolithic clearance while similar evidence from the hillfort at Rams Hill suggests early clearance with reversion to woodland several times in the Bronze Age. Final clearance here appears to date to about 900-800BC (Evans, J.G. 1975). Tree cover was maintained on the ridgeline during the Bronze Age, with seasonal grazing possible in the open valleys. The prospect that the Berkshire Downs were not wooded however, is suggested by Rhodes (1950) on the grounds that the chalk bedrock would have been "geologically insufficient ever to have supported woodland".

The spread of activity on the Berkshire Downs in the Early Bronze Age is manifest in a large number of round barrows. Of 169 recorded barrows, the largest concentration (32) constitute the Seven Barrows cemetery. More convincing evidence of occupation and land use can be seen in the swathes of ancient fields which occupy about 20km^2 and have been dated at their earliest to the first millenium BC (Richards 1978, 38). The blocks of ancient fields on the Berkshire Downs are one of the largest concentrations in Southern Britain. The relative distribution of fields here throughout the Bronze Age to Romano-British period is variably argued, although both Later Bronze Age and Roman fields appear to occupy large tracts suggesting widespread agricultural expansion during both these periods (Bradley and Ellison 1975; Richards 1978; Bowden *et al.* 1991b).

The function of the Ridgeway hillforts appears to be ambiguous. Hardwell Camp has not been excavated. Uffington Castle is of Late Iron Age date and has a curious lack of domestic structures, a feature which has lead to the suggestion that it had a prominent ceremonial function (Gosden and Lock 1998). Rams Hill was occupied from the Early-Middle Bronze Age to the Iron Age and was characterised both by a paucity of grain and by the mix of local and imported artefacts suggesting some form of transitional and specialised function. Segsbury was occupied between the Bronze and Early Iron Age and appears to have been prominent as a domestic centre. Numerous round houses and refuse pits were identified by geophysical survey and recent excavation (Lock and Gosden 1997b).

The uncertainty about the function of the hillforts does not greatly assist with the reconstruction of the prehistoric landscape of the Berkshire Downs. Uffington Castle has been linked with the prehistoric monuments in its vicinity (Gosden and Lock 1997a) but Rams Hill is the only hillfort/enclosure which has been tenuously linked to the wider local landscape (Bradley and Ellison 1975). The variety of finds at this site and its position at the crest of the ridgeline, suggest that this hillfort was in command of both the "ritual" landscape of the Lambourn barrow cemetery and the Vale of the White Horse in turn.
The more recent re-dating of Rams Hill from the Early to the Late Bronze Age (Needham and Ambers 1994) however argues against a contemporary link between the cemetery and the hillfort.

Evidence of lower order settlements has been drawn from limited excavation and a Sites and Monuments Record (SMR) which reveals a sparse distribution of cropmarks and enclosures which are suggestive, on morphological grounds and in the absence of surface pottery, of prehistoric activity. The Maddle Farm survey found two pottery scatters which might imply Late Bronze Age settlement sites, one at Weathercock Hill at the far west of the project area (Bowden *et al.* 1991b) and a second just west of the Bronze Age cemetery at Seven Barrows (Gaffney and Tingle 1989). Another Late Bronze Age site was discovered at Tower Hill by the Oxford Archaeological Unit (in prep). Large ditch boundaries imply the division of a largely pastoral landscape in the Late Bronze Age which local mollusc sequences indicate continued into the Iron Age (Bradley and Ellison 1975, 196; Gaffney and Tingle 1989, 93). The existence of funerary monuments, linear earthworks and field boundaries demonstrate considerable activity throughout the Bronze and Iron Age which is not complemented by settlement features and surface pottery.

Earthworks and ditched enclosures excavated at Botley Copse, Odstone Down, Uffington Down and Knighton Bushes (Piggott and Piggott 1940; Rhodes 1950; Bradley and Ellison 1975) represent settlements which predate and continue into the Romano-British period. Renewed arable expansion in the Romano-British flourished between about 50 and 250 AD, a development supported by dating of the some of the field lynchets (Bowden *et al.* 1991b), before decline in the 5th century AD. The Maddle Farm survey included detailed intensive and extensive survey and describes a landscape on the Berkshire Downs of a sparsely spread heirachy of villa estates and lower order Roman settlements (Gaffney and Tingle 1989).

Linear ditches, excavation evidence in the form of agricultural storage, processing artefacts and environmental evidence provide information from which we might identify regimes of prehistoric land use and erosion on the Berkshire Downs. The most prominent and widespread evidence for ancient land use in the project area however are the ancient fields.

4.5 FIELD SYSTEMS

The traces of ancient fields can be seen across Britain, ambiguously referred to as "Celtic" fields. The boundaries of these fields can be seen as obvious lynchets (field banks) or as crop-marks or soil marks barely visible on the ground but clearly evident on aerial photographs. The extent of these fossilised fields was first recognised across Southern Britain on aerial photographs by Crawford (1928). The blocks of fields on the Berkshire Downs are some of the largest on the Chalkland and were first mapped by Rhodes (1950). The extent of these fields has been subsequently added to and reinterpreted by Bradley and Ellison (1975), Richards (1978) and Bowden *et al.* (1991b).

The subtle expression of these features under particular soil, seasonal or light conditions means that their visibility may vary from year to year. While aerial photographs are taken by English Heritage every few years, the dry summers of the late 1970's and mid 1990's produced the best visibility and many new features have emerged and been plotted on the Chalkland in the last twenty years. A programme was commenced in 1997 by the Royal Commission for Historic Monuments (RCHME) as part of the National Mapping Program to plot the most recent aerial survey of the Berkshire Downs, but at the time of writing was not complete.

Richards suggests that his mapping of the fields was thorough, and asserts that it is unlikely that many new boundaries will be discovered (Richards 1978, 37). A certain expertise is necessary to identify and record these relict boundaries, though some differences in interpretation are evident in some of the elements of the field systems between the maps of Richards (1978) and Bowden *et al.* (1991b) for example. Nevertheless, for the purposes of a regional study, the overall pattern of field layout on the different maps is broadly consistent.

4.5.1 Dating the Fields

The varied configuration of ancient fields across Britain has been used to develop broad typologies for dating field systems. The arrangement of field blocks has also been used to develop concepts of social organisation. The main feature of many of the large swathes of fields is that they display a consistent pattern of basic layout with little accommodation to topography (Bowen 1975; Bowen and Fowler 1978). The planned, single-phase appearance (co-axial fields), suggest organisation of labour and a certain level of social cohesion (Fleming 1986). The precise age and continuity of these fields in many parts of Britain are in dispute, though the prehistoric origin of many large blocks means that they can be used to ascribe regimes of ancient land use and its impact across a region. Large blocks of coaxial field systems have been given firm Bronze Age dates at Dartmoor and Peterborough for example (Bradley and Ellison 1975, 196). Assertions of Bronze Age dates for these field systems also comes from Bowen (1975), Fasham (1980), Drewett (1982) and Fowler (1983).

The 20km^2 of ancient fields occupying the north-western part of the Berkshire Downs in two main blocks to the west of the Uffington and Segsbury hillforts respectively contain large elements of co-axial layout (Fig 9). Within the swathes of fields are both cohesive systems, composed of elements which imply organised layout, and aggregate systems in smaller blocks which imply more piecemeal construction (Richards 1978, 39). In general, the small square fields are ascribed, on morphological grounds, to the prehistoric period and linear fields to the Roman period (Bowen 1975).

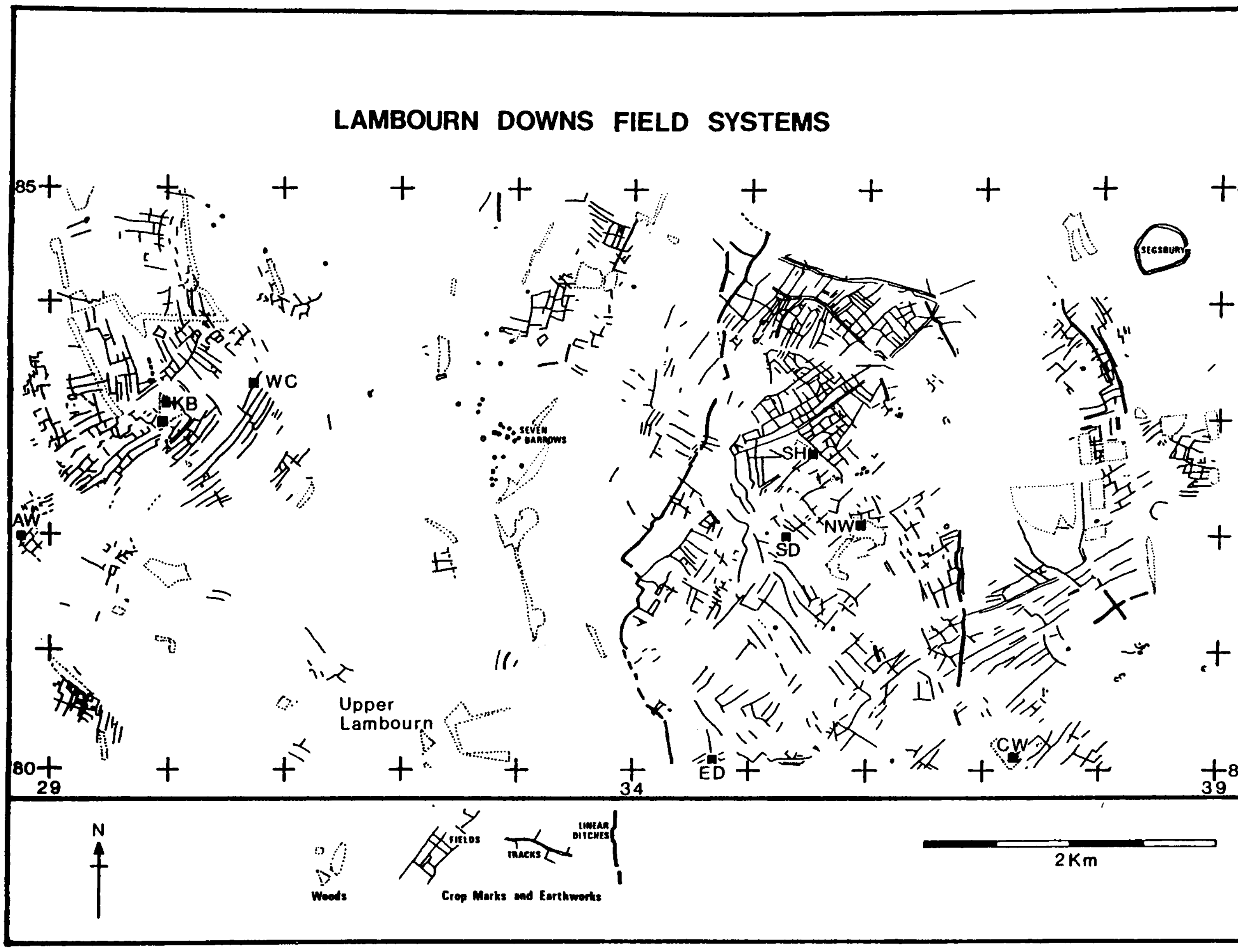


Figure 9. Ancient fields on the Berkshire Downs (Bowden *et al.* 1991b).

It is generally acknowledged that elements of both prehistoric and Roman fields exist, though the proportion of each, their origin and length of use had been the subject of debate over the past 20 years. The present pattern of fields on the Berkshire Downs has been variably put at Early Bronze Age (Rhodes 1950, Bradley and Ellison 1975 and Richards 1978) or Roman (Bowden *et al.* 1991b). Richards (1978) cites the relationship of field boundaries to round barrows as evidence of their prehistoric age. Bowden *et al.* (1991b), however, noted a number of inconsistencies in the relationship between fields and prehistoric features which belied the development of any clear chronology. He conducted a programme of lynchet excavation in which stratigraphies were developed using entrained artefacts. The conclusion of his survey, on the basis of the paucity of prehistoric pottery and general field shape was for a predominantly Roman date (1^{st} - mid 3^{rd} C) of arable expansion on the Berkshire Downs.

Without extensive investigation of the field relationships, questions of continuity and modification during the Roman period will remain difficult to interpret. The poor preservation of prehistoric pottery or lack of manuring, the process by which pottery enters the wider landscape, may also explain the absence of pre-Roman material. It must be emphasised though, that in a number of lynchet cross-sections, much of the pottery in the lower stratigraphy (which may have been prehistoric in date) was poorly preserved and was classed as undatable (Bowden *et al.* 1991b, 128). A more fundamental query from Bowden's conclusions are why the Berkshire Downs were left largely undeveloped until Roman times while, according to evidence from the wider Downland, the rest of Southern Britain had been under intensive cultivation for some 1000 years. A review of the dating of fields on the Berkshire Downs is discussed further in Chapter 10.

Support for Roman intensification has come from Bradley *et al.* (1994, 126) who suggests arable expansion during this period is becoming a more recurring pattern across southern England. On Salisbury Plain the majority of ancient fields in their final form date from the Romano-British period and while traces of earlier fields will undoubtedly be discovered, these, according to Bradley, are likely to represent a minor part of the observable pattern. While linear ditches from both the Berkshire Downs and the Salisbury Plain respect some earlier boundaries, the majority of fields, he asserts, reflect a much later stage of landscape development.

The question of age and use of ancient fields across Southern Britain requires more accurate dating from closer investigation of the individual elements and synthesis of archaeological , environmental, and land use evidence. The dating of fields on the Berkshire Downs (Bowden *et al.* 1991b) represents an attempt at understanding the age of these fields and raises a number of queries and inconsistencies.

In the light of an inadequate and sometimes contradictory interpretation of the prehistoric landscape of Southern Britain, which demonstrates regional differences in the age and length of arable land use (Chapter 3), considerable caution should be exercised in the adoption of general land use models or the extrapolation of these models from one sub-region region to another. The work of Bowden *et al.* (1991b) represents the most rigorous investigation and dating of ancient fields on the Southern Downland but the results are indicative rather than conclusive. In the absence of settlement evidence, especially from the Early Bronze Age, the pattern of ancient fields is perhaps the most enduring record of multi-period occupation and land use on the Berkshire Downs. Their complex morphology raises questions of their age, length of use and the functions which they defined ; the answers to which would seem in part to be derived from the transported soil which they retain as lynchets or the sediments which they shed and remain preserved as colluvium in the valleys below. The benefit of a project of this nature is that colluvium represents a potentially more widely distributed product of ancient erosion. A focus on dry valley sediments would therefore complement any lynchet-based field dating studies.

4.5.2 Ancient arable on the Berkshire Downs

Fields and linear ditches on the Berkshire Downs indicate, for different periods throughout prehistory, an occupied and organised agricultural landscape. The extent to which this landscape was organised for arable use comes from a limited range of archaeological and environmental evidence. Strong circumstantial evidence comes from a sparse distribution of extant field lynchets and widespread distribution in surface soil and valley sediments of pottery fragments, presumed to have been introduced by manuring (Mercer 1981) - both the consequence of cropping practices.

The earliest cultivation is implied from mollusc sequences which indicate that the lower slopes of the Berkshire Downs appear to have been open and cultivated at least in some part during the Neolithic (Bradley and Ellison 1975; 208, Atkinson 1965). Richards (1986) suggests that grain from barrow excavations in the western part of the Berkshire Downs can be dated to the early Neolithic. There is also evidence for cropping at this time in the form of quernstones and grain impressions from Waylands Smithy (Atkinson 1965; Whittle 1988). The earliest evidence of arable on the Berkshire Downs comes from around the Lambourn region, where the chalk soils are most widespread. The curious absence of fields, if indeed fields were enclosed in this part of the Berkshire Downs in the Neolithic, may have much to do with the great antiquity of agriculture there, of which all evidence has been removed. Field traces persist in even the thinnest chalk soils (Moffat 1988) so that even the earliest boundaries, if there, would presumably still persist. Field boundaries may not have been widespread in early arable landscapes. In both the Stonehenge landscape (Richards 1990) and the Dorchester bypass study (Allen 1997a, 280), there is ample evidence for arable activity during the Neolithic with a clear absence of field boundaries. Richards (1978) suggests that the Lambourn region was never farmed, an assertion which, in the light of the thin soils of this catchment, is refuted and more fully discussed in Chapter 10.

Elements of the ancient field systems on the Berkshire Downs might be assigned to the Late Bronze Age according to their morphology, which implies that cropping was widespread and formalised during this period. Material evidence for cropping is sparse and limited to evidence from the Bronze Age enclosure at Rams Hill although no grain or quernstones were recovered during excavation (Bradley and Ellison 1975, 218).

Roman cropping carried out within the elongated fields at Maddle Farm is supported most prominently by the high density of Roman sherds recovered during extensive field survey and attributed to widespread manuring of arable fields. The evidence for a predominantly Roman date for large blocks of the fields (Bowden *et al.* 1991b), and that they were used for arable, is also supported by grain and quernstones recovered by excavation at Maddle Farm, and more circumstantially, the obvious demand for grain of the Roman army and a vastly increased Downland population during this period (Gaffney and Tingle 1989).

The regional limitations and poor precision which characterises the land use history of the Chalkland both across the region and through 6,000 years of arable history are acknowledged. For the purposes of this project, the evidence that the Berkshire Downs was cultivated in one form or another for over three millennia up to and including Romano-British times provides support for a number of phases of land use and consequently potential periods of colluviation. This gives some encouragement that ancient deposits might be found and investigated on the Berkshire Downs.

The impact on soils of past agricultural practices were introduced in Chapter 3. Differences in the size of fields and the nature of management throughout prehistory and later Roman times were shown to have different effects on the extent of soil loss. Rough tillage methods, lighter soils, wetter climate and winter sowing are factors likely to have encouraged erosion during this period. The earliest ard ploughs used before the Iron Age would have had comparatively little erosive effect according to Moffat (1988), with more substantial losses associated with the heavier ploughs, and coulters used from Iron Age to Roman times.

The assumption that the ancient fields on the Berkshire Downs characterised an arable landscape, that agricultural practices produced soil losses, and at a regional scale these fields delimit areas of greater erosion than surrounding pastoral or forested areas, will form the basis of a number of assumptions about prehistoric soil loss in the development of a colluvial predictive model in the next chapter.

4.6 LINEAR DITCHES

A second class of ancient boundary on the Berkshire Downs are linear ditches, the traces of which occupy up to 48km in segments of various lengths, broadly trending north-south and coincident with major ridge lines. The longest of these is East Ditch in the centre of the project area, which is some five kilometres long. Linear ditches are common across the prehistoric landscape of southern Britain and have been discussed in detail by Bowen (1978), Bowen and Fowler (1978), Fowler (1983) and Crawford (1953). As was the case with field systems, linear ditches raise questions about function and chronology.

On the Berkshire Downs, ceramic evidence suggests a Late Bronze Age date (Richards 1978), although the ditches appear to post-date many of the barrows. According to the Rams Hill study (Bradley and Ellison 1975), the linear ditches post-date the ancient fields. This invokes ideas of land use shifts from arable to pasture in the Late Bronze Age. It is a popular notion that these linear features in Southern Britain were ranch boundaries defining large grazing estates (Bowen 1978; Bowen and Fowler 1978). Richards (1986) cites the frequency of linear ditches on the heavier soils to the east of the project area as support in this region for a predominantly pastoral zone.

Bowden *et al.* (1991b) however records that most fields respect the linear features implying their contiguity with the age of the fields and their role in arable land use. The fact that ditches across the Berkshire Downs variably cut and are cut by fields, or appear contemporaneous with them, presents sufficient apparent chronological inconsistency to prevent generalisations about linear ditches and their broad pastoral role.

The relationship of the linear ditches to the hillforts at Rams Hill, Uffington and Segsbury also presents ambiguities. Some terminate at a hillfort, while others have no apparent link. The East Ditch and East Garston Ditch just to the west of Segsbury hillfort define one of the "busiest" swathes of field systems on the Berkshire Downs and a region surrounded by poorer soils. A further possible role therefore is that they define arable districts or catchments of productive soils.

Ford (1982) examined some sections of the linear ditches on the Berkshire Downs and while acknowledging that his dating evidence was of uneven quality and reliability, identified a number of functions. Some of the linear ditches certainly appear to separate arable from pasture (above). Evidence that these ditches post-date fields and therefore function as later pastoral boundaries, he suggests, is neither common nor convincing (Ford 1982, 16). Some of the linear ditches even vary in this relationship along the course of a single earthwork. Ford recognised the relationship of these features with local ridgelines and suggested a three tiered territorial division with successively smaller land units, territories or communities. A decisive notion of the function and age of these features on the Berkshire Downs, however, remains elusive.

Multi-period use and re-use of these boundaries produces a complex pattern of ditch and field relationships which remain difficult to unravel and date. A closer focus on these features appears to preclude simple explanations and some of the generalisations of past studies. Localised and systematic examination of the archaeology and relationship of these features incorporating both ceramic and sediment dating methods would seem the most appropriate method of discerning their age and function from district to district.

4.7 RECENT ARABLE HISTORY

The evidence of ancient cultivation provides the basis for assumptions of ancient soil loss and colluvial deposition, however it is realistic to expect the masking or "contamination" of these sediments by material deposited during more recent phases of cultivation. While it is convenient to think that the soils of the Downs have preserved ancient landscapes unchanged for 1500 years, there have nevertheless been episodes of ploughing since prehistoric and Romano-British times (Evans R. 1990, 1992). Evidence for Medieval ploughing exists in ridge and furrow in Uffington Castle and occasional lynchets on the Chalk scarp. Larger scale episodes of arable are also suggested in the 18th century (Gaffney and Tingle 1989).

Nevertheless the simple model of arable use on the Berkshire Downs is that, while evidence exists for cropping since Romano-British times, it was in general not widespread or sustained, certainly when compared with earlier Roman and prehistoric phases. Colluvium has therefore been preserved on the Downland, until recently, by a non-destructive pastoral regime.

The most fundamental changes by way of a reversion to arable on the Downs since Roman times appear to have occurred in the past 50 years. Rhodes (1950) provides a map of the extent of arable land use on the Berkshire Downs just after World War 2. The present pattern of arable represents a 40% expansion since the immediate post-war period and reports of erosion events over the past 20 years demonstrate the implications of such wide-scale change (Boardman *et al.* 1996). Bell and Allen found medieval and modern sequences in dry valley profiles although these generally overlay deeper sequences of Roman and prehistoric sediments supporting the notion that long phases of deposition from these periods remain preserved below much shallower more recently deposited material.

The archaeological evidence on the Berkshire Downs suggests up to 3,000 years of arable activity during prehistory and Roman times, and while this was not continuous, it exceeds by an order of magnitude the duration of any period of arable since. The clear implication is that the erosion and accumulation of valley soils associated with arable activities during this period would have been widespread and profound. On the Berkshire Downs, where there is extensive evidence of pastoral activity since the Roman period, prehistoric cropping and its eroded products, however truncated and redistributed by subsequent erosion, would be expected to constitute the greater proportion of local colluvial sequences.

4.7.1 The Berkshire Downs in a regional context

The ancient fields which occupy the north-western corner of the Berkshire Downs are the only main field blocks on the wider Berkshire Downs ($450 km^2$). These fields occupy about five per cent of this larger region and lie within a landscape predominantly of Clay with flint deposits. It is apparent that these fields are concentrated on the only substantial patch of chalk soils in the entire region, its value as an island of productive soils in a sea of clay soils arguably defined by linear ditches.

Richards (1986) suggests that an agricultural distinction based on soils, field boundaries and concentration of funerary monuments, may have created two zones : the "Lambourn Zone" to the west and the "Beedon Zone" to the east (Fig 10). The Lambourn zone which occupies most of the project area reflect more arable farming while the heavier soils of the east, the Beedon Zone were more favoured for pastoral use.

The implications of such a concentration of arable activity on soil erosion within this high Downland setting is expanded in Chapter 10 together with a more detailed comparison of landscape and colluvium in other arable districts on the Chalkland. It has however already been suggested that at the northern periphery of the Downland, the Berkshire Downs was a marginal setting (Taylor 1970; Mills 1985a; Harding 1974) – in part supported by evidence from the Bronze Age enclosure at Rams Hill which implies a transitional function.

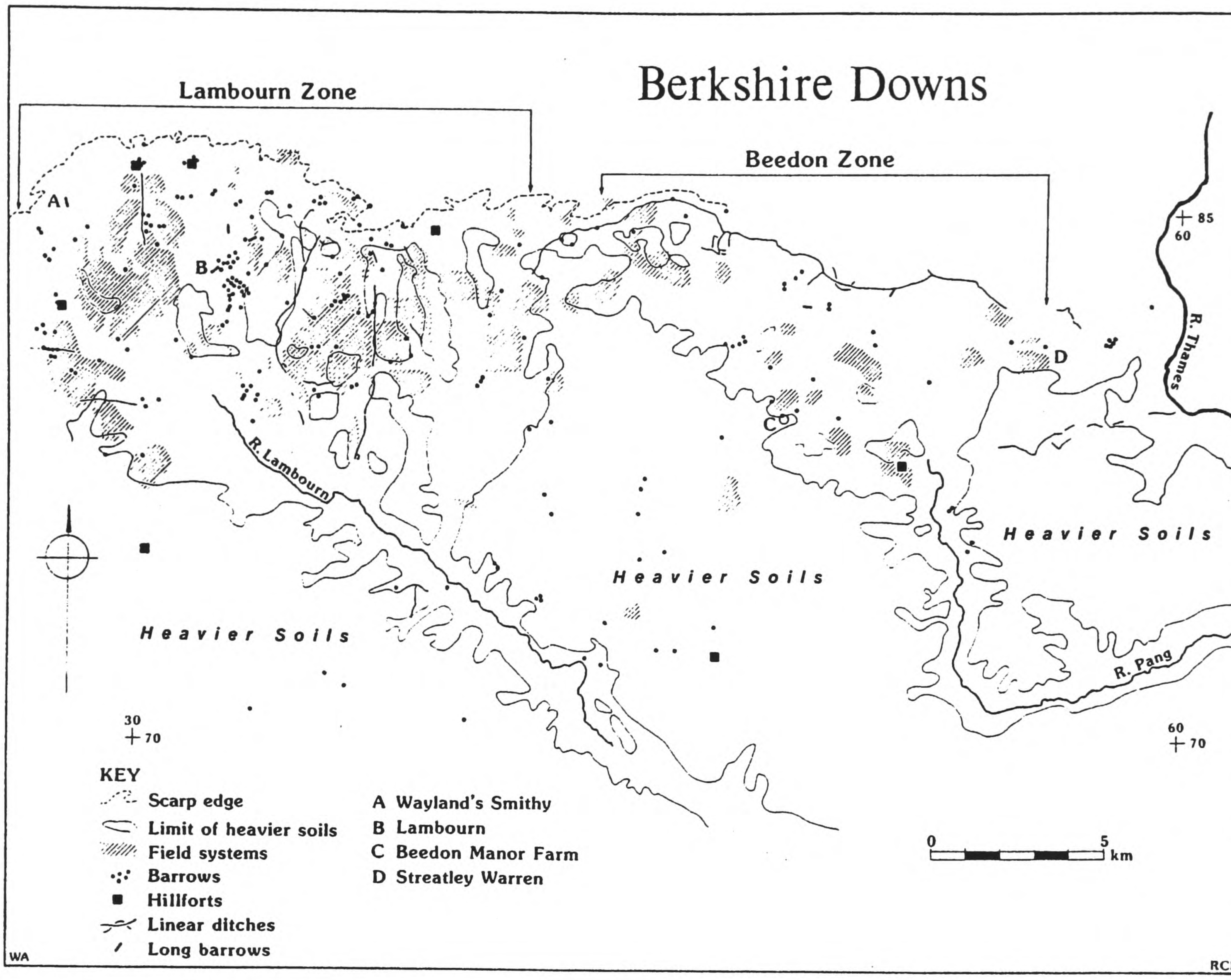


Figure 10 Prehistoric land use on the Berkshire Downs (Richards 1986)

4.8 EROSION AND ARCHAEOLOGICAL INTERPRETATION ON THE BERKSHIRE DOWNS

As a final caution, the pattern of archaeology on the Berkshire Downs and the Chalkland in general are characterised by poor survival of archaeological remains, particularly settlement features. 'Absence of evidence is not evidence of absence' is perhaps the best known of archaeological maxims. The paucity of Mesolithic, Neolithic and early Bronze Age evidence from the Berkshire Downs (Richards 1978) may be as much a function of its removal by erosion as its original distribution.

The evidence for selective removal of evidence is demonstrated by the multi-period maps of archaeology on the Berkshire Downs which imply that from the Mesolithic to the Iron Age activity was progressively shifting up-slope (Fig 11) (Richards 1978). On the eroded landscape of the Berkshire Downs a strong case exists that this sequence is a result of progressive removal of earliest evidence from the eroding upper landscape, resulting in the appearance of a shift in activity further up-slope over time.

It is a feature on the Chalk that bedrock dissolution and landscape lowering would act to destroy the traces of settlement, such as ditches, pits and post holes etched onto the chalk surface. Atkinson (1957) measured rates of chalk dissolution based on differential bedrock levels around long barrows of 75cm in 3,000 years. As thinning of soil cover continued throughout prehistory, chalk would become gradually more exposed to these processes.

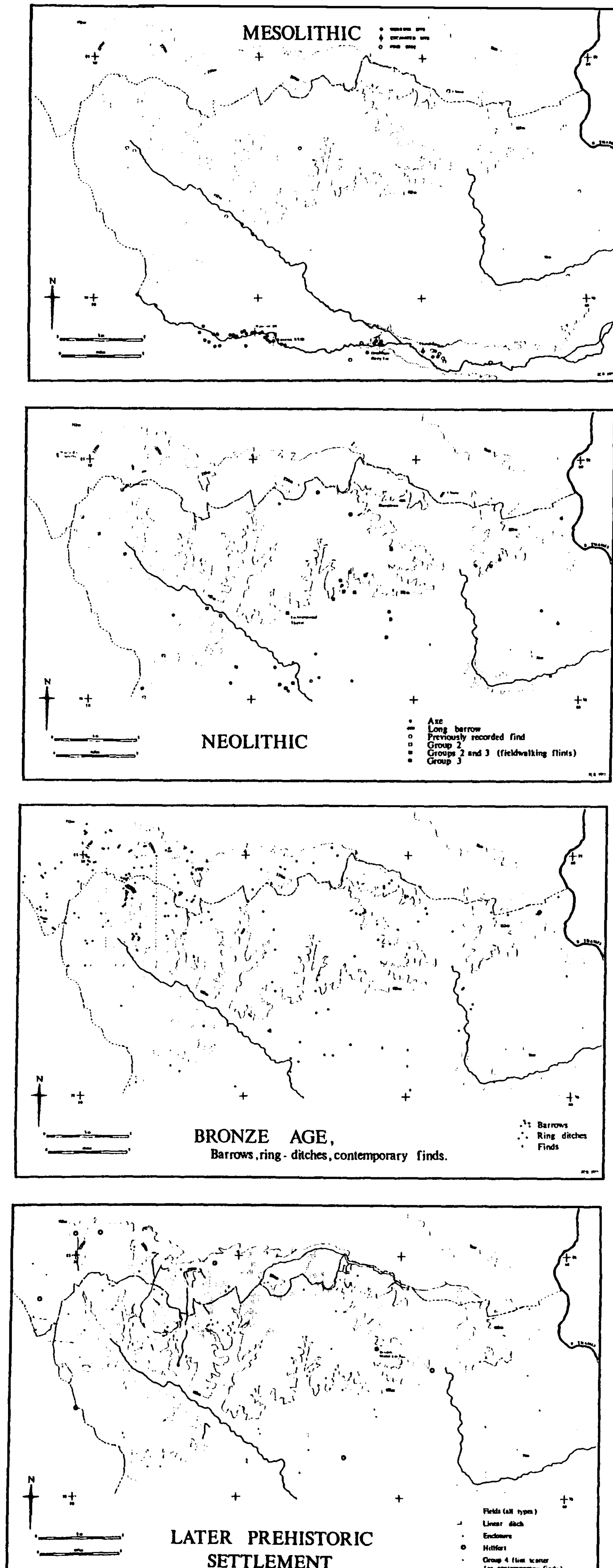


Figure 11 A pattern of multi-period archaeological survival on the Berkshire Downs

4.9 SUMMARY

It has been suggested that there has been an inadequate investigation of archaeological landscapes across Southern Britain (Haselgrove *et al.* 1985) which has been redressed in some part over the past ten years. There have been two main responses to the gaps in knowledge presented by the Chalkland. Some field workers have interpreted these gaps, such as widespread absence of Early Bronze Age settlement sites, as a true reflection of the settlement record suggesting that the Downland may have been peripheral to economic activity (Mills 1985a, 42; Taylor 1970). Others suggest that much of the settlement evidence has been destroyed by mechanical weathering or chemical decay. What should seem an obvious extension of the second response, namely that the evidence is lost, is that vital clues may not in fact be lost but shifted off-site to the lower landscape or buried there *in situ*. The prospect that this "lost" material might be found in colluvial deposits and that these might be predicted would appear to hold great potential for answering some of the enduring archaeological questions on the Downland.

CHAPTER FIVE

A GIS BASED PREDICTIVE METHOD

5.1 RESEARCH APPROACH AND TERMS OF REFERENCE

Attempts to locate deposits of archaeo-colluvium have not been related to land use factors or formation processes. In past studies, colluvium was sought close to known archaeological sites or according to local topographic indicators. Published soil maps are limited in determining the spatial distribution of these deposits as they lack firm dating criteria (Section 2.3.1). For the purposes of this project, a more systematic approach for locating these deposits is to develop and test a predictive method, which is based on past land use indicators and some simple soil and topographic parameters.

While it has been suggested that prediction is too difficult according to the complexity of causal factors, there has been no investigation of the spatial control on colluvial distribution by the traces of past cultivation. A rich record of ancient land use exists on the Berkshire Downs, from which observations and assumptions might be used to model the distribution and impact of human activity and the products of erosion. The combination of archaeology and geomorphology in this way is novel. If successful, the results will be extended to draw some general conclusions about the distribution of colluvium and what it implies about the land use prehistory of landscape change on the Berkshire Downs.

The research strategy of this project will be to focus on broad rather than local patterns. The work on colluvium across Southern Britain to date has been site-specific with typical detail and rigorous analysis of soil environmental and archaeological stratigraphy (Section 2.1.2). These studies featured detailed chronological and compositional sequences which were used to develop ideas about the character, age and local formation processes of these deposits.

A balance in this project will be sought between a necessary level of local detail to affirm the antiquity of colluvial sites, and a reasonable distribution and variety of sites across the Berkshire Downs from which some broad archaeological patterns might be determined - certainly at a scale which might be replicable across the wider Downland. Choice of smaller catchments and a programme of detailed and rigorous terrain analysis and archaeological survey would provide detailed local information but fail to address wider spatial aspects. A broad programme of soil sampling would answer questions about the regional distribution of these valley sediments but would lack critical detail about the age and processes which influence their formation.

It is important to distinguish archaeo-colluvium from deposits which are more recent, therefore both the composition and age of these soils will be verified by a programme of field checking. In addition to testing the model, field investigation will reveal the actual pattern and thickness of colluvium from which a chronology of land use across the project area might be developed. An equally important product of the field-work are observations about the distribution of these deposits, processes of formation and preservation.

The questions posed by the project might be summarised :

a) **Can a predictive approach be used to locate archaeo-colluvium ?**

b) **What does the distribution of archaeo-colluvium imply about conditions of preservation ?**

c) **If successful, what does the age and distribution of archaeo-colluvium imply about he prehistoric land use of the region ?**

The size of the study area is large (58 km^2), and the soils and geological information for the region are of similar large scale. This limits the resolution of the physical information, though the information provides a guide to the main soil groups and general erosion regimes across the project area. The criteria for field checking will be of a correspondingly broad scale with soil and chronological sequences constructed to meet the broad objectives outlined above. Essentially the success of the model will depend on testing the thickness and antiquity of the deposits determined according to broad compositional differences and entrained artefacts. Where colluvium is absent an assessment will be made of possible localised causes.

Given the scale and complexity of colluvial formation, the model is expected to be indicative rather than specific. Deposits of prominent and datable colluvium will be targeted according to the premise that thicker and more widespread deposits might be found in valleys where there is widespread evidence of ancient fields. The prospect of linking archaeo-colluvium to nearby slopes on which traces of ancient arable exist thereby assumes a close link between the distribution of fields and the antiquity and subsequent preservation of these sediments.

The research approach is therefore wholly predictive. The success or otherwise of the method will be judged by the effectiveness of the prediction not by the detailed construction of colluvial chronologies. The methods by which the model will be developed and tested involves geomorphological, soil and archaeological survey, therefore not simply a method of spatial mapping but of strategic location of prominent prehistoric valley deposits on which further archaeological investigation might be focused.

The archaeological potential of colluvium is expected to be three-fold. Material shed from ancient manured fields in the form of datable artefacts allows some estimates to be made about the chronology and extent of use of ancient field systems. Archaeo-colluvium also offers a repository of secondary settlement material from nearby sites of activity. A final prospect is that primary sites may be found buried by colluvium. Such a synthesis of land use and archaeological information in a predictive model would therefore offer the possibility for optimal recovery of archaeological evidence from strategically defined sites within the landscape.

5.2 APPROACHES TO MODELLING ANCIENT EROSION

A number of erosion models have been used in archaeology for studies of ancient erosion, for the most part based on models developed for processes of contemporary land degradation. Erosion models fall into one of two groups : quantitative or qualitative models. Quantitative models employ a formula incorporating key parameters. The best known of these is the Universal Soil Loss Equation (USLE) (Wischmeier and Smith 1978). Qualitative models though, are not necessarily less reliable and in some cases have been preferred for reasons of data availability and resolution. The USLE has been less favoured in recent years because of accusations that the established parameters only apply to certain parts of the USA (Verhagen 1995).

A second distinction is between lumped models and distributed models, the latter of which accounts for the spatial component of erosion. The third distinction is between static and dynamic models. Static models aim at providing soil loss predictions as a one-way process while dynamic models integrate change and feedback loops.

Podbonikar *et al.* (1998) adopt a qualitative approach which uses Geographic Information Systems (GIS) with terrain, soil, vegetation and climatic regimes to derive erosion and depositional zones on the island of Brac, Dalmatia. Rather than quantify erosion, this model identifies composite zones of erodibility which delineate regions of greater or lesser archaeological visibility or threat from destruction. While a useful exercise for GIS, a criticism of this study is that an equally valid division of the island might have been made using a simple interpretation based on existing soil and geological maps.

An example of an attempt to apply a model developed for contemporary erosion and to adapt it for modelling of past landscapes has been made by Verhagen (1995). He uses a dynamic modelling approach with GIS, in combination with USLE, to estimate the impact of human activity over the past 6,000 years for an area in the Middle Aguas Valley in Southern Spain. He reconstructs past environments using palaeo-botanical data, while slope data was assumed to be relatively constant and easily determined using a GIS derived topographic surface. Water flow was estimated using various cumulative overland flow models derived for GIS terrain models. The results of this work - a map of sediment transport capacity and erosion potential - however, represents a preliminary attempt which is limited by gaps in environmental data and terrain model sediment transport factors. It was a notable weakness of this model, developed as it was for past soil loss, that it relied on both modern and very broad scale soils information. The full potential of such a model is dependant on the availability of data, particularly information on past soils and susceptibility. The use of present soil maps in landscapes where the evidence for landscape change and past soils is irrefutable, is useful for showing zones of archaeological visibility, but limited in showing ancient sediment movement. A fundamental weakness of most erosion models with respect to predicting past erosion is the paucity of information about past soils and vegetation regimes.

Wainwright (1994) demonstrates an example of a quantitative and distributed model, which uses vegetation cover and climatic data to estimate conditions of erosion and deposition, ostensibly to explain intensified erosion during the Early Bronze Age (2,000-1,600 BC) in Southern France. Using a simulation of vegetation cycles, erosion sensitivity and climatic events, it was his conclusion that the erosion rate in the study area was stable except during periods of extreme rainfall. Wainwright integrated hydrologic and sediment transport components and simulated the interaction of these with vegetation growth. The model quantifies erosion and deposition in upper and lower catchment locations for 1 and 50 year periods. At the other end of the scale are small and highly empirical erosion models. Wainwright and Thornes (1991) for example, use stochastic overland flow modelling to approximate the down-slope sorting of archaeological site remains using small-scale laboratory simulation experiments.

Favis-Mortlock *et al.* (1997) developed a time-series model for the thinning of a loessic soil cover on the South Downs of Britain by incorporating climate and land use regimes over a 7,000 year period (Fig. 12). Using the EPIC model (Putman 1988), soil erosion was simulated for past land use and climatic regimes. This model produced estimates of modern soil thickness which proved a reasonable comparison with present thin soils on the Downs.

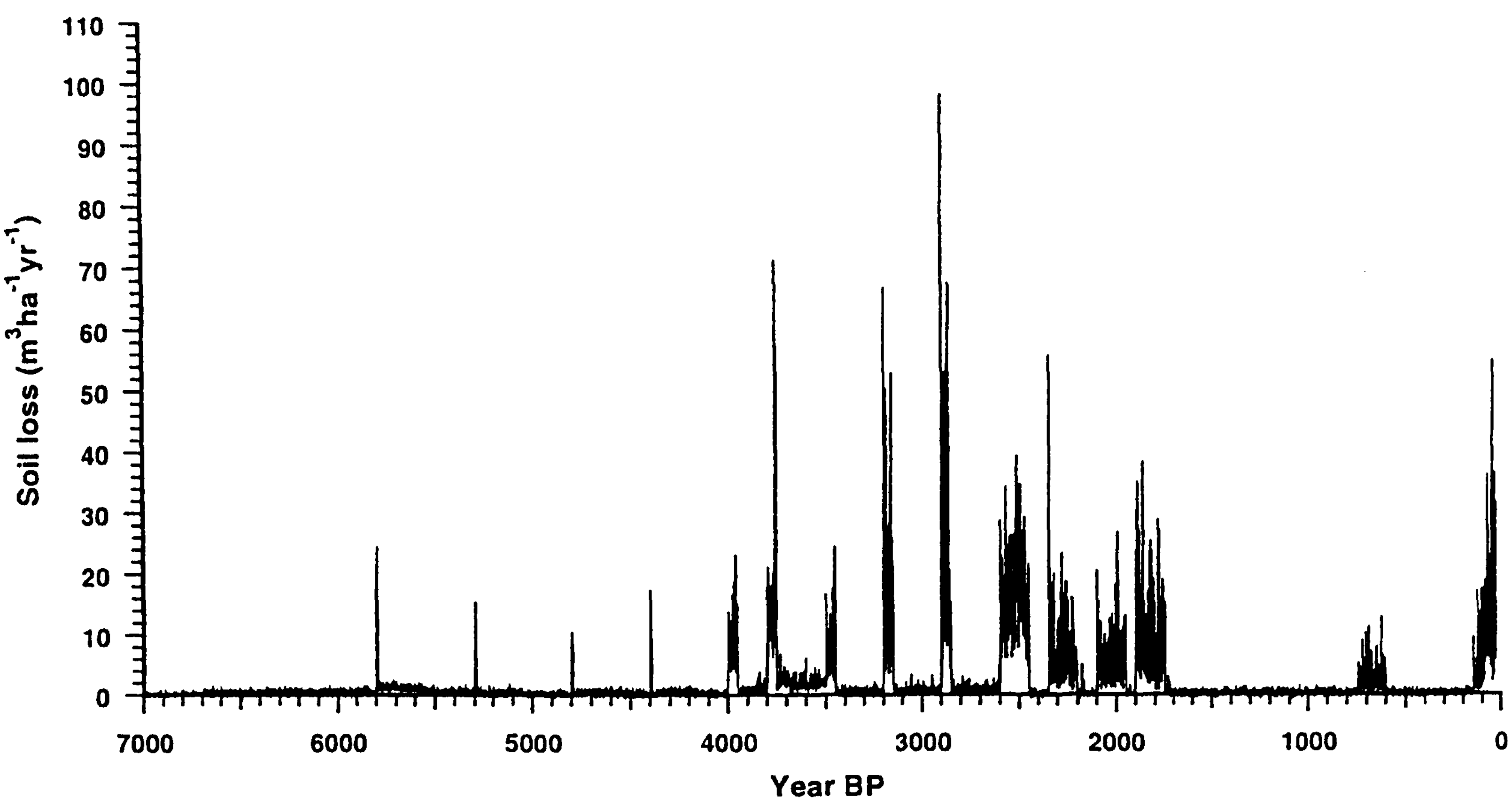


Figure 12 Simulation of Downland erosion (Favis-Mortlock et al. 1997)

Many of the parameters and assumptions used in this simulation represent useful approximations of the type of land use, and archaeological assumptions which might be incorporated into the model developed by this project.

The models briefly described above represent some of the more prominent attempts at modelling sediment movement and processes of past erosion at various scales, incorporating in some instances relatively sophisticated adaptation of GIS. These approaches however seem unsuited for the specific aims and scale of this project.

Firstly, any prediction of past erosion and dry valley colluvium on the Berkshire Downs must be relevant at both a sub-regional and regional scale. This limits the application of models which deal at the laboratory, hillslope or field scale. Secondly, as the aim of the model is to predict the relative distribution of colluvium rather than precise measurements of soil loss (kg/ha for example), it is unnecessary to employ quantitative models which seek high degrees of accuracy. Such models require large amounts of input data and time-consuming assembly of field measurements. A broad-scale approach also precludes the need for highly detailed maps of erosion or depositional sites, and for this reason there is no hydrologic component, sediment transport model or climatic input. Rather than using GIS terrain analysis functions to delineate high resolution sediment sink and source sites at the type of scale used by Mitasova (1996), or at coarser resolution by Podbonikar *et al.* (1998), the Berkshire Downs model will use valley receptor sites and erosion zones at sub-regional/catchment scale, based on relatively broad topographic and land use parameters. Thirdly, while many erosion models go to great lengths to develop and verify the input parameters, very few provide any follow-up field checking against which the accuracy of the models might be evaluated. The field checking necessary to prove a model of the scale at the Middle Aguas Valley (Verhagen 1995) would understandably be very labour intensive. It is this characteristic lack of field verification, however, which consigns most models of past erosion to the theoretical.

A further distinction which can be made with erosion models in archaeology, is that they do not specifically target eroded soils for off-site remains or relict land use information, though they might be adapted for such a purpose. They are commonly used to assist with the interpretation of field survey results and to elucidate areas of variable archaeological survival (Podbonikar *et al.* 1998). This is perhaps because the archaeological landscapes hitherto modelled, most of which exist in southern Europe, do not possess the "proxy" ancient land use information by way of field boundaries, broad arable zones and datable artefacts spread by manuring so well preserved by the relative stability (geological and land use) of large regions in southern Britain for example.

It has been a criticism of erosion models of past landscapes that their data needs are immense without in some cases any increase in accuracy, and also that many attempts at modelling past erosion do not fulfil all criteria with respect to quality of data inputs and scale. Rather than rely on any of the established erosion models it was considered the best use of time and resources, in pursuit of the broad aims of this project, that a simple predictive model might be both developed and evaluated through a programme of field checking.

The Berkshire Downs does not have comprehensive information about past soils although it does possess a critical source of past land use in the form of ancient fields - a resource for this type of exercise which are widespread on the Southern Chalkland. The project also has little scope for detailed research of the processes of deposition. While the complexity of colluvial formation is acknowledged, this project is a first attempt at linking past land use and the present landscape with the aim of predicting the distribution of these deposits.

5.3 USING GIS FOR LANDSCAPE AND MAP ANALYSIS

5.3.1 Introduction

The task of predicting the location of archaeo-colluvium will involve an examination of available topographic, soils, archaeological and past land use information, drawn from both the Berkshire Downs and from relevant studies of the wider Downland. The combination of multiple physical and archaeological information, the reconciling of differences in scale and resolution and the need to generate numerous maps is a time consuming component of the modelling process. A fundamental requirement of the project is the assembly, analysis and preparation of this information and the combination and testing of a range of landscape and land use scenarios.

The initial task of generating maps drawn from different sources of data at different scales and resolution could in principal be achieved by manual drafting or photographic methods. Because the project is of regional scale, requiring map production and potentially complex manipulation and interpretation of landscape information, it was decided to use a computer based drafting package together with a Geographic Information Systems (GIS) program as the primary mapping and data manipulation tools for the project.

Geographic Information Systems refers to computer driven programs which order, store, analyse and display spatial information. Developed in the early 1970's and greatly aided by the rapid advances in computer sophistication and capacity, GIS is used across a range of disciplines which require rapid and accurate processing of landscape information. The technology of managing and analysing spatial data is a multi-million dollar industry with widespread use by utility companies such as Gas, Telecommunication or Defence agencies. Some of the most graphic examples of the use of this type of spatial data processing were demonstrated in 1993 during the Gulf War.

Computers have been used in spatial data processing and map drawing of which packages such as CAD (computer aided drawing) and CAM (computer aided mapping) reflect great advances in storage capacity and processing speed over the past 15 years. Geographic Information Systems however are seen as a significant advance on many of these data handling and mapping programmes, not only by virtue of their capacity to store and manipulate data but also to generate new data (Savage 1990). GIS are therefore distinguished from other computer systems which simply draw maps, by their capacity to be analytical, to transform and manipulate spatial information and generate new information. The real advantage of GIS is its' ability to store not only locational and attribute information but the topological relationships between them. Spatial links between coverages can be stored and used to generate new coverages.

GIS offers four primary functions :

1) Entry systems which handle translation of raw data.

2) Data storage and retrieval - capture and organisation of spatial data.
Computer drafting, manipulation of scales and map printing.
Overlay of multiple information layers.

3) Data manipulation, transformation and analysis.
Rapid computation, measurement of areas (map algebra).
Generation of new data from existing information.

4) Data display. Rapid visualisation of multiple data arrangements.

The use of GIS in archaeological work has been slower to develop than in other disciplines. Despite the regional and multidisciplinary foci of many archaeological projects over the past 20 years, for which GIS would seem well suited, its widespread adoption in Britain appears to have been suppressed by problems of data availability, cost and poor agency co-ordination (Harris and Lock 1990). A series of published conferences entitled Computers Applications in Archaeology provide a history of the development of GIS in archaeology from 1986, when the first paper on GIS was published, until 1996 (CAA proceedings 1986-96). Some of the more recent conference proceedings provide a range of case studies and discuss theoretical issues.

In general, application of GIS in archaeology is divided into two areas : Cultural resource management (CRM) and landscape analysis. CRM uses the management capacity of GIS to integrate large and diverse data sets which geo-reference spatial data and incorporate textual databases. While not always the case in CRM, analysis plays a secondary role. Landscape applications in GIS are favoured more for mapping than analytical functions, though the early work of (Gaffney and Stancic 1991) and the seminal paper by Van Leusen (1992) showcase a range of analytical techniques in landscape studies (Allen, K.M.S. *et al.* 1990; Aldenderfer and Maschner 1996; Lock and Stancic 1995).

The region surrounding the Danebury hillfort in Hampshire was the subject of a GIS based landscape project which analysed the relationship of physical resources, such as soil and water supply to settlement patterns (Lock and Harris 1996). Some of the more sophisticated functions of GIS used in this paper, such as "viewshed", which examines the intervisiblity of funerary sites have been used in archaeology to reconstruct ritual landscapes (Ruggles 1992; Llobera 1996). The Wroxeter Hinterland project (Gaffney and van Leusen 1995), the Upper Tisza project in Hungary (Gillings 1995, 67-84), and the GIS study of landscape evolution in the Yorkshire Dales (Martlew 1995, 293-296) are further examples which for the most part present interim evaluations of GIS and its limitations in landscape projects.

The use of GIS in archaeological projects in which ancient and modern landscapes have been integrated are less common. The best known of these has already been cited, that of the landscape project on the island of Hvar, Greece (Gaffney and Stancic 1991). Topographic and soils information are used to determine soil productivity, settlement, catchments, and transit times in order to develop concepts of security, instability and change. Some of the other examples were discussed in the previous section on erosion modelling (Verhagen 1995; Wainwright 1994). The capacity of GIS to provide time-slice images and to integrate landscape and archaeological data opens a wide field for the understanding of past landscapes.

The task presented by this project of locating ancient deposits, in an exercise which blends soil studies, geomorphology and archaeology, would appear ideally suited for some of the functions offered by GIS.

5.3.2 GIS and Environmental Determinism.

A criticism levelled at the way GIS is used within archaeology is that it favours a wholly environmentally deterministic approach. GIS uses spatially referenced data for the most part featuring environmental factors such as soils, terrain and vegetation. These have been used in what has been regarded as a non-flexible emphasis on past settlement and activity, based on economic principles. It is now accepted that past human behaviour and distribution of activity incorporates ritual belief systems and social motivation, perception and constraints, which transcend simple economic models and the interpretation of (for the most part) Western modernist observations (Tilley 1994). A simple example from Papua New Guinea shows that village status dictated which crops could be grown - an illustration that economic activities could be constrained by ritual and tradition (Head L. *et al.* 1994).

There is a very good reason why GIS has trouble representing this aspect of landscape archaeology and that is because the ritual and the perceptive cannot be easily quantified or spatially referenced. According to Lock (1995, 16) if something cannot be referenced then it cannot be included in computer based analysis. Gaffney *et al.* (1995) suggests therefore that environmental data should be augmented with parallel consideration of cultural and belief systems. Indeed in this article, Gaffney *et al.* sought to right their deterministic shortcomings by a reconsideration of his GIS based landscape study of the Island of Hvar. His initial study sought answers to settlement from soil type and land productivity. By incorporating the distribution of ritual cairns into his analysis, he drew a connection between the dead and agricultural activity from which he was able to discern patterns of activity beyond the economic.

Burial mounds have proved irresistible to archaeologists using GIS, shrinking from the accusations of excessive determinism. The Danebury landscape supplies a useful scatter of barrows from which Lock and Harris (1996) were able to note a curious lack of intervisibility leading to conclusions of "enclosed landscapes". Indeed with so many barrows and funerary monuments across Southern Britain it is curious how these prominent "ritual landscapes" could have been missed, in favour of more deterministic factors in even the earliest GIS-archaeology projects. The GIS "viewshed" function has managed to satisfy many critics of archaeological determinism through its complex analysis of funerary and linear ditch-bound landscapes. Intervisibility however does not constitute explanation, and the consideration that meaning is culturally embedded within a landscape argues for GIS technology to be theory rather than data-driven (Tilley 1994). Llobera (1996) has taken this further in an attempt to formalise various indices of landscape topography and perception which account for social experience of landscapes and the so-called humanisation of space.

With the swing more to social and ritual demands in the interpretation of archaeological landscapes there is always the risk of a backlash against social determinism. Gosden tempers the argument by suggesting that peoples' links with the world are not divided into social or economic but from webs of interconnection between people and things - no one is more basic than the other (Gosden 1994, 34).

The problem GIS will always struggle with, is that subjective factors such as perception, sense of awe, respect or fear can never be represented. This is fundamentally because it is impossible for any researcher to know how space was perceived in the past. The fact that different deterministics and dynamics should not privilege the visible over the invisible or the understood over the unknown is a principle which is fundamental to any branch of archaeology and particularly to landscape archaeology.

It is assumed in this project that prehistoric farming favoured productive soils, and that these were exploited according to economic demands. The scale of the project is sufficiently broad to account for seasonal avoidance or occasional ritual fallow such as might have occurred according to the ethno-graphic given above. Avoidance of broad regions for other than economic reasons is relevant to the Berkshire Downs. The Seven Barrows catchment in the centre of the project area appears to have been avoided because of ritual association with the large Bronze Age cemetery in the valley floor (Bradley and Ellison 1975). This is discussed in the light of a wider examination of landscape and land use in Chapter 10. Such a perspective might deflect criticism that this project takes a wholly deterministic approach.

5.4 DATA ENTRY : DIGITISING MAP INFORMATION

The first step of the modelling exercise was to compile and standardise all relevant physical and archaeological information such as geology, soils, topography and distribution of field systems from primary map sources. For the most part this information was then digitised using Autocad - a PC based computer aided drafting package. Autocad accepts spatial information in the form of vectors (points and lines) rather than raster format (grid cells). Catchment boundaries, soil units or blocks of ancient fields constitute either lines or polygons for example. Lines can be smoothed according to nearest-point algorithms, map scales can be changed and sub-sections highlighted. From many often raw and disparate sources of data, the process of computerisation creates a digital landscape which can be readily modified and manipulated.

- Topographic information was initially digitised from 1:50,000 scale Ordnance Survey maps, (Abingdon mapsheet 254, 1986) which presented contour information at 10m intervals and base cadastral information. During the final months of this project digital information became available for the project area at 1:10,000 scale, with 5m contour intervals from the Ordnance Survey Department through DIGIMAP, a digital data service run by Edinburgh University.

- Information about superficial deposits was transferred from the Geological Survey 1:50,000 scale mapsheet, (Geological Survey of England and Wales, Abingdon Drift map,1971).

- Soils information was hand digitised from the 1:63,360 scale Abingdon mapsheet (Soil Survey of England and Wales, Jarvis 1973). Three simple soils divisions were chosen for the project, (1) the Icknield soils which represent the thin soils of the chalk crests and hillslopes, (2) soils derived from Clay with flints covering hillcrests and (3) soils of lower slope drift material known as Charity series soils. These were chosen as the major Downland soils relevant to erosion and colluvial accumulation on the Berkshire Downs. Descriptions of these units are provided in Chapter 4. Valley soils were not included because they are relatively small in extent and are not widely occupied by ancient fields. Because valley floors are the potential receptor sites of the archaeo-colluvium, the predictive process effectively represents a re-interpretation of the soils in this part of the landscape.

- Archaeological information in the form of field systems, linear ditches, hillfort and settlement sites was digitised from the multi-period survey of the Berkshire Downs (Richards 1978) and more recent local surveys (Richards 1986; Bowden *et al.* 1991; Gaffney and Tingle 1989). The focus of this project on the archaeology of the Neolithic to the Roman period recognises that it is during these four millenia that earliest land use and human impact is thought to have reached a zenith in Southern Britain. It is this period which is most prominently represented by the blocks of ancient fields, from which the spatial patterns of erosion in antiquity might be interpreted.

Richards suggests that the resolution of his mapping, based on the high archaeological visibility of the 1969 air photo series and combined with localised field checking was sufficient to identify all the major blocks of fields. More recent air photo interpretation has not added significantly to Richards survey of 18 years ago (Ford 1988). It is notable that some authors have chosen maps based on different air photo coverages of the Berkshire Downs (Richards 1978, Bowden *et al.* 1991b), as considerable inconsistencies appear within some of the blocks of fields. For the purposes of the predictive process and the regional aims of the project, the identification of the main swathes of fields is sufficient to provide a catchment-wide pattern of the distribution of ancient agriculture.

Topography	Geology	Soils	Archaeology and Ancient Fields	Settlement
Ordnance Survey 1:50,000 scale. Contour interval 15m. & OS 1:10,000 Scale(digital) Contour interval 5m	Geol. Survey Drift Map, Abingdon Sheet 1:63,360 scale	Soil Survey of England and Wales, Abingdon Sheet 1:63,360 scale	Richards (1978) from 1969 English Heritage air photo series.	Richards (1978); Gaffney and Tingle (1989); Bowden *et al.* (1991b).

Table 5 Data sources for colluvial prediction on the Berkshire Downs

Autocad data are commonly stored as data layers or themes. Catchment boundaries, water courses and soil types are three separate themes used in this project for example. These can then be geo-referenced and exported to sophisticated graphics packages for manipulation and analysis. Autocad however is fundamentally a drafting tool. In order to undertake the tasks of overlay, selection and manipulation of landscape and archaeological information for the purpose of predictive modelling it is necessary to transfer the base information stored in Autocad to a GIS for landscape analysis.

5.5 COMBINING AND ANALYSING THE LANDSCAPE DATA : IDRISI

IDRISI is a Geographic Information System which offers a range of functions (modules) for landscape analysis (Eastman 1983) and because it is relatively simple to operate, cheap and portable was chosen for this project over other programs such as GRASS and ARCINFO. Digitising landscape information using Autocad and preparing it for the raster based IDRISI program was the most time consuming stage of the process. While Autocad stores information in vector form, IDRISI programs require data in raster format in which spatial information is stored and analysed as grid cells. The landscape is therefore reduced to a digital environment composed of component cells. A simple program for converting autocad files to IDRISI is provided by D.Wheatley (p. comm.). Once the database was assembled and transferred to IDRISI, the multiple modules enable rapid combination, analysis and visualisation of all layers of spatial information.

All map information converted to IDRISI, (boundaries, lines, units, features) are represented by cell values (identifiers). For example, streams, roads, catchment boundaries and contours are registered as features of single cell width with a unique identifying number, while soil units for example are registered as blocks of cells with a common identifier. The benefit of a digital array of map information is that it facilitates the rapid analysis, manipulation and display of spatial data. Using subtraction, addition and multiplication functions, called map algebra (Van Leusen 1992) spatial information may be overlain, selectively highlighted, cut and pasted and if necessary, quantified in both graphical and tabular form. One of the most important functions of IDRISI is presentation and analysis of topographic information. Fundamental to this process is the development of a Digital Elevation Model (DEM).

5.6 RECREATING THE TOPOGRAPHY : THE DIGITAL ELEVATION MODEL

Analysis of topographic information is central in any investigation of erosion and landscape processes. Once converted to raster format, the 1:10,000 scale contour information was used to generate a Digital Elevation Model (DEM), a process by which an elevation value is ascribed to each cell and interpolated to produce a topographic surface. The DEM represents the topographic configuration of the project area from which IDRISI can derive slope and aspect information. This surface is the product of interpolation of the contour data, the accuracy of which is a function of a number of possible algorithms.

The algorithm which IDRISI uses in the "Intercon" module is a modification of CONSURF developed by David Douglas at the University of Ottawa, Canada. It acts on topographic data by constructing profiles around the four edges of the map to produce an enclosed space. A set of horizontal profiles are created using these edge profiles and any contours which cross each row in turn. At cells of unknown height the interpolated profile height is recorded together with the profile slope at that point. Profiles are then created moving vertically along the columns and diagonally, left to right, across the image. Final heights recorded for each cell represent the value of the profile with the maximum slope. Testing of this procedure proved that any error exceeding half a contour interval was less than one per cent. Some hillcrest points and shallow areas on occasions oscillated widely although these irregularities are infrequent and can be easily detected in the image (Eastman 1993, 87-88).

A deficiency in the IDRISI algorithm however is that it cannot accommodate spot heights and additions to contour data may be necessary on open hillcrests and ridge lines for example. While certain such small anomalies on the Berkshire Downs DEM do exist they are relatively minor and not have any influence on the interpretation of the slopes and lower areas which are more the focus of this project. The greater the distance between contours, the greater the need for extrapolation and potential inaccuracy. A raw DEM often contains numerous anomalies, artefacts and inaccuracies which are the product of interpolation error or inability to interpolate flat areas for example. For this reason DEMs require processing by way of smoothing functions. This will be carried out using topographic filter programmes within IDRISI.

While it is recognised that landscape shape may vary with different interpolation algorithms (Kvamme 1990) the smoothed DEM developed for the Berkshire Downs did not appear compromised by using the algorithm used by the IDRISI programme. From this interpolation of contour data the "SURFACE" module in IDRISI is able to generate both slope and aspect maps from the DEM (Fig. 14). The DEM shown in Figure 13 shows small anomalies by way of flat areas on some hillcrests and valley floors even after several smoothing procedures. However these errors are negligible for the purposes and scale of this project.

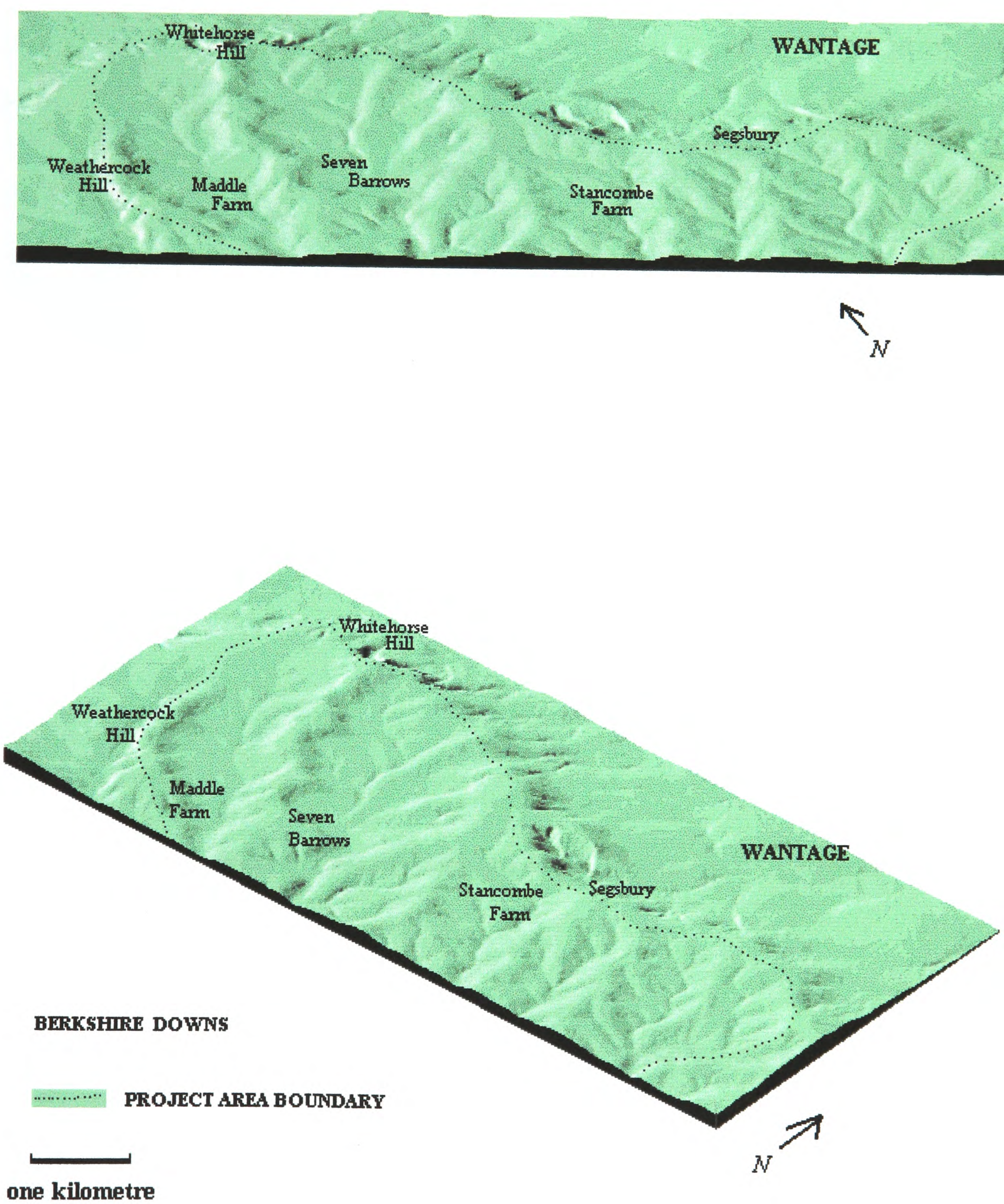


Figure 13 Berkshire Downs DEM

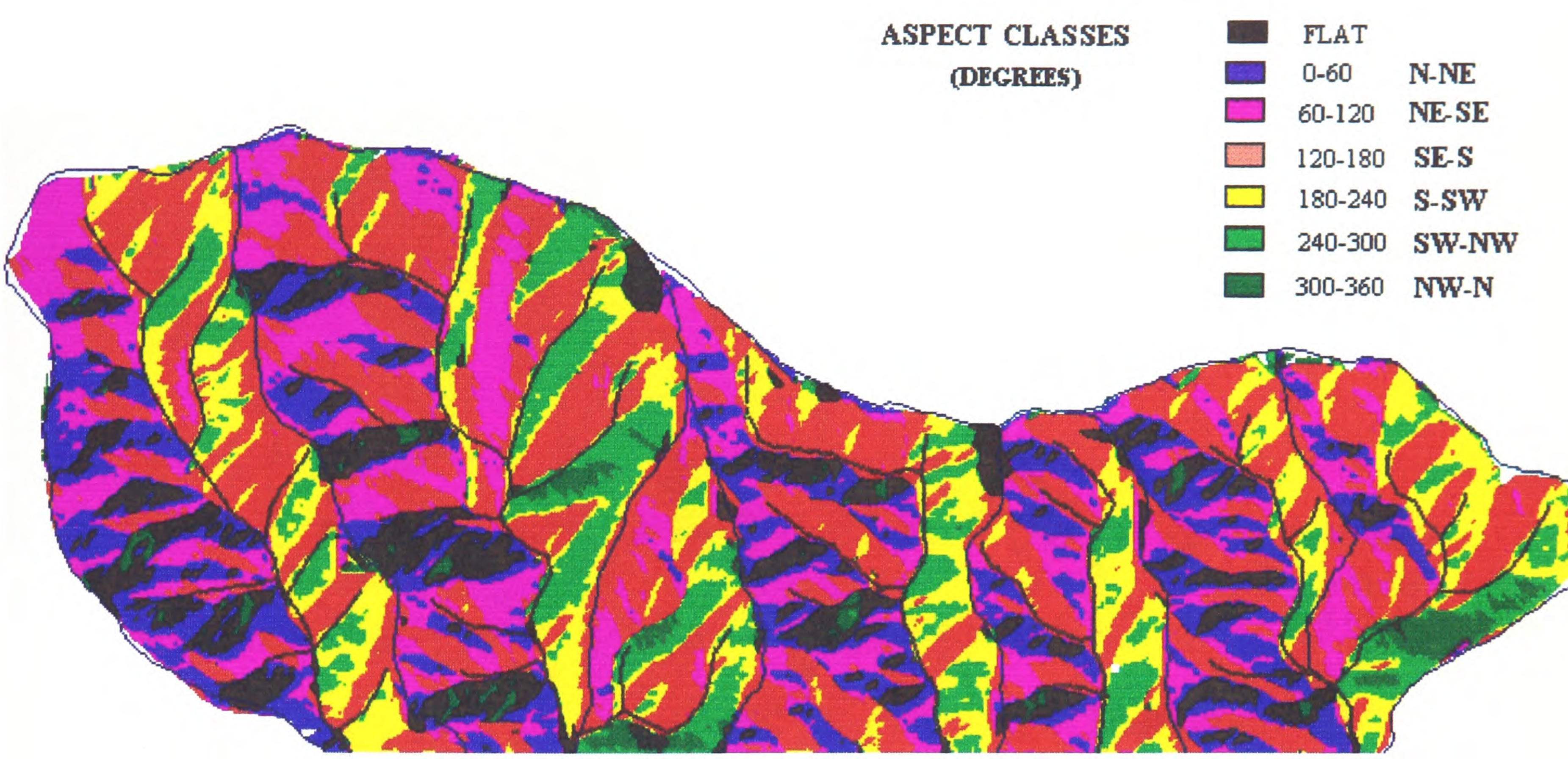


Figure 14 Aspect map of Berkshire Downs project area derived from DEM

There were 5 main themes or data layers compiled from sources within autocad and then transferred to IDRISI.

- catchment boundaries and drainage lines
- soils ; separated into (a) Chalk (b) Clay with flints and (c) Charity drift soils
- ancient fields
- aspect information
- slope information

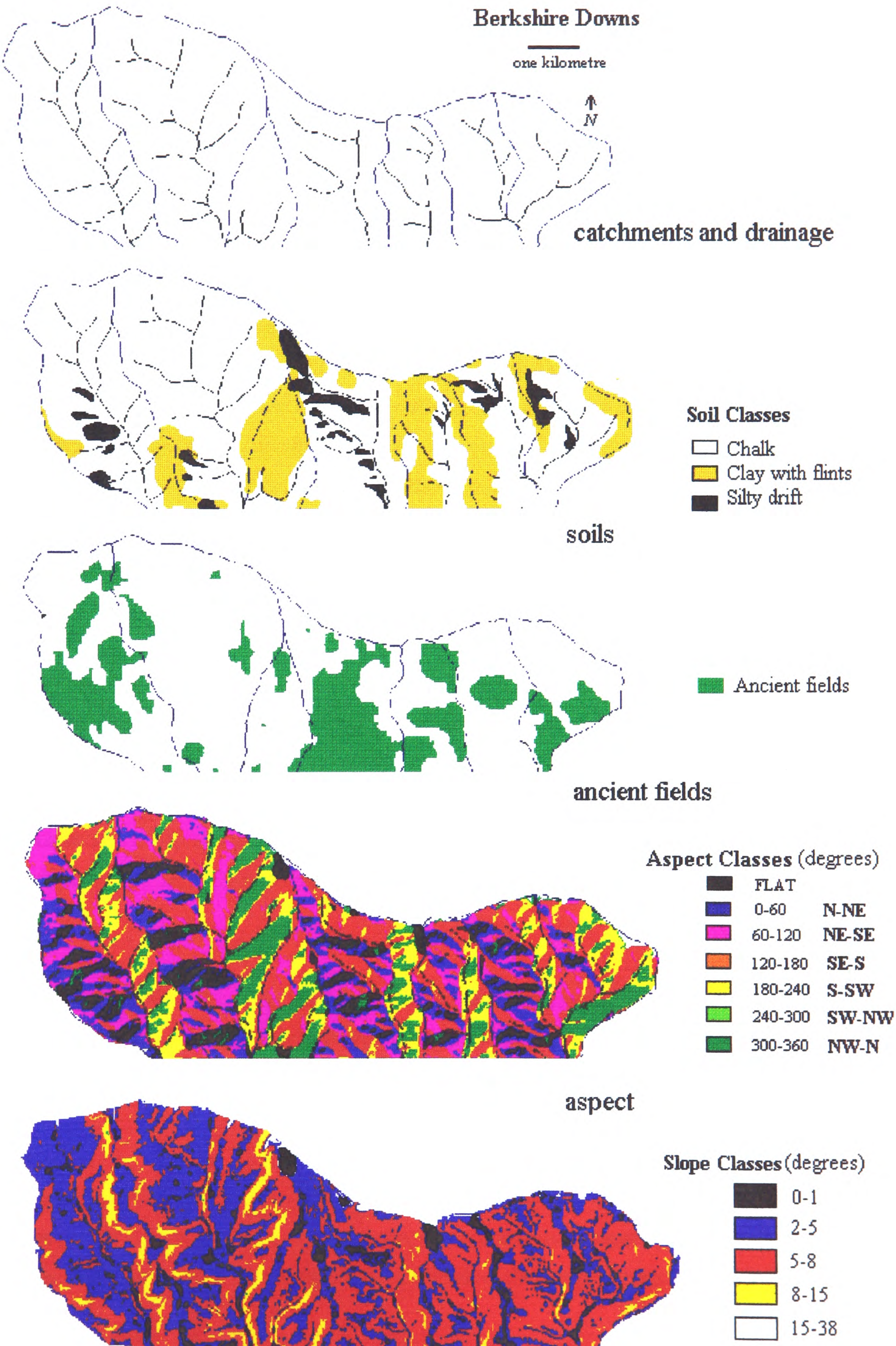


Figure 15 Data themes used for GIS predictive model

5.7 IDRISI FUNCTIONS

IDRISI acts upon spatial information through a series of programme modules. A summary of the commonly used modules is provided below.

Overlay

This module produces new images from the addition, subtraction, multiplication or coverage of two input images. The "cover" function blankets the pixels of the second image with those of the first except where the first image has values of zero. This application of map algebra allows the selective combination, exclusion and overlay of map information and is therefore useful for selection of soils, fields and archaeology relevant to the tasks of predicting ancient colluvium. For example the areas of ancient fields which overlap with chalk soils can be isolated and viewed by simply using the "cover" function within overlay. If the background of both images is kept at zero, the area of overlap can be selected.

Histo

This module produces a frequency histogram of cell values in an IDRISI image. Histograms are created by dividing the data range into classes of user-specified width, and the frequency within each class is tabulated in graphical or numerical form. Histo allows complete tabulation of the pixels represented in each class for each image (for example, the area of fields which overlap chalk soils). This tabulation of image data is useful for identifying and eliminating unwanted data classes which may be difficult to see on the image.

Surface

The surface module calculates slope, aspect and shaded relief images from a digital elevation model. Again with the DEM providing elevation values for each cell or pixel, slope and aspect maps are derived using nearest cell algorithms.

Reclass

Reclass classifies or reclassifies pixel data stored in image or attribute value files. When used with slope and aspect images for example, specific slope categories or aspect classes can be selected by choosing the desired range and setting the rest of the image to zero. Reclass also allows selection of discrete subsets and manipulation of images such as setting classes to zero prior to using "overlay".

Distance

The Euclidean or "as the crow flies" distance between each pixel and nearest set of target features is measured by this module. A popular use of this function in archaeology is to create a buffer zone of designated width around a central point or feature. This buffer zone might exist around a Roman road within which coins might be found or ridge line buffers within which certain soils might be expected.

Ortho

Ortho produces three-dimensional images of IDRISI as orthographic perspective displays. The surface image which is produced can be draped with a second surface. Over a three dimensional plot of the Berkshire Downs for example might be draped the image of soils and ancient fields. This gives a very useful three-dimensional perspective from which observations and relationships might be noted. Ortho allows the images to be viewed from an angle of 0 (due north) - 90 degrees (due east) and the viewing angle can be chosen from horizontal to vertical. Finally vertical exaggeration can be changed to enhance relief or create a realistic surface.

Transpos

This module can be used in conjunction with Ortho to rotate the Ortho block image by 90 degree increments allowing the image to be viewed from any direction.

Through these primary modules IDRISI has the capacity to rapidly combine and manipulate and display an enormous array of information. By its capacity to allow rapid visualisation of both map and tabular information, a series of images and landscape combinations specific to the project aims can be sorted, chosen and analysed.

5.7.1 Map resolution

The resolution of the map information according to the IDRISI raster format was chosen to be 20m x 20m. This represents the subdivision of the project area into 750 columns and 350 rows and was the maximum resolution possible given the size of the study area and storage limitations of the IDRISI programme. Matching resolution and map scale is commonly an arbitrary decision in GIS projects. The practitioner must balance the choice of cell size with the scale of the map information to be digitised which best integrates the information, while minimising areas which need to be interpolated. Ideally, the choice of resolution should be large enough to accommodate the topographic information without need for excessive interpolation. For the greater part of this project 1:50,000 scale contour information was used for the development of the predictive model. Slope and aspect maps derived at 20mx20m cell size from the 1:50,000 scale DEM had a clear north west – south east grain which was a product of interpolation across large areas on the more coarse contour data. When 1:10,000 scale topographic information became available in early 1999, through DIGIMAP and T.Bell at Inst. Archaelogy Oxford, it was decided to overhaul the predictive model with the more detailed DEM and terrain information. A comparison of the model developed at different scales is discussed and shown in section 9.6.1.

5.8 SUMMARY

This chapter summarises the range of computer based methods used in this project from compilation of base data to selection and presentation of landscape information. In a project of this nature some ambiguity might arise over the definition of a method or a result, especially where initial information processing is necessary in the model construction. This chapter therefore stops short of discussing the parameters and steps involved in the prediction of archaeo-colluvium because the data which has been generated and the assumptions which are used constitute a specialised assembly of factors and GIS based analysis. It might be expected that discussion of the parameters and steps involved in construction of any model constitutes a method. For this project however, they represent the product of original work by way of observations and a novel synthesis of information, and for this reason have been included at the beginning of the next chapter.

CHAPTER SIX

CHOICE OF MODEL PARAMETERS AND COLLUVIAL PREDICTION

6.1 BASE MAP PRODUCTION and ANALYSIS

The first stage in the development of a colluvial model is the compilation and production of relevant physical and archaeological information. Figure 16 shows the IDRISI generated distribution of superimposed ancient field systems, the main soil types, and catchment boundaries. A summary of all areas and proportions of soil types and fields can be seen in Tables 6 and 7. It is possible to draw some conclusions from this pattern about the preference of prehistoric land use for different soils. Some inferences can also be made about susceptibility to erosion across the Berkshire Downs based on the distribution of fields and soils.

The overlay of soils, and fields on the Berkshire Downs has been done previously by Bowen (1961), Rhodes (1950) and Richards (1978). Such a map could have been compiled manually in the space of a few hours, although the benefit of GIS is the almost instantaneous computation of areas necessary to quantify the different soil and field relationships, and the rapid display of different map combinations which can be viewed and interpreted. It is worth emphasising that the capacity of IDRISI to display three-dimensional terrain images and an array of data combinations for viewing is an invaluable tool for this type of landscape interpretation.

The subdivision of the Berkshire Downs according to catchments recognises the principle that the processes which influence soil movement, water flow and colluvial location (though not always archaeology), will be confined within these basic hydrologic units. Though not so readily recognised in archaeological studies, hydrologic catchments form the basis for any study of soils and soil movement and provide a logical sub-division of the Berkshire Downs landscape. In most instances the prominent north-south ridges across the region divide the landscape into seven main catchments, which are numbered from west to east. All of these valleys drain to the south and ultimately into the Lambourn and Kennet Rivers to the Thames.

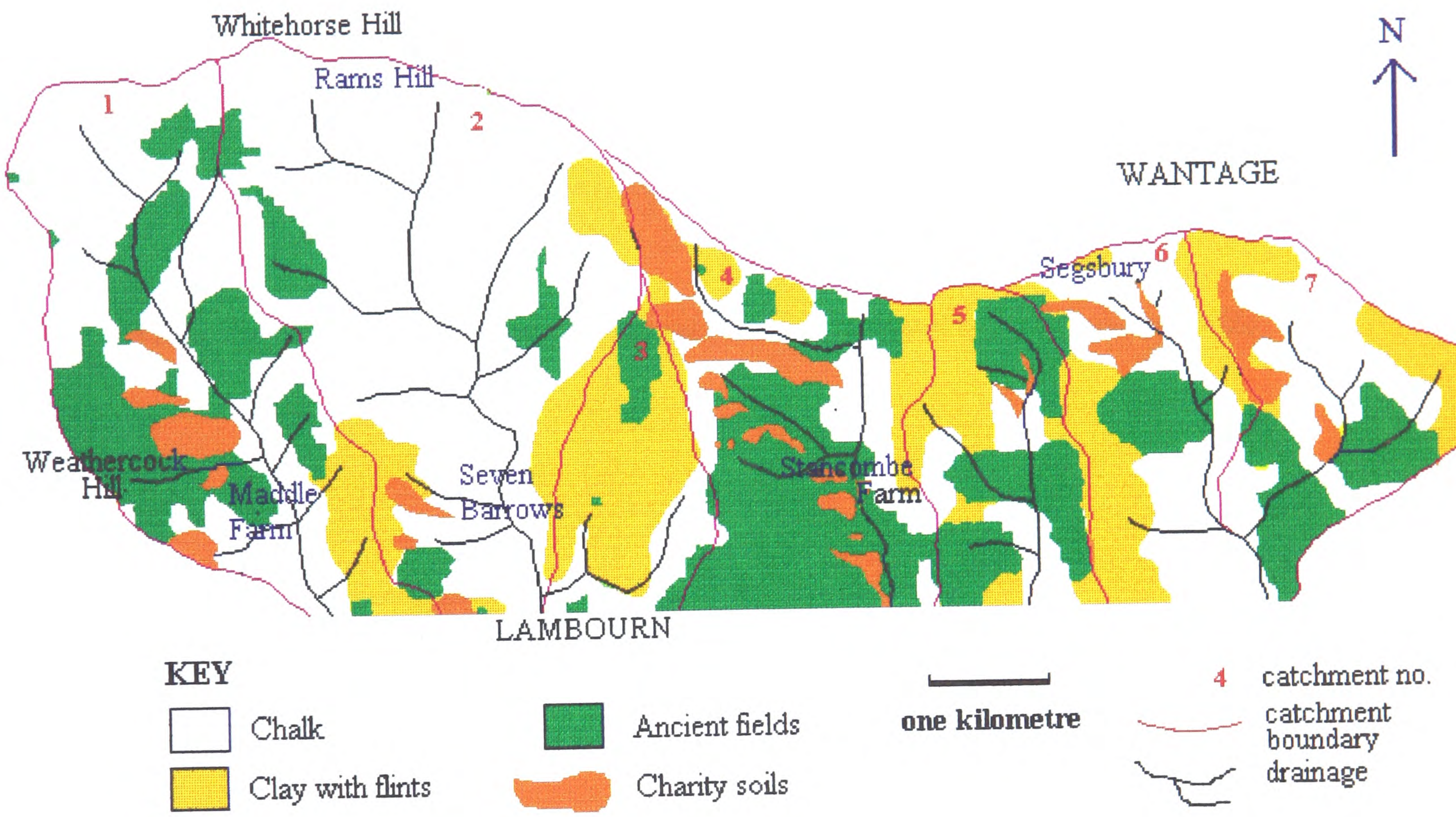


Figure 16 Map of ancient fields and soils on the Berkshire Downs

Catchment no.	Total area (km^2)	Chalk soils %	ClaywithFlint soils %	Charity soils %	Valley soils %	Fields %
1	11.0	68.3	10.7	5.8	15.2	37.1
2	14.6	71.7	10.9	1.6	13.8	8.1
3	3.4	19.7	72.0	0	8.2	14.1
4	7.9	60.1	17.4	15.8	6.7	55.0
5	4.9	31.3	59.6	1.3	7.8	44.5
6	5.0	48.6	30.4	6.5	8.5	15.7
7	5.4	49.0	28.9	8.3	13.8	29.9

Table 6. Percentage occupation within each catchment of soil types and ancient fields

Catchment no.	Chalk soils %	ClaywithFlint soils %	Charity soils %	Valley soils %
1	79	9	7	5
2	94	4	2	0
3	5	92	1	2
4	83	4	11	2
5	33	58	6	3
6	70	26	2	2
7	77	16	4	3
Total area (av.)	78	18	3	1

Table 7 Percentage distribution of ancient fields within each catchment on each soil type

6.2 SOIL and ANCIENT FIELDS ; RELATIONSHIPS ON THE BERKSHIRE DOWNS

The combination of topographic, archaeological, soils and geological information made possible the following observations for the seven catchments of the Berkshire Downs.

6.2.1 Soil distribution within each catchment

While a general description of the geology and soils of the Berkshire Downs was given in Chapter 4, the subdivision of the project area into catchments allows a closer examination of the mix of soils and fields and therefore general depositional settings as they vary from catchment to catchment. Studies of fields and soil relationships carried out on the Downs have been regional in scale (Moffat 1988; Bradley and Richards 1978) and tend to provide composite averages of field/soil overlap across large areas. For the aims of this project, the relative proportions of physical and land use factors at local catchment scale, however, have an important bearing on the erosional regime and distribution of colluvium from valley to valley.

It can be observed in Figure 16 that chalk soils predominate in the large western catchments, while Clay with flints occupy large areas in the centre and east. This mix of chalk and clay soils presents a clear distinction in erosion potential from valley to valley across the Berkshire Downs. For example, while both catchment 1 and catchment 2 have about 70% chalk soils and approximately the same proportion of Clay with flints, catchment 1 has some large soil units derived from drift material (Charity series) situated on the lower east-facing slopes. Catchment 4 in the centre of the study area has some 60% occupation by chalk soils but large and roughly equal proportions of less erodible Clay with flint and Charity soils, which occupy over 34% of this catchment. Chalk and Clay with flints are more evenly apportioned in the three eastern catchments. Catchments 1, 2 and 7 also have broad flat valleys which is reflected in the much larger proportion of valley soils (14-15%).

The implication of the mix of soils and topography in each catchment on colluvial distribution is discussed in detail after the predictive model has been developed and tested (Chapter 10). A distinction in erodibility between chalk and clay soils however is an assumption which is fundamental to the model and is discussed below.

6.2.2 Fields generally favour chalk soils

Across the project area, 78% of the ancient fields lie on chalk soils (Table 7). This corresponds with a similar figure (75%) measured by Rhodes (1950) for a much wider area of the Berkshire Downs and by Moffat (1988) for soils and ancient fields in Hampshire. The preference of fields for chalk soils is a trend which is evident across the Southern Chalkland. There are two main swathes of fields - at the far west and in the centre of the project area which occupy 79% and 83% of chalk soils within catchments 1 and 4 respectively. Catchment 3 is almost wholly Clay with flints and further to the east in catchments 5,6 there is a mixture of Chalk and Clay with flint soils where fields on chalk varies between 30 and 70%. It is also notable in catchment 2 that this large chalk catchment has very few fields (8% area). While the total chalk and field overlap across the Berkshire Downs is high, consistent with other regions in southern Britain, it is the soil/field proportion within individual catchments which has a more critical bearing on the likely distribution of ancient erosion across the project area. For example, in catchment 5 the proportion of fields on chalk soils is only 33%.

6.2.3 Fields generally avoid Clay with flint soils

Across the project area only 18% of the fields are on the Clay with flint soil unit. In his study of field and soil type relationships in Hampshire, Moffat (1988) confirmed that only 21% of the ancient fields were located on soils upon Clay with flints. Rhodes (1950) calculated that only 9% of the ancient fields which he had mapped across the entire Berkshire Downs were on Clay with flints, confirming a generally held assertion that these soils were avoided in prehistory (Fowler 1983; Bradley and Richards 1978). It was also noted on the Chilterns that Neolithic and Bronze Age sites avoided these areas of heavy soils (Head, J.F. 1955).

Within some catchments however, the widespread pattern of avoidance of these soils is contradicted, notably in catchment 3 (though only by a small patch of fields) and in catchment 5 where 58% of the fields lie on these heavier soils. There are several possible explanations. Firstly, the thickness and variable character of soils on Clay with flints meant that in some places the contrast in arable potential between chalk and clay soils would not have been as significant as the generalised pattern of avoidance might suggest. Secondly, in Romano-British times, the acidity of these soils was overcome by marling (Pliny *NH* xvii (5-8)) while the heavier texture might have been accommodated through the introduction of iron ploughs in this period (Chapter 3.3.4). The block of fields located on Clay with flints in catchment 3 for example appear to be associated with numerous pits implying that marling was undertaken here.

In his description of the ancient fields of the Berkshire Downs, Richards (1978) observes that fields which are more "aggregate" in layout appear to spill onto the Clay with flints. This appears to be the case in catchment 3 and implies later occupation, arguably of poorer soils in response to local land use pressure. It is also interesting to note that catchment 5, where Clay with flints have been most widely encroached by fields, lies directly adjacent the Segsbury hillfort. As there are no other settlements in the vicinity and Segsbury is of Iron Age date it might be implied that these fields were farmed from this centre during this period. The "Roman" appearance of some of the fields (Bowden *et al.* 1991b) on the soils of the Clay with flints also implies the later use of these parts of the landscape.

6.2.4 The absence of fields in the Lambourn Catchment.

Despite apparently suitable soils within the Lambourn catchment (catchment 2) the almost complete absence of ancient fields here presents a curious gap between the large swathes of fields in the western and eastern part of the region. Apart from some small blocks of fields in the upper valley which occupy only 8% of the catchment, a vast landscape of chalk soils appears to have been spared from cultivation.

Bradley and Ellison (1975) suggest that the Rams Hill Bronze Age enclosure at the head of this valley and the Lambourn barrow cemetery were elements of a pastoral landscape of ritual *set-aside*. This project assumes that further interpretation of aerial photography is unlikely to add significantly to the ancient fields and features on the Berkshire Downs (Richards, 1978). Moffat (1988) examined fields and soils across 250 km^2 in Hampshire and concluded that while lynchets might be destroyed, fields traces would be preserved even on the thinnest soils. Until evidence appears to the contrary on the Berkshire Downs, for the purposes of this study it will be assumed that this catchment is currently and has always been largely free of fields.

Areas of ritual exclusion are not uncommon on the Chalkland and have been noted on Salisbury Plain (Bradley *et al.* 1994) and the Stonehenge landscape (Richards 1990).

6.2.5 Fields and valley soils

Blocks of ancient fields have some overlap with valley soils in all of the catchments except catchment 2. The valley soils, for the purposes of this project, play little part in colluvial prediction. The valley floors occupy a relatively small proportion of the catchments and are therefore not likely to have been a large source area for colluvial sediments. It is indeed only in catchments 1 and 2 where valleys are broad enough that much arable would have been possible. When the individual elements of the field blocks are more closely examined, however, many of the field boundaries are not continuous, implying avoidance of arable across valley floors. Both valley and valley edge soils play a far less significant role than the much larger units on the surrounding slopes. As this project represents a re-interpretation of soils in this part of the landscape, the mapped valley soils have not been included. The Soil Survey maps represent the valley soils as shallow and calcareous and overlying Coombe deposits.

6.2.6 Charity soils and ancient fields

The Charity soil series have developed on undifferentiated de-calcified silty drift (Jarvis 1973) and lie on the lower hillslopes across the project area. Such a definition does not confine itself to late peri-glacial drift deposits and is ambiguous enough to apply to more recent deposits. There are nearly 3km^2 of Charity soil units which exist as patches up to 0.25km^2 in size, located on both in upper and lower valley locations and commonly on gentle to moderate east-facing slopes or as terrace-like benches (Jarvis 1973, 43). Ancient fields exist on these small soil units as their topographic position and favourable arable soils would have made them suitable for agriculture, particularly the larger bench-like deposits in catchment 1 (M.Jarvis p.comm).

In the light of the composition and nature of these deposits, another relationship with the fields is worth considering. It is possible that the Charity drift deposits and/or the soils formed upon them may be a product of the ancient fields. Forty percent of the Charity units lie within or in positions down-slope from field systems. The rest of these units lie topographically above any ancient fields in positions unlikely to have resulted from cultivation generated soil erosion. When the Charity soils in upper catchment locations are subtracted, the proportion linked to fields rises to 76%. Thus over three-quarters of the Charity soil units which occupy lower slope positions also lie below fields, a correlation which suggests some depositional link.

A cursory examination of the Charity soils and their parent material in upper catchment locations, particularly the large units near Green Down revealed head deposits of peri-glacial rather than human origin. Reference to the more detailed soil maps in Kent (Green and Fordham 1980) and the Hampshire survey (Moffat 1988), and discussion with soil surveyors familiar with Chalkland soils (p. comm M.Jarvis; A.Moffat; B.Whitfield) suggest that these upper catchment drift units and Charity soils are probably of Pleistocene age. It would seem reasonable to exclude them from any discussion of archaeo-colluvium.

The patches of these soils which occupy slopes in lower catchment positions however, offer more promise. On the basis of discussion with local soil consultants (*ibid*) and some brief field observations, the relationship which these units have with ancient fields in these parts of the landscape would seem to be more than circumstantial. In the absence of a more detailed soil survey and a programme of soil dating it would be imprudent to take the observation further, suffice to suggest that the Charity series present the possibility that in some parts of the Berkshire Downs, archaeo-colluvium was unwittingly identified during Soil Survey mapping as part of a broadly defined soil series developed on lower slope drift. The patches in the Maddle Farm catchment and around Stancombe farm for example appear more likely to be colluvial soils, linked as they are, both with ancient fields and located in the lower landscape in valley edges and valley floors. This argument might be summarised :

1) Catchments 1 and 4 have the highest percentage occupation (largest swathes) of fields on the shallow rendzinas of the Icknield group soils (about 80%). The corresponding highest incidence of lower slope Charity soils in these catchments suggests some depositional relationship.

2) In the eastern catchments, fields and (less erodible) heavier soils are more frequent and Charity soils are absent as lower slope deposits. This apparent negative association strengthens the notion that these soils are the eroded product of ancient fields.

3) Many of the Charity deposits occur in the lower landscape at the base of gentler east-facing slopes of asymmetric valleys (Jarvis 1973).

While the Soil Survey map of the project area does not represent colluvial soils, a re-interpretation of the Charity soils in relation to the ancient fields yields an interesting association. This gives some support to the idea that parts of this unit might be regarded as a proxy product of ancient arable and therefore be analogous with archaeo-colluvium. The tentative link between some of these drift-derived soils and ancient fields is the first time such a relationship has been noted. Small regions of southern Britain have been mapped at 1:25,000 and include colluvial soil units (Chapter 2.3.1), though none of these have been linked with the distribution of ancient fields. The pattern of distribution of the Charity unit also provides useful information about depositional settings from which erosion and colluvial processes on the Berkshire Downs might be interpreted. The presence of many of the Charity soils on east-facing slopes for example provides some evidence that deposition across much of the Berkshire Downs, whether the product of human or peri-glacial activity, favours these topographic settings.

6.2.7 Summary of Soil and Field relationships on the Berkshire Downs

The observations made about the soil-field relationships on the Berkshire Downs provide some support for links between ancient fields, Clay with flints and possible colluvial units. At a regional scale this provides a framework on which a predictive model for archaeo-colluvial deposits on the Berkshire Downs might be based and can be summarised :

1) Fields are located predominantly on the Chalk soils.

2) Fields for the most part avoid Clay with flints.

3) Local variations occur at catchment scale within this general pattern, with fields in some of the eastern catchments spreading more onto the heavier soils.

4) Large swathes of fields appear linked with lower slope deposition in the form of soils formed on Charity drift material, generally concentrated on the gentle east-facing slopes.

These form the basis of the model parameters which are described in the next section.

6.3 MODEL PARAMETERS AND ASSUMPTIONS

In the previous section, relationships were observed about ancient fields and soil types from which regimes of possible past land use impact and therefore colluviation were suggested. Most significant of these was the avoidance by ancient fields of Clay with flint soils and the partial association of ancient field systems with soils of undifferentiated lower slope drift deposits (Charity series). These observations and a number of assumptions about ancient land use, processes of ancient soil loss and some simple topographic factors define a number of parameters from which a predictive model for archaeo-colluvium will be developed. These are discussed below.

6.3.1 Ancient fields imply ancient arable

It is a fundamental assumption that the presence of ancient fields indicates predominantly arable land use and conversely that the absence of fields indicates predominantly pastoral use. The evidence that ancient fields were used for arable across Southern Britain was discussed in section 3.5.1 and is summarised here.

It is widely held that the small size and layout of these fields, together with the presence of plough-formed lynchets indicates, at least circumstantially, arable rather than pastoral use (Fowler 1983; Bradley 1978; Bowen 1961). The products of cropping or pastoral use do not survive *in situ* within the fields (Mercer 1981), hence any evidence of farming activity is commonly extrapolated from regional environmental evidence, such as pollen or mollusc data or archaeological material such as food remains, animal bones, agricultural tools and storage structures.

The presence of these type of indicators are however sparse on the Berkshire Downs (Gaffney and Tingle 1989). Ford (p. comm) asserts that the paucity of environmental and archaeological evidence of prehistoric cultivation here is probably due to local cereal processing methods and a lack of excavated settlements where the remains of grain might be expected. The support for ancient arable activity on the Berkshire Downs which is provided in Chapter 4, is briefly reiterated.

Grain is conspicuously absent from Rams Hill (Bradley and Ellison 1975) and only a few cereal grains indicating Neolithic cropping were found at Waylands Smithy (Atkinson 1965; Whittle 1988). The most substantial evidence from field shape, presence of manured pottery and lynchet excavation (Bowden *et al.* 1991b) and cereal recovery (Lock and Gosden 1997a) is for Roman cropping. While the age, extent and continuity of arable activity between prehistory and the Roman period remains in dispute, it is assumed to have been continuous and widespread enough to generate erosion and thereby accumulation of lower slope deposits. The existence of prominent blocks of fields on the Berkshire Downs and that they reflect ancient boundaries of arable fields is assumed for the purposes of this study.

6.3.2 The pattern of fields is equivalent to their original extent

The distribution of ancient fields which imply the extent of past arable landscapes and erosional regimes have been interpreted and plotted by Richards (1978) from 1969 aerial photography and are assumed to represent their original extent (Chapter 4.5). According to Richards it is not expected that any more significant blocks of fields will be discovered. This part of the Berkshire Downs represents one of the most studied swathes of ancient fields in southern Britain and the 1969 aerial photo series produced exceptionally high archaeological visibility. Rhodes (1950) was the first to interpret ancient fields on the Berkshire Downs from aerial photography and suggested that blank areas were the consequence of destruction by modern ploughing. On later examination however it proved simply to be a function of poor visibility. When viewed under fallow by Richards some 25 years later these areas proved to contain prominent blocks of ancient fields. Until future aerial photography or field evidence reveals significant new blocks of fields, it is assumed that colluvium will be distributed according to the pattern of fields represented in Figure 16. A programme of recent survey of aerial photography by English Heritage of the Berkshire Region was due to be published in 1999 but was not available in time for use in this project.

Ancient field boundaries have been destroyed by later ploughing particularly by broad-scale agricultural expansion on the Downland over the past 50 years. While extant field boundaries have in many landscapes been completely removed, Moffat (1988) suggests that field traces are visible even in areas where soils are very thin which implies the persistence of fossilised fields even after long periods of use or subsequent degradation. This has already been mentioned with respect to catchment 2 and is the basis for suggesting that the pattern of fields represented on the Berkshire Downs are broadly equivalent to their extent in antiquity.

6.3.3 Ancient fields indicate more soil loss than pastoral regimes

A third premise is that the ancient fields are likely to be the sites of accelerated soil erosion, whether all the fields were used at the same time or not. It is beyond the scope of this study to estimate differences in the rates of erosion within the blocks of fields, based on their size and shape or on their length of use or management methods. The simple assumption is that slopes occupied by field systems produced significantly more soil loss in general and on a relative scale than slopes devoid of fields. Given the uncertainty about the age of the fields, as well as the absence of any record of land use which might indicate sowing season or tillage methods for example, further resolution in terms of the likely rate, duration or volume of loss within the field systems cannot be supported by substantial evidence. It is indeed only once the eroded products of these fields are located and examined that some of these questions might be addressed. It is not suggested that the remainder of the landscape was free of erosion, but that under an uncultivated regime whether native forest, regenerated forest, scrubland or pasture, erosion would have been much reduced by comparison.

It has already been suggested that these small ancient fields were deliberately constructed to conserve soil (Bell 1986; Bradley 1978). Whether deliberate or not, a certain proportion of the cultivated soils form positive field lynchets effectively conserving soil on the slope. It is reasonable however to assume that under the arable land use implied by these field systems, greater erosion would have been possible, even between fields and down perpendicular boundaries, than under pasture or forested conditions (Morgan 1992). Even greater erosion would be likely during periods when the fields were abandoned as field boundaries were breached and lynchet deposits were redistributed.

Because there has been very little work done throughout Southern Britain on the spatial aspects of colluvium, the relationship of blocks of ancient fields and colluvial thickness has rarely been considered. Moffat (1988) asserts in his East Hampshire study that fields and colluvium do not appear to be linked, based on soil mapping carried out by Moffat and Cope (1984) and Moffat (1986). However, as these soils were undated it is difficult to separate soils derived from the older fields with those of more modern date. It was his conclusion, based on the composition of these soils that most of them post-date the fields. This in no way invalidates the field-colluvium assumption of this project, though it further highlights the need for accurate dating to separate colluvium which is contemporary with ancient fields with more modern deposits.

6.3.4 Use of modern soil maps : reconstructing ancient erosion regimes

The reconstruction of past erosion is limited on the Berkshire Downs by an absence of information about ancient soils. The difference in the nature and thickness of current soils compared with those of prehistory was referred to in Chapter 2. It is most likely that loess rich brown-earth soils covered the Berkshire Downs in early prehistory to be replaced by shallow grey rendzinas, initially through the action of late Devensian peri-glacial activity and fluvial action, then gradually after intensive clearance, land use and soil thinning by prehistoric and Romano-British times (section 3.2.2). It is implied that any fields, if they existed, and land use patterns associated with these earlier soils will have also been removed.

It will be assumed that the simple soil divisions currently observed - soils developed on Chalk, Clay with flints and drift units - broadly reflect the relative differences in productivity and erodibility and the arable imprint at least of later prehistory. The fact that these fields favour chalk and avoid clay soils across much of southern Britain shows that the pattern of ancient soil preferences still partly persists in the present landscape. In the absence of any substantial evidence of cultivation on the earliest loessic soils, the current soil maps are useful for approximating erosional regimes from a durable and widespread pattern of fields. The assumption was made above that there is no differentiation of rates of erosion across the field systems on the basis of age or continuity of use. Similarly, for the purpose of this study, it will be assumed that across the field blocks broad differences in erosion rates, which might be implied from the current soils, are comparable with those when the fields were in use.

It is worth emphasising that a programme of colluvial field work designed to verify the predictive model is an important element of this project and follows the development of the model in the next section. Such a survey will reveal the nature and distribution of valley soils and may well elucidate the fate of missing elements of the earliest soil cover and associated human activity on the Berkshire Downs.

6.3.5 Soil erodibility

It is a simple assumption of the model that chalk soils are more erodible than Clay with flint soils. The silty loams common to Chalk soils are three times more erodible than the heavier soils on Clay with flints, according to soil erodibility values (Evans, R., 1980, Hodgson 1967, 131; Moffat 1988). Evans' survey of colluvium across the United Kingdom supports the notion that chalk soils are four times more likely to produce colluvium than clay soils (Evans 1992, 58). The observation that soils in all the chalk landscapes of the Berkshire Downs have been eroded, in some places almost to bedrock, implies a long history of erodibility.

Moffat (1988) observes that Clay with flint soils contributed less erosion in prehistory and notes the absence of colluvial soils from some dry valley bottoms in proximity to Clay with flints. He also suggests that a range of soil types and thicknesses are found on these residual units which defy such simplification. Indeed with closer examination of many of the units mapped as Clay with flints, considerable variation in the nature, composition and by implication, age of these sediments has been revealed. Acknowledging that such variation exists, it is nevertheless assumed that soils derived from Clay with flints were considerably less erodible than those formed on chalk soils. The distribution of fields on both chalk and less commonly clay soils presents a distinction in land use and landscape erodibility across the project area.

The previous assumptions (6.3.1 - 6.3.5) relate to landscape erodibility based on ancient cultivation and simple soil differences. If it is assumed that these fields were predominantly cropped, that cropping implies a regime of soil erosion, that chalk soils are erodible, compared with Clay with flint soils and that the traces of fields represent their original extent, then it is possible to delimit areas within the landscape likely to have generated significant erosion in antiquity.

6.3.6 Choice of east-facing slopes

Many of the valleys of the Berkshire Downs and indeed the wider Downland of Southern Britain are asymmetric with steeper west-facing slopes. Silty and flinty Charity series soils commonly occupy the lower parts of the gentler east-facing slopes (Jarvis 1973, 31), a feature of the soil distribution on the Berkshire Downs which was discussed in section 6.2.6. One of the explanations is that variable diurnal moisture regimes (longer exposure to sunlight) on easterly aspects may produce more favourable conditions for soil movement and accumulation. It was also noted that nearly 40% of ancient fields on the Berkshire Downs occupy slopes of easterly aspect. In Moffat's Hampshire Survey ancient fields favoured both easterly and south-facing slopes, avoiding the steeper assymmetric limbs of dry valleys (Moffat 1988, 19). It is assumed for this project that colluvial accumulation will favour slopes of easterly aspect.

6.3.7 Choice of slope angle

Several simple criteria were chosen to account for the topographic control of colluvium. A slope angle of 2 degrees or above was chosen as a minimum slope angle from which soil loss would occur. When combined with the easterly aspect criteria (above), the areas from which accelerated erosion is predicted are slopes which exceed 2 degrees and are east-facing.

6.3.8 Choice of source and receptor areas.

Source areas

Topographic factors such as valley shape, slope angle and slope length influence the nature and amount of soil loss and therefore the distribution of colluvium. Soil movement occurs on slopes ranging from gentle to steep and on slopes of any length. Convex slopes with wide crestal areas for example, act as collecting grounds for runoff and are susceptible to erosion (Evans 1980). For the purposes of this study, slopes covered by ancient fields represent the source of these ancient deposits. The irregular distribution of fields across the Berkshire Downs means that the length of slopes occupied by fields varies between a few metres to over

750m. To provide a significant length of ancient cultivated slopes as a source area for colluvium, a 500m slope length, measure from the valley centre in each catchment was chosen. Boardman (1992) suggests that fields of 200m length and 10 degree slopes represent high risk sites for erosion on the Downland. The choice of 500m is large enough to "capture" the prominent field blocks.

Receptor areas.

Bell (1986) identifies a range of topographic sites favoured for deposition of archaeo-colluvium, although the deepest deposits are commonly found in lower slopes and valley floors. It is assumed that the dry valleys and valley edges on the Berkshire Downs will be the main repository of sediments eroded from ancient fields. Some erosion models use DEM data to derive maps of terrain sensitivity to erosion and model sediment movement according to complex hydrologic models (Mitasova 1996; Van Oost *et al.* 1998). It will be assumed for this study, however, that all valley floors are potential receptors of eroded material and that the main drainage network represents the sites of the most prominent deposits. A buffer zone 200m from the valley axis in each catchment was chosen to represent potential receptor sites at both valley and valley edge locations.

6.3.9 Preservation assumptions

Finally, the assumption that fields and archaeo-colluvium might be linked presumes that these deposits at the base of slope or valley floor will have survived in some form from the time when the fields were in use The fact that many of the colluvial sequences are truncated or missing on the Chalkland (Bell 1992; Staines 1991, 15) implies that material can be removed from the dry valleys. The processes by which this occurs have been discussed in Chapter 2.5 and includes removal by seasonal streams and catastrophic rainfall events. This serves as a reminder of the complex conditions under which these soils have been preserved and re-iterates the generally unexplained processes by which many of the original soils of the Downland have been removed.

The lack of any spatial studies means however, that there is little information about the conditions of colluvial preservation across the Chalkland. It is thereby an assumption of this project that by focusing on ancient fields as source areas for ancient colluvium, valleys below these areas will retain a greater thickness of archaeo-colluvium relative to other parts of the landscape. It is also assumed that across all the blocks of fields conditions of preservation will be equivalent so that colluvial thickness is expected to be comparable across the project area.

Using the above criteria, increasingly specific localities within the valley floors on the Berkshire Downs emerge as predicted locations of archaeo-colluvium. These sites might be summarised according to the following criteria : colluvium shed from ancient fields on the Berkshire Downs is predicted below ancient fields, on chalk soils within a 500m source area and preserved within a 200m receptor area from the valley axis, where slopes exceed two degrees and have an easterly aspect.

6.4 DEVELOPMENT OF A GIS BASED MODEL

6.4.1 Using IDRISI

The first stage of the development of the predictive model was the preparation, generation and analysis of multiple layers of landscape information described in Chapter 5 and summarised in Figure 16. Observations about the distribution of ancient land use, potential arable erosion and terrain factors which appear to influence colluvial formation on the Berkshire Downs were in part derived from this map. The second stage involves the IDRISI-based selection and combination of all relevant soil, archaeological and terrain information which incorporate the assumptions and chosen parameters discussed in the last section. These were assembled from the five layers (data themes) of map information compiled in the GIS database (Fig 15) and the model was developed using the IDRISI functions described in Chapter 5.7.

6.4.2 IDRISI selection

Sensitivity of landscape to erosion

(1) The project area was subdivided according to drainage catchments and all areas of ancient fields on chalk soils were selected as the primary zones of past arable land use and soil erosion. The exclusion of all areas devoid of fields makes the assumption that these parts of the landscape sustained relatively little soil loss in the absence of ancient arable use.

(2) All blocks of ancient fields located on Clay with flint soils were excluded according to the assumption that erosion generated from these fields will be negligible. This procedure was performed by subtraction of the Clay with flints map layer from the layer of ancient fields. The resulting map represents just the ancient fields located on the more erodible chalk soils (Fig. 17-1)

Slope and aspect parameters

(3) All areas with slopes greater than 2 degrees were selected from the IDRISI slope map according to the assumption that soil movement would be expected to occur on slopes at

or above this angle (Fig. 17-2). Some topographic control of colluvium appears likely on asymmetric valleys according to the observation that east-facing slopes were favoured by ancient fields and by undifferentiated drift deposits. All areas with an easterly aspect (between 45 and 135 degrees) were selected.

Source areas and receptor zones

(4) The definition of all main drainage lines represent the valley axes around which a 500 m buffer zone was constructed to represent source areas up-slope from all valley floors. This zone represents a minimum source area for colluvium. Receptor zones were defined by a 200 metre buffer zone constructed around each valley floor (Fig. 17-4).

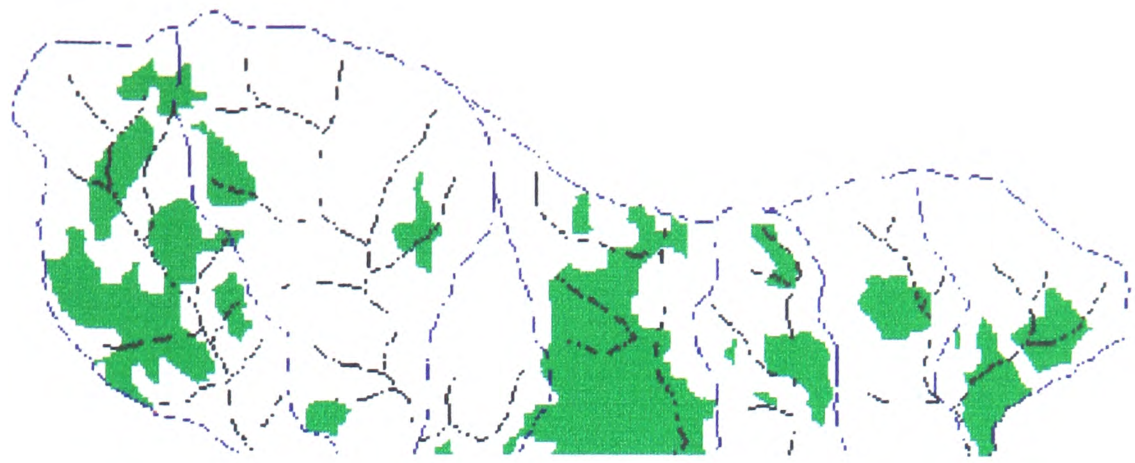
GIS combination

The following steps represent the overlay of map layers and the definition of the predicted sites (Fig. 17).

(5) The overlay of the ancient fields occurring exclusively on chalk soils with the slope and aspect parameters generated in 17-2 produces a composite map of all ancient fields which occupy east-facing slopes of 2 degrees or more (Fig. 17-3).

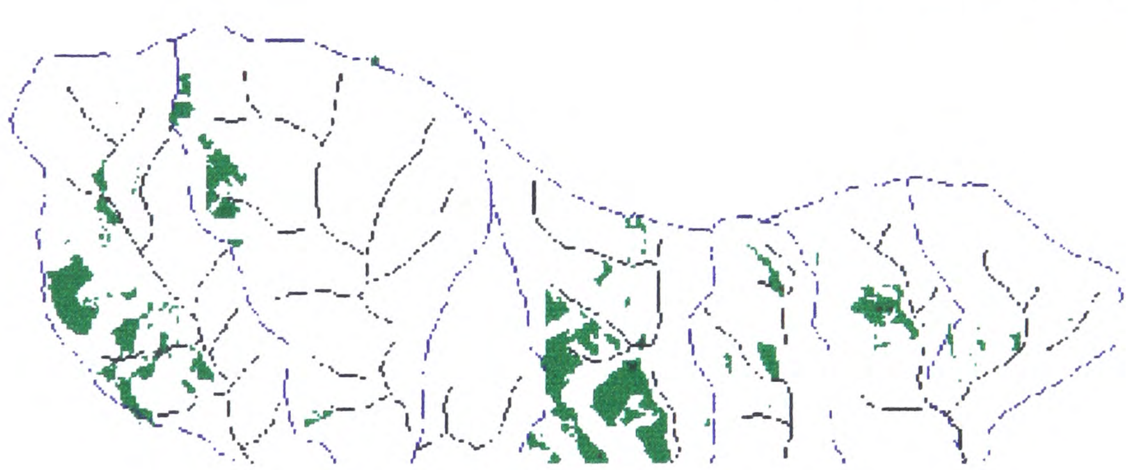
(6) The next stage involves the overlay of the map generated in Figure 17-3 - all fields of 2 degrees slope or more with east-facing slopes - firstly with the 500m buffer which provides a generalised distribution of source areas and finally with a 200m buffer zone which represents the receptor sites.

(7) Given the condition that colluvium will form below ancient fields with the slope and aspect characteristics and occupying the 500m buffer discussed in 6.3.6 - 6.3.8, the 200m valley buffer captures sites of predicted colluvium which are separated into two classes (Fig. 18). The first order sites (red areas) are those which lie below or are surrounded by a reasonable continuity of ancient fields within the 500m buffer. Second order sites (yellow areas) are those which do not have a large source area of fields beyond the 200m buffer.

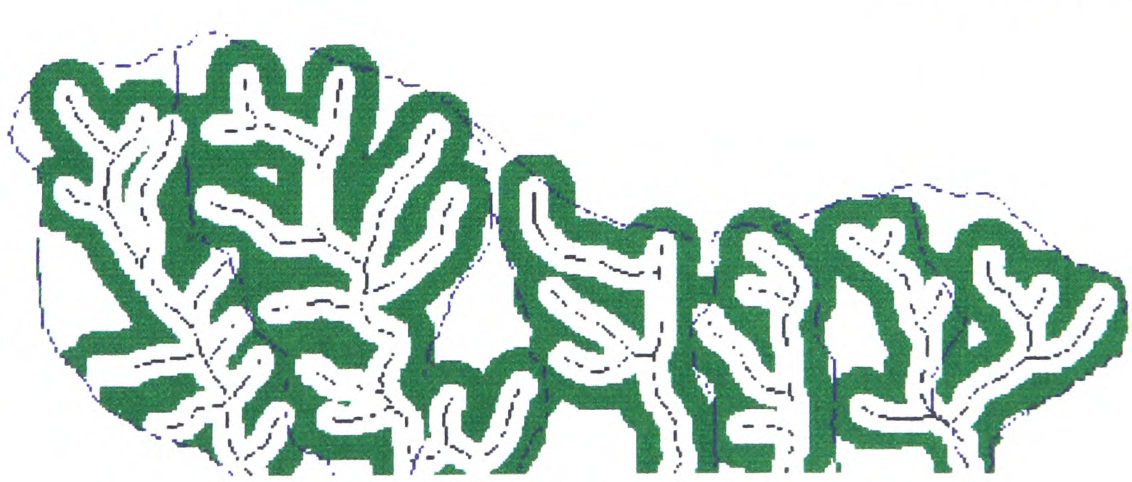


1 Fields on chalk soils

2 East facing slopes, > 2 degrees



3 Step 1+2 Ancient Fields on
east facing slopes, > 2 degrees.



4 500m and 200m buffer zones

Figure 17 GIS selection sequence for archaeo-colluvial prediction

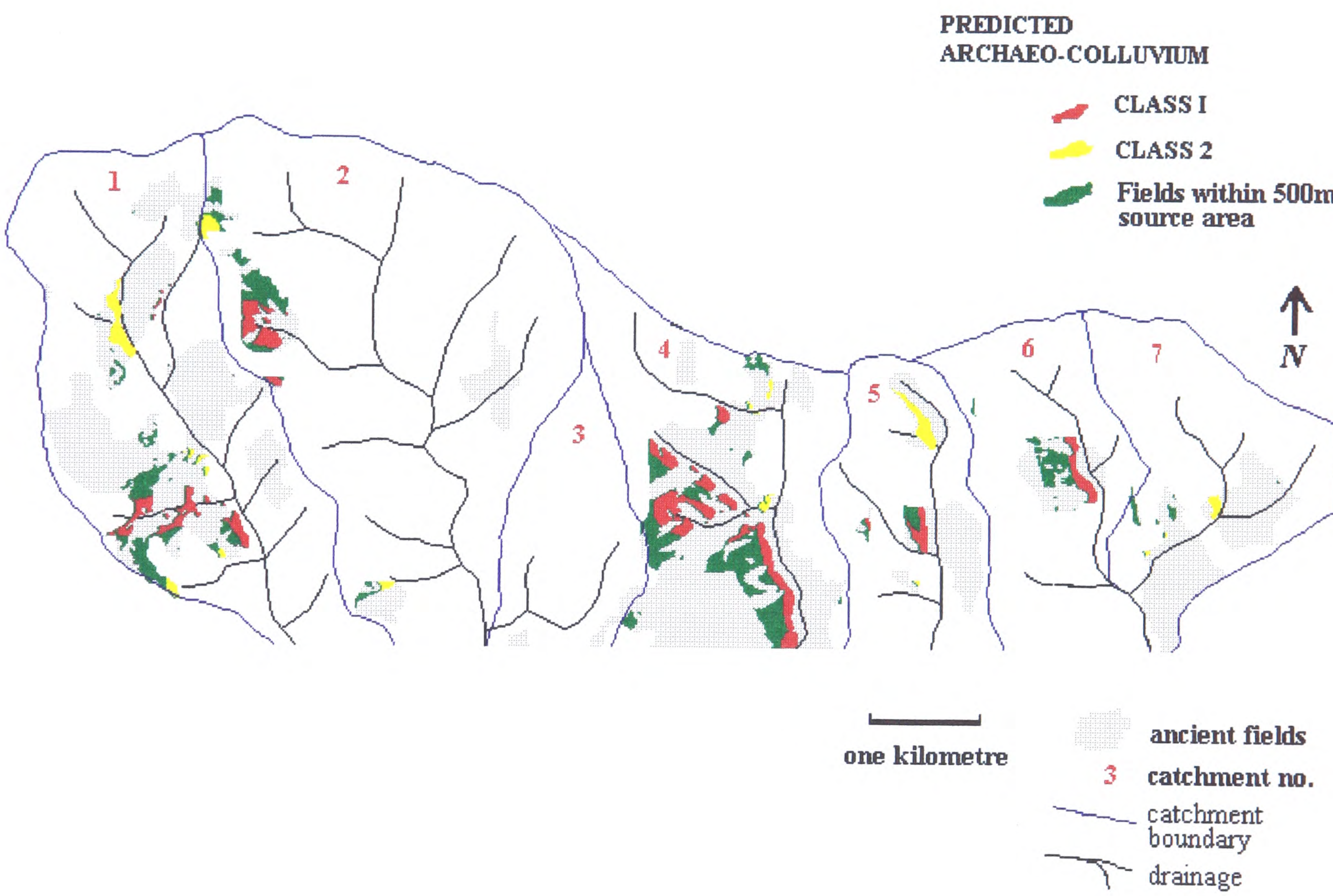


Figure 18 Predicted archaeo-colluvium on the Berkshire Downs

6.5 PREDICTED SITES MAP

Figure 18 represents the culmination of the seven GIS generated stages, presenting areas across the Berkshire Downs where colluvium generated from ancient cultivated slopes might be located. The class one sites are prominently in catchments 1 and 4 coincident with the major blocks of fields. In catchment 1, however, there are large blocks of fields which occupy the mid or upper slopes and are not captured by the 500m buffer. The prospect that colluvium might be associated with these fields is a question which is addressed during the field checking programme, the results of which are discussed in the next section. Most of the class 1 sites in catchment 1 occupy a tributary valley above Maddle Farm. A large class 2 site exists in the upper part of this catchment.

In catchment 2, the main site is predictably below the only block of east-facing fields in this catchment. In catchment 3 there are no sites because fields in this catchment are on clay soils. Catchment 4 has the largest distribution of class 1 sites most of which occur around Stancombe Farm and along the main valley to the south. In catchment 5, a small class one site exists in the lower catchment while a class 2 site was interpreted from the narrow swathe of field blocks in the upper catchment. In catchment 6 there is a prominent class one site in the upper catchment associated with the only patch of fields in this valley. Despite the large swathes of fields in catchment 7, there is only one small class 2 site because there are few fields within the buffer zones that have an easterly aspect.

CHAPTER SEVEN

FIELD CHECKING THE MODEL : METHODS

7.1 INTRODUCTION

The selection of predicted sites is based on the input of soil, terrain and archaeological parameters which were generated by IDRISI. The explanation of the criteria chosen and the GIS based development of the model culminated in a map of predicted colluvial sites (Fig 18). A programme of field checking was conducted to evaluate the model, undertaken in two phases. The first phase was a general survey which was aimed at testing whether colluvium occurs at predicted and non predicted sites. A second phase, involved more detailed investigation at prospective sites chosen during phase one and aimed specifically at confirming the antiquity of the colluvium.

7.2 PHASE 1 : COLLUVIUM SURVEY

A programme of hand augered test holes (40mm diameter) and small hand excavated pits was undertaken for the purpose of identifying the presence and depth of colluvium. Transects were up to 500m long, across valley edges and valley floors with test holes spaced at 20m or 50m intervals, though occasionally at closer intervals across narrow valleys. Both predicted and non-predicted sites were sampled.

Colluvium was identified during this survey according to criteria developed for the general classification of these deposits by Bell (1986) and Avery (1980). Most prominent among the criteria was the presence of both calcareous and non-calcareous silty soils with or without chalk and flint horizons. Avery (1980) referred to these soils as having weakly developed profiles, uniform in colour, with little evidence of leaching or weathering *in-situ*. Soil depth was another simple indicator. In the examination of ancient field-soil relationships in Hampshire (Moffat 1988) these soils were recognised to be uniformly coloured flinty, silty clay loams, at least 80cm deep, in places overlying buried topsoil horizons containing organic matter. On the Berkshire Downs however, in a landscape of shallow chalky soils commonly less than 30cm deep, any valley soils over 50cm deep were regarded as potential colluvium. With colluvium occupying similar settings elsewhere on the Downland, it was hoped that a significant component of the valley sediments on the Berkshire Downs might also be ancient.

At each test site soils were hand textured with brief profile descriptions including soil texture, colour, stoniness and presence of calcareous or de-calcified horizons (see Appendix 1). In a number of the transects small soil pits were dug wherever flints or chalk rubble prevented augering. The initial identification of potential archaeo-colluvial deposits was for the most part subjective according to the criteria discussed above. The choice of what constitutes a "prominent" colluvial deposit however, on the basis of thickness or density of artefacts is difficult to quantify. A thickness of 40-50cm would appear to be a minimum criteria and was adopted for this project. Shallower deposits would present problems in the identification and construction of sequences and be vulnerable to disturbance by modern ploughing. The field checking of valley sediments in phase 1 was of reconnaissance scale for the purpose of both rapidly eliminating areas devoid of colluvium and noting the distribution of likely ancient deposits. A follow-up and more intensive phase was necessary to confirm the age and stratigraphy of these soils.

7.3 PHASE 2 : COLLUVIUM DATING

The second phase of field checking involved excavating a series of small trenches in valley floors though occasionally at valley edge sites to confirm the antiquity of the colluvium. Trench sites were chosen within some of the prominent or prospective colluvial deposits identified during the auger transect survey in phase 1. The trenches were up to four metres long and 0.5m wide and were excavated to parent material which in the valleys was either Chalk bedrock, Coombe deposits or Clay with flints. After initial excavation, during which un-stratified artefacts were noted, one face of the trench 15cm wide was carefully trowelled to the base, during which stratigraphy was recorded and artefacts were plotted according to two dimensional co-ordinates, following a general methodology observed by Bell (1983). All artefacts recovered in this way were collected for dating and soil cores were taken at 10 sites for dating by Optically Stimulated Luminescence (OSL)(below). Sediment colour, texture and structure, evidence of horizon development, presence of chalk or flinty layers, clay enrichment or old land surfaces were noted in the field and used, in conjunction with sediment dating to identify some broad colluvial chronologies and land use phases.

7.3.1 Dating Methods

As precise chronologies in this study are less important than a verification of the antiquity of the predicted soils, the dating method which best suits these aims is the recovery and dating of human artefacts, most commonly pottery. This is based on the premise that pottery spread on fields by manuring will become entrained in valley sediments and become broadly stratified and therefore representative of past phases of agriculture (Rhodes 1950; Gaffney and Tingle 1991; Bowden *et al.* 1991b). The large concentrations of pottery recovered in colluvial soils on the South Downs (64-250 sherds per m^3) and the frequency of pottery sherds within many sequences of dry valley colluvium across the Southern Chalkland (Allen 1988; 1992), indicate the potential for recovering sufficient quantities of datable material on the Berkshire Downs.

To support dates determined by artefact recovery it was decided to trial Optically Stimulated Luminescence (OSL) on the valley soils of the Berkshire Downs. OSL measures the absorbed luminescence of sediments during their period of burial, a technique similar to thermo-luminescence (Aitken 1985). OSL has been used to date the White Horse of Uffington (Rees-Jones and Tite 1996) which lies near the north west corner of the project area, though this method has not been tested widely within the sediments of the Chalkland dry valleys. As a relatively new technique OSL has opened great possibilities for dating *in situ* sediments which might otherwise be devoid of datable charcoal, bone or archaeological material (Lang and Wagner 1995). OSL sites were chosen, where possible, where they might provide cross-reference dates for the recovered pottery.

7.3.2 Artefact dating and assumptions.

The method of assigning chronology to colluvial deposits using entrained artefacts relies predominantly on pottery typology, though some small pieces of diagnostic metalwork were also recovered. This was achieved by the identification of pottery fabric, colour and decoration. Pottery fragments were assigned general dates after examination by prehistoric and Roman pottery specialists George Lambrick, Paul Booth and Alistair Barclay (Oxford Archaeological Unit), Lisa Brown and Alison MacDonald (Institute of Archaeology, Oxford). Finds were plotted according to two dimensional co-ordinates on the section face and broad archaeological contexts and general chronological relationships were recorded. Particular note was made of the earliest colluvial stratigraphy in each trench site and *terminus post quem* relationships (youngest artefacts recovered from the base of the colluvium) were adhered to throughout the survey.

The chronological relationship of colluvial sediments is based wholly on the assumption that the entrained objects are deposited in a broad sequence, coincident with the successive periods of field use. The possibility of secondary deposition and sediment mixing however must be acknowledged in any study of dry valley sediments which relies on this form of dating.

It is assumed that artefacts arrive in the field either through manuring or as a result of the ploughing up of pre-field occupation debris (Drewett 1982, 209-10). The widespread nature of fragmentary pottery over ancient fields and within lynchets makes manuring a probability, but manuring will only take place as Drewett cautions, when the soil requires it - after a decline in fertility. The deposition level in a lynchet may therefore be a result of erosion from an un-manured field and contain rubbish already on the field from earlier occupation remains or from earlier manuring. A Roman lynchet may for example be the product of exclusively pre-Roman material.

Direct manuring too will leave no archaeological trace and entire episodes of ploughing could be missed or alternately entire episodes of ploughing could introduce false pottery chronologies. Drewett suggests for example that the large quantity of medieval pottery in the top metre at Kiln Combe may have been the result of 18th century ploughing over an old midden. Loose midden material would move rapidly into the valley floor and create a depth of "medieval" soil .

It is also acknowledged that with re-deposited material such as colluvium caution should be exercised in the interpretation of stratigraphic relationships. The process of down-slope soil movement and successive episodes of ploughing over long time periods will prevent precise layering of soils and cultural material. Until submerged beneath the plough zone, the soil material and artefacts may be successively mixed and inverted. Similarly, the action of frost shattering and worms may upset stratigraphy. Recovery of pottery may be residual for example and with such a small sample may merely be the product of random mixing during colluvial formation. In addition, reliance on pottery and assumptions of manuring imply contemporaneity with the earliest phases of cropping. Cultivation may have been in place long before manuring was first applied, similarly the end of Roman cultivation for example, may be difficult to prove as the subsequent Saxon period was relatively aceramic (Bowden *et al.* 1991b).

Despite these potential methodological and stratigraphic problems, the results from earlier colluvial and lynchet investigation studies suggest that the process of lower slope accumulation of colluvium and field lynchets does preserve useful stratigraphic sequences and reliable chronologies (Bell 1983; Bowden *et al.* 1991b). The methodological problems detailed above are recognised and therefore *terminus post quem* dates and broad stratigraphy has been recorded only where obvious. As mentioned, a parallel programme of OSL sediment dating, as a relatively new and alternative method will provide a useful cross reference to the artefact chronologies.

7.4 OPTICALLY STIMULATED LUMINESCENCE

7.4.1 Background

Sediment dating is necessary in a range of research fields, most commonly environmental studies, climatic studies, geomorphology and archaeology. The possibility of dating sediments directly presents (in principle), clear benefits over more common methods which rely on entrained material such as carbon, bones and artefacts. One method which has been adopted and achieved considerable refinement in archaeology is Optically Stimulated Luminescence (OSL) - a technique which uses the natural properties of minerals to absorb radiation and store it as an electrical charge. This electrical signal is drained from sediments when exposed to light and reabsorbed during the period of burial (Fig 19). By laboratory stimulation and measurement of background radiation at the sample site, the amount of stored radiation can be approximated and used to estimate the duration of burial.

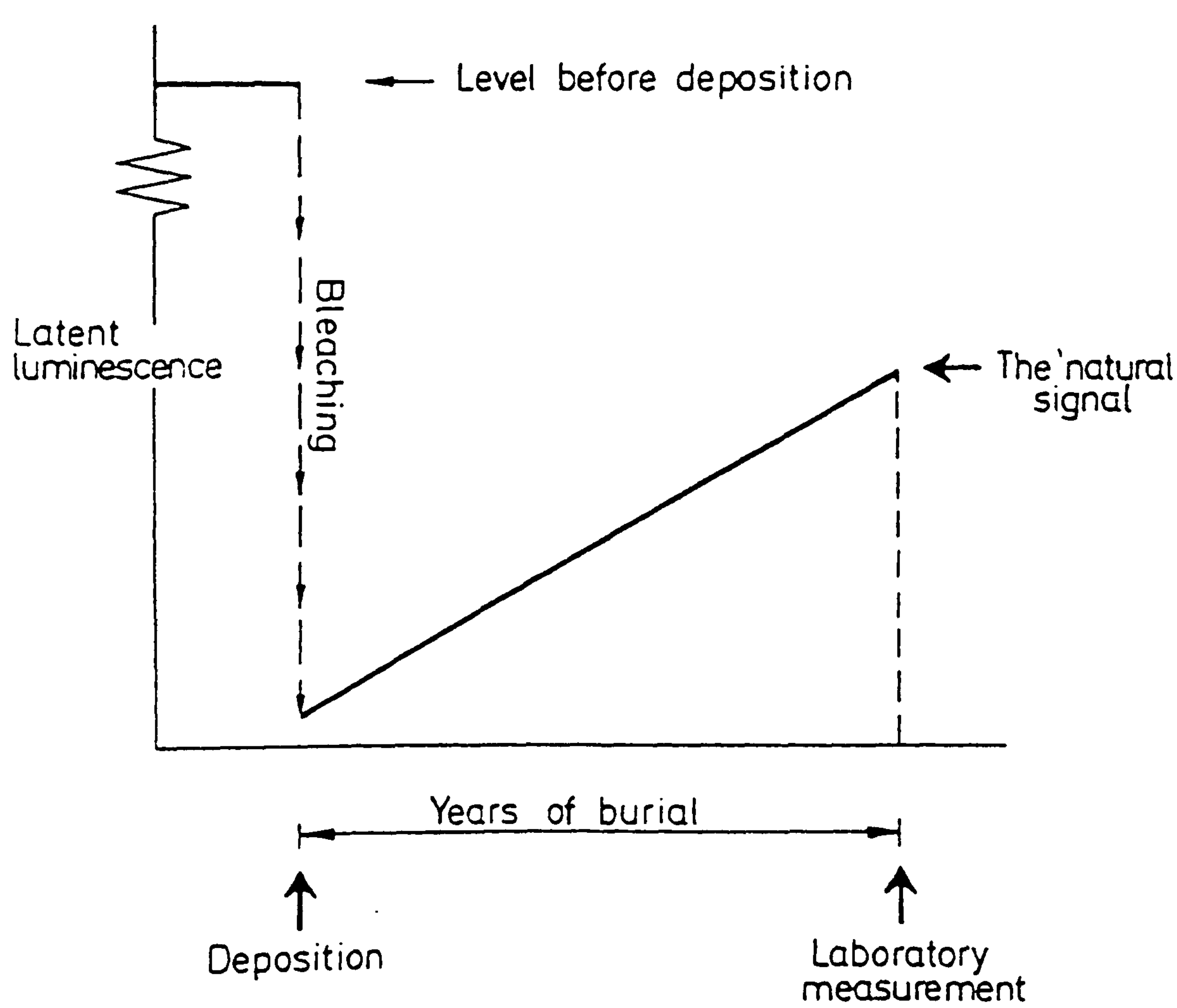


Figure 19 OSL principles (Aitken 1998).

The use of OSL in archaeological studies has produced highly successful results in deep alluvial and wind-blown settings in arid and semi-arid settings. Some notable results include the dating of one of the earliest homonid burials (85,000 years before present (BP)) in south west Egypt (Vermeersch *et al.* 1998) and dating of occupation horizons in cave sediments in Northern Australia at 50-60,000BP which has set earliest human occupation of Australia back some 20,000 years earlier than previous estimates (Roberts *et al.* 1994).

Papers which discuss methodology and case studies are summarised in the Quaternary Science Review. The application of OSL in archaeology are summarised in Archaeometry, a quarterly journal published by the Oxford Research Laboratory for Archaeology. A review of OSL research has been summarised by Wintle (1996). The use of OSL in late prehistoric settings includes that of Lang and Wagner (1995) who dated Neolithic and Bronze Age colluvial sequences in Central Germany.

Use of OSL in Britain has been relatively recent and has been reviewed by Rees-Jones and Tite (1997) and Aitken (1992). This review suggests that the technique in Britain is not without problems. OSL studies have been conducted on coarse and fine-grained sediments (Smith B.W. *et al.* 1990; Perkins and Rhodes 1994; Aitken and Xie 1992 and Parish 1992), though many of the dates determined for these studies are characterised by low sensitivities (the inability of tested sediments to retain a luminescence signal), or errors in excess of 20% with some up to 40% (Rees-Jones and Tite 1997).

Sediments of Palaeolithic to Roman age were dated using OSL at Hengistbury Head and showed agreement with radiocarbon and thermoluminescence results (Smith, B.W. *et al.* 1990). Perhaps the most celebrated use of OSL in Southern Britain has been the dating of the White Horse hill figure at Uffington (Rees Jones and Tite1996). This chalk figure, some 30km south west of Oxford was thought to date to either the late prehistoric or Saxon times. The dating carried out in 1994-5 provides a scientific basis for concluding that the figure dates to around 1000BC. The use of OSL to date sediments in a range of environments has broadened over the past 5 years although there are few examples of OSL dating from Chalkland dry valleys. Nevertheless, the success of OSL on chalky sediments at Uffington offered some promise that the technique might be successful in nearby dry valleys.

7.4.2 OSL Principles

Both quartz and felspar occur abundantly across the earths surface and these minerals are primarily used for OSL dating. Both have slightly different luminescence properties with felspars exhibiting brighter luminescence characteristics.

The discovery that light could be used to stimulate a luminescence signal and to date sediments was made by Huntley *et al.* (1985). OSL uses the principal that natural luminescence is a property of all non-conducting crystalline materials. When insulating minerals such as quartz and felspar are exposed to ionising radiation - whether natural or under laboratory conditions, electrons become released and accumulate in irregularities or traps within the crystal structure. This continual redistribution occurs as long as the felspars are exposed, hence the amount of trapped charge (which can accumulate over less than a second to over a million years) is proportional to both the duration and intensity of the exposure. Exposure to light drains the luminescence signal to zero, hence the trapped charge which had accumulated is removed. On subsequent deposition the mineral grains are again returned to darkness and accumulation of charge begins again.

When the mineral sample is exposed to doses of radiation in the laboratory, the emission of energy as these electrons are re-stimulated produces a luminescence signal which is proportional to the total absorbed dose. Luminescence emission is proportional to the radiation dose received and the luminescence intensity provides the basis for dating.

$$\text{Age} = \frac{\text{total absorbed dose}}{\text{dose per year (U,Th,K)}}$$

After Aitken (1985).

7.4.3 OSL field sampling strategy

Soil cores were taken most commonly where some cross-reference with entrained pottery was possible. As the number of samples which could be processed was limited by time and cost of analysis, it was decided to opt for a range of single dates from sites distributed across the landscape, rather than multiple chronologies at a smaller number of sites. A horizontal core was taken at each of 9 sites as close as possible to depths of recorded prehistoric pottery or in basal parts of the colluvial profile. Two cores were taken at site 4G. The location of sample sites can be seen in figure 57 in Chapter 8. The general sequence of field collection and OSL measurement follows the procedure outlined below.

7.4.4 Field Methods

Steel cylinders of 8cm diameter were driven horizontally into the section face and carefully withdrawn. Both ends of the soil core were sealed and the sample was stored in a light proof bag. The hole from which each soil sample was extracted was re-augered so that *in-situ* gamma radiation dosimetry could be measured.

7.4.5 Dosimetry

Annual dose rates which must be incorporated into the OSL dating calculation (above) refers to the natural radiation received by sediments from the decay of radioisotopes of uranium, thorium and potassium and from cosmic radiation. While in the field, the annual dose rate was measured using a portable gamma spectrometer which measures gamma activity *in-situ* – effectively from within a 30 cm radius of the sample core (photo over page). These measurements were made over 50 minute periods. Gamma radiation fluctuates according to soil water content, hence small sub-samples of soil were taken for water content estimation for use in calibration of final results.

7.4.6 Laboratory preparation

Felspar exhibits brighter luminescence and was favoured above quartz as the OSL technique for dating sediments on the Berkshire Downs. The following procedure was conducted to separate the fine-grained mineral fraction from the raw soil sample. Sample processing was conducted at all times in subdued red/yellow light to prevent bleaching of the luminescence signal. The following process took up to 10 weeks :

- The ends of the sampled soil cores, exposed to light during collection were removed before sample treatment.
- Samples were then treated with 10% hydrochloric acid to remove carbonates. The sediment was left in solution often for many days until any reaction had ceased
- Following rinsing with distilled water, hydrogen peroxide was added to remove organic material, again, a process which may take several days.
- The sample was then rinsed and fine and coarse grains separated to simplify dosimetry calculations. The smaller grains were retained as they carry more evenly distributed

radiation doses. Fine grains were rinsed with distilled water in a centrifuge (3min@3000rpm) often up to 20 times until the supernatant liquid was clear, with clay particles removed in cloudy solution.

- The sediment was washed in acetone to separate very fine grains (4-11 microns) and briefly hand shaken. After a 2 minute settling period, the fine and coarse fractions were decanted into separate beakers.
- The fine fraction was then further washed in acetone for 20 minutes to separate the 1-8 micron fraction (of which a substantial proportion are expected to be felspars). This 3 stage wash and settling process separates the fine fraction sediment for analysis.
- The fine fraction was deposited onto 120 aluminium discs.

7.4.7 OSL method

The mineral fraction on each disc is then subjected to laboratory radiation and corresponding luminescence measurement involving multiple stages. Radiation doses are applied using Elsec 9022 automated irradiators of both alpha and beta sources. Infra-red light was used to stimulate felspar luminescence measured by a photo-multiplier.

Pre-heat plateau

An initial pre-heat phase in necessary to remove unstable energy traps which are not present due to fading of the natural signal after burial, but become filled by laboratory irradiation. This process is required to ensure that only the stable signal is measured. On all fine-grained samples a preheat temperature of 160 degrees was used with the following sequence. 21 discs were exposed to infra-red short shine for normalisation. A process of normalisation is necessary before radiation dosing in order to counter both the variation in sample amount and variation in brightness of sample from disc to disc. Most common wavelengths used are green light (GLSL) and infra-red light (IRSL).

Beta radiation was applied (3 discs per dose point) and all discs were heated to 160 degrees for 30min. Heating and measurements were repeated for intervals of 1,2,4,6 and 8 hours with graphs plotted of time against radiation dose. The plateau segment of the graph (stable signal) denoted the appropriate preheat time. For all the Berkshire Downs samples stable signals were achieved at 2-6 hours.

Equivalent dose

To produce a luminescence signal equivalent to the observed natural signal, additive growth curves were constructed for all samples to calculate Palaeodose or Equivalent Dose (ED). The equivalent dose is an estimate of the total dose absorbed during the period of irradiation (since last zeroing in antiquity). Progressive doses of radiation are applied (the range of dosage chosen to cover the approximated age spread) using 40-60 discs and luminescence is measured producing a graph of light emission for progressive doses of radiation shown in Figure 20. For fine-grained sediments both alpha and beta radiation was used to measure the efficiency of the alpha dosage to stimulate a luminescence signal (Rees-Jones 1996).

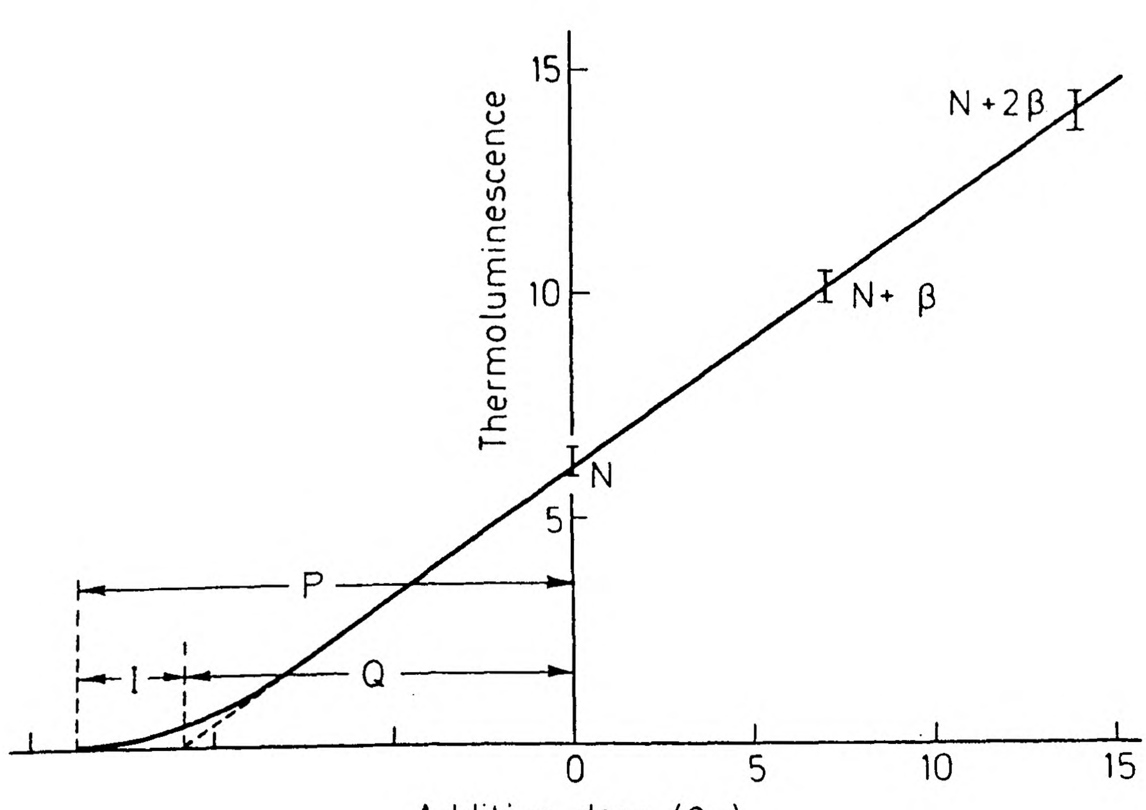


Figure 20 Equivalent dose curve using additive dose method where I = Intercept correction, Q = Equivalent dose, P = Palaeodose and N = Natural signal to which ß radiation doses are added (Aitken 1998).

Pre-heat

A further period of 3 days storage at 100 degrees C followed by several days at room temperature was undertaken to remove any thermally accelerated anomalous fading component (Spooner 1992). Pre-heats indicated by the pre-heat plateau tests were used for constructing additive growth curves for dating.

Final date calculation

The final date ascribed to each sample is a function of both the absorbed dose rate (equivalent dose) and the annual dose rate as described in 7.4.2. Calculations of these incorporate various curve fitting routines and other algorithms. The final statistical uncertainty of the age comes from the propogation of uncertainties on each of these inputs. Data input from the various field and laboratory based measurements were processed by the Plato Elsec computer program. An example of these inputs and final date calculation for one of the sites (T5A) on the Berkshire Downs is shown in Appendix 2(b).

7.4.8 Problems and sources of error with OSL.

Best results are achieved in thick and homogeneous media such as loessic or dune deposits in which there is limited likelihood of sediments mixing after deposition. Annual dose rates are also more reliable in deeper deposits than in excessively leached horizons, surface layers or soil too near to bedrock (of different natural gamma dosage). Shallow samples with thin or irregular sedimentary layers are a potential source of error for OSL measurement. Gamma radiation *in-situ* is measured by the spectrometer for a 30cm radius for example which enables both cosmic and gamma radiation detection from layers above and below the sample point. Radiation may also vary according to daily variations, water content and radioactive dis-equilibrium over the burial period.

Preparation of samples can be very difficult particularly with calcareous and clay rich samples. Even with the most thorough washing and separation, the proper suspension may not be isolated because felspars are weathered or stuck together, coated in iron oxides or calcium carbonate despite repeated HCL washes. In general this implies that for a number of reasons it may be difficult to extract clean felspars.

Errors are possible during laboratory measurement procedures. Luminescence sensitivity changes may occur due to laboratory bleaching, dosing or preheating. The stabilisation of the additive growth curve is fundamental to achieving a reliable Equivalent Dose value. If a sample has been insufficiently bleached, in other words it retains a residual signal, or is saturated, an irregular scatter of points may be produced making it impossible to construct a meaningful response curve. One of the frustrating aspects of the OSL technique is that the prospect of a sample yielding a successful result may not be known until after weeks of processing. In effect there is no way of predicting whether a sample is fully bleached, saturated or retains a residual signal.

Anomalous fading is also possible from felspars, so that quartz is becoming a more favoured technique in British settings (Wintle 1996). Errors are also associated with radioactive source calibration and in the parameters used in converting isotope activities to dose rates. There are also a range of problems which relate to curve fitting and counting statistics in dose rate determination, the accumulated uncertainties of which produce a final uncertainty of 5-20% which is generally incorporated in the age estimate.

CHAPTER EIGHT

RESULTS of FIELD CHECKING

8.1 INTRODUCTION

The map (Fig 18) provides a potential guide to the location of archaeo-colluvial sites on the Berkshire Downs. It was constructed according to a simple set of slope and aspect criteria and on the basis of assumptions about the relative generation of erosion from ancient fields on different soil types, set out in Section 6.3.

The primary aim of the field checking programme is to evaluate the model by determining the broad pattern of colluvial distribution at both predicted and non-predicted sites. A reconnaissance auger survey (phase 1) revealed the presence and depth of colluvium while a follow-up programme of targeted trenches (phase 2) examined the age and composition of these sediments. It was decided that for a regional survey of this nature, recovery and dating of artefacts (predominantly pottery sherds) following the methodology used by Bell (1981a, 1983) and described in Section 7.3, be the main method employed to provide a general date for the colluvium. A second trial dating technique using Optically Stimulated Luminescence was used to attempt to provide a cross-reference with any recovered artefacts.

8.2 RESULTS OF COLLUVIUM TRANSECT SURVEY : PHASE 1

The method by which potential colluvium was determined was from soil investigation along auger transects, the locations of which are shown in Figure 21. Valley cross sections and summaries of the soils and colluvial information are shown for each of the catchments in Figures 22 - 55.

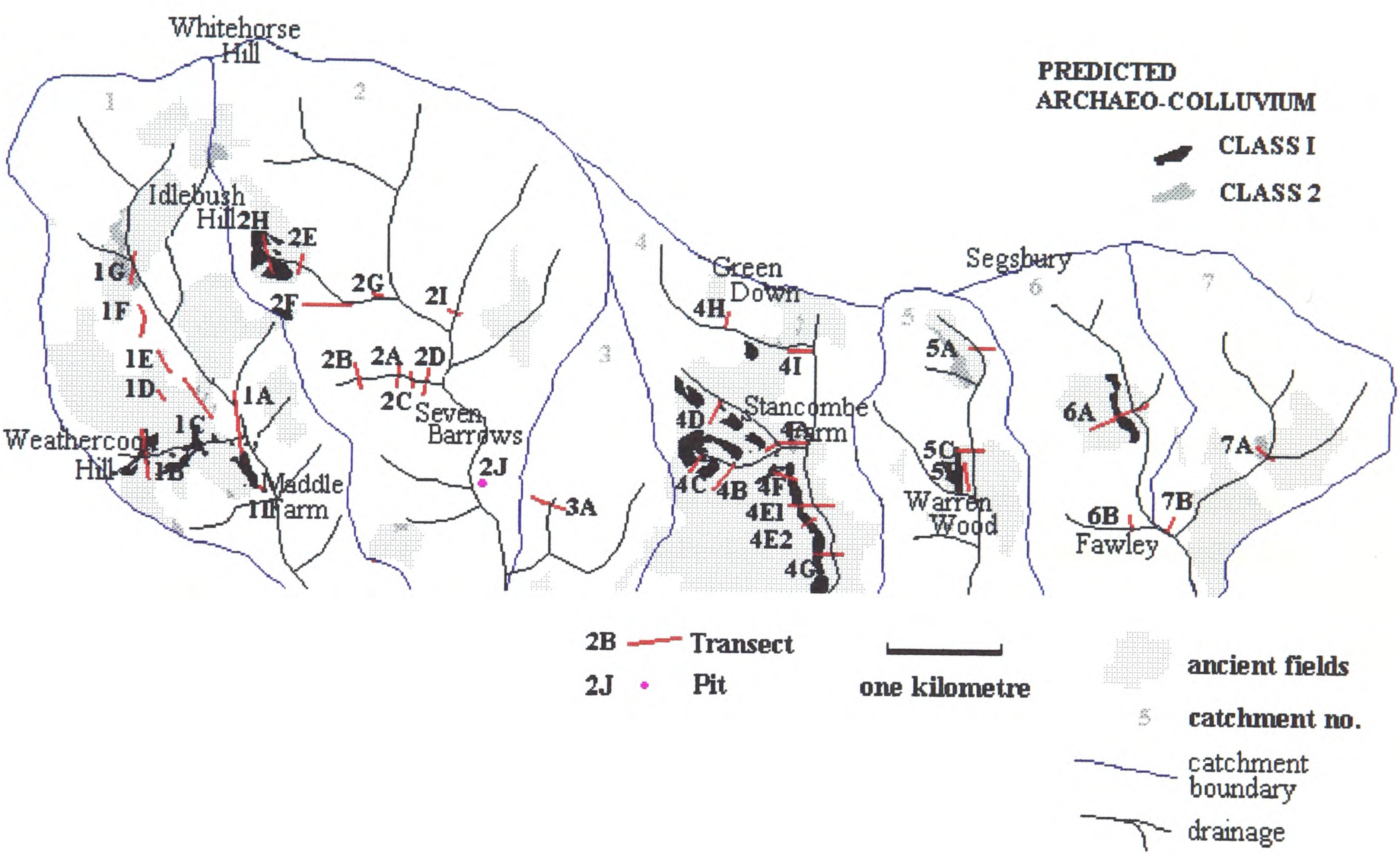


Figure 21 Valley transects

Catchment One

Transect 1A

Transect 1A (Fig 22) was aligned northwards from Maddle Farm for some 900m across two small tributary dry valleys, the main trunk valley and the opposite slope. The soils of the region are lower slope Charity series and valley floor Coombe series soils. Archaeo-colluvium was not predicted in this locality though it was decided to investigate whether colluvium existed in association with Charity soils on the lower east-facing slopes, in the main dry valley, or at the base of slopes on the opposite side of the valley. Soils were investigated at 25m intervals across the smaller tributary valleys with wider spacing of 50m across the main valley.

The auger survey revealed reddish-brown de-calcified Charity soils up to 1m deep above both silty drift and Coombe deposits. Colluvium up to 40cm deep was recorded in the small east-facing tributary dry valleys (auger sites 9-12, 16-18), while in the main broad trunk valley and at the northern end of the transect, colluvium was calcareous, very flinty and less than 30cm deep (auger sites 27 –29). These results suggested that the prediction was accurate at this site with almost negligible shallow and flinty colluvium common in both the main and smaller dry valleys.

Transect 1B

Transect 1B (Fig 23) was 425m long, oriented south-north across predicted sites in a dry valley tributary below Weathercock Hill. It also extended across the mid-slope of Weathercock Hill to investigate whether colluvium exists in association with ancient fields in a part of the catchment otherwise excluded by the model. Auger holes were spaced at 50m intervals with closer (25m and 12m) spacing across some of the valley floors. Dark chalky colluvium up to 60cm thick was confined to the tributary valley at the southern end of the transect (auger sites 4-8), a site chosen for an exploratory trench. The model proved accurate within the tributary valley and also substantiated the prediction that colluvium does not appear to be preserved in mid-slope within or below the large block of ancient fields in this catchment.

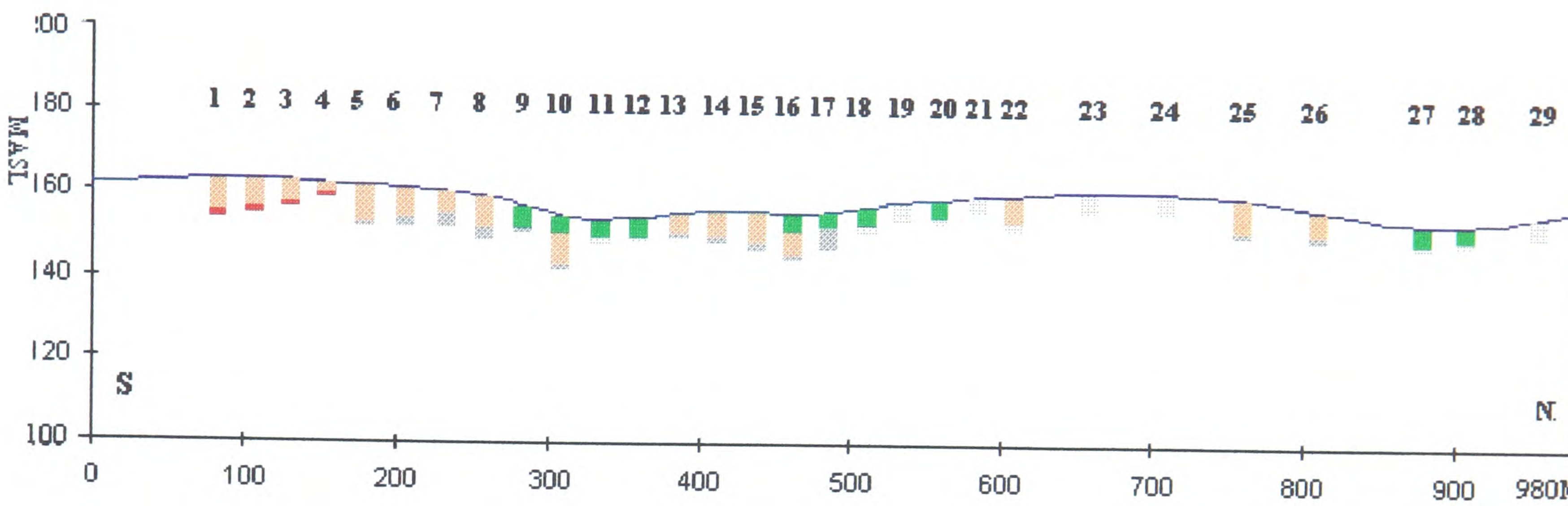


Figure 22 Transect 1A

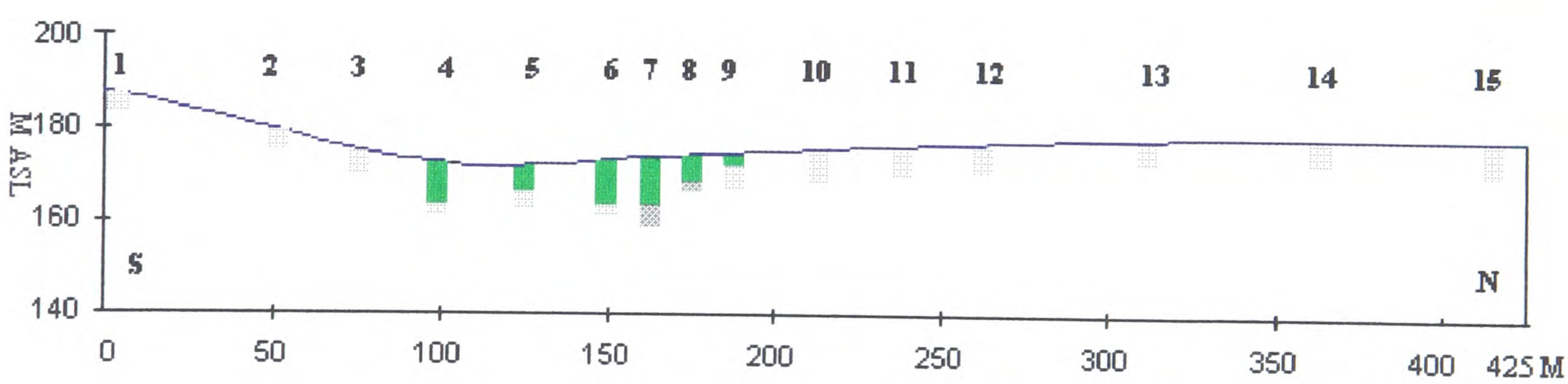


Figure 23 Transect 1B

KEY TO VALLEY PROFILES

Colluvium

Chalk bedrock/ shallow Icknield soils

Coombe deposits

Charity/drift soils

Clay with flints

Flinty(impenetrable)

Pleistocene Sands

SCALE (CM)

0
25
50
75
100

Transects 1C-F were aligned across valley floors and Charity soils in the upper part of catchment 1 to investigate the association of these soils and the silty drift deposits on which they have formed (Jarvis 1973) with ancient fields and archaeo-colluvium. Transects 1C-E were across Charity soils in the lower slope in the western part of the Berkshire Downs north of Maddle Farm. Colluvium was not predicted here as the ancient fields lie beyond the 500m slope buffer zone.

Transect 1C

Transect 1C (Fig 24) extends for 450m across a large bench-like Charity series unit some 600m north-west of Maddle Farm. Auger holes were dug at 50m intervals with more closely spaced holes in the valley bottom. Reddish-brown de-calcified silty soils were recorded across this transect matching the Soil Survey description for Charity series soils (Jarvis 1973, 42). While the age and origin of the Charity soils remain ambiguous, the soils found along this transect do not appear to comply with descriptions of colluvium defined by Avery (1980). Silty de-calcified colluvium derived from the Charity soils, up to 60cm deep, was recorded in the centre of the small valley at the northern end of the transect (auger sites 7, 9-10). This particular dry valley was too small to be included as one of the trunk valleys or tributaries and was therefore excluded by the model.

Transect 1D

Transect 1D is only 120m long across a small dry valley in a mid-slope position north of transect 1C. Though located within the large block of fields, less than 25cm of calcareous colluvium was found in the centre of the valley (Fig 25).

Transect 1E

Transect 1E is 275m long aligned across the same dry valley as transect 1D, though some 400m down-slope (Fig 26). The transect traversed Charity series soils at a locality not

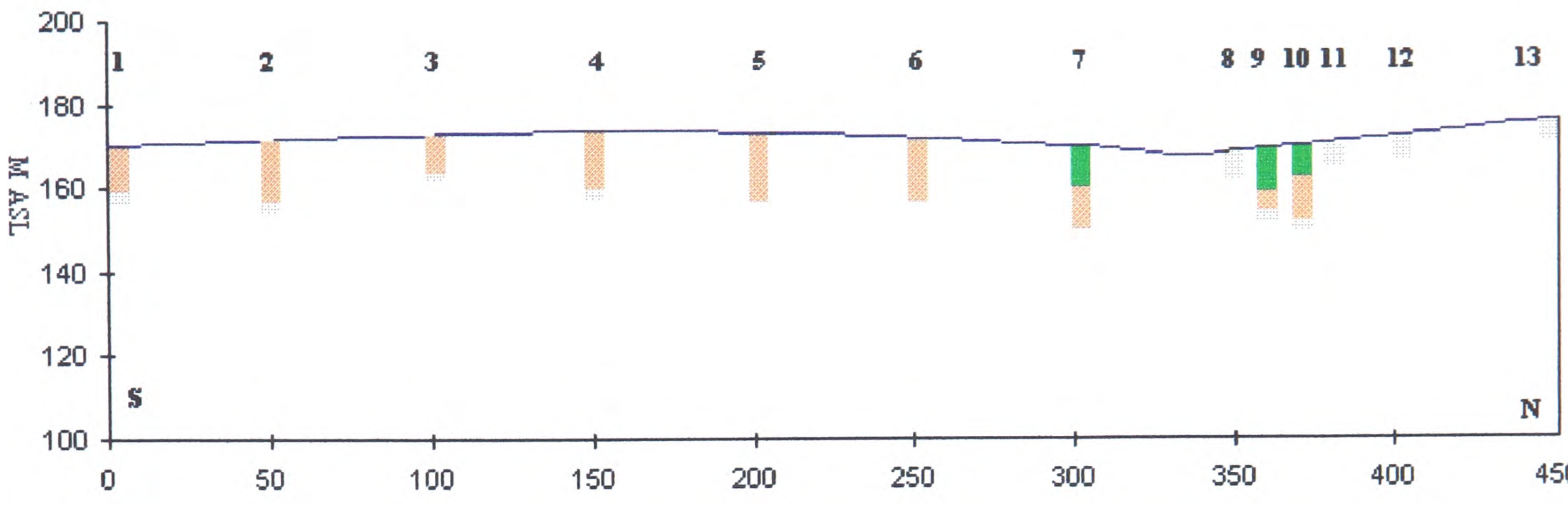


Figure 24 Transect 1C

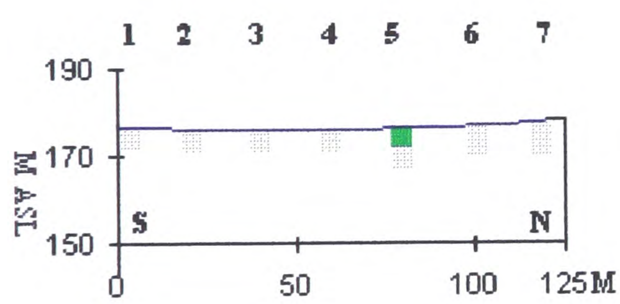


Figure 25 Transect 1D

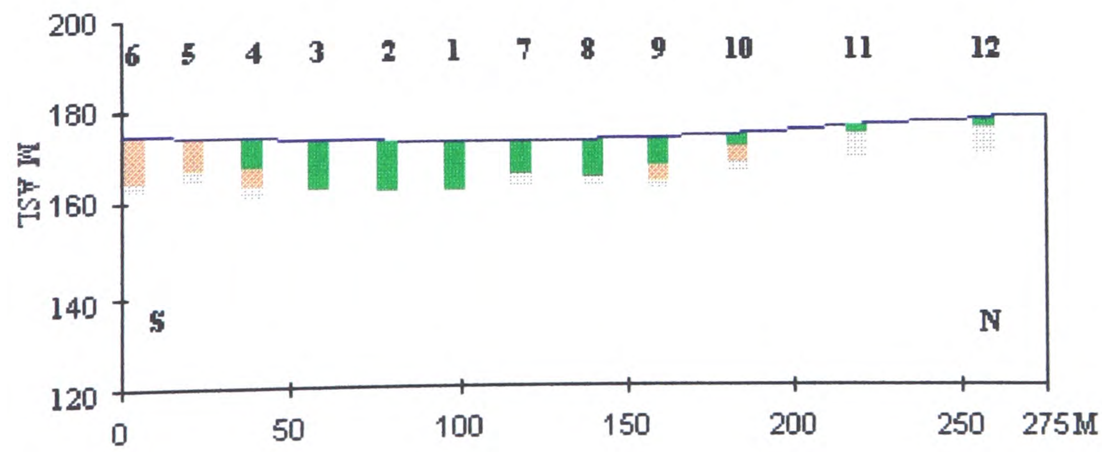


Figure 26 Transect 1E

predicted by the model. De-calcified silty material up to 60cm deep, provisionally characterised as colluvium, and derived from the Charity soils was recorded across the broad valley (auger sites 4-9). While these deep reddish-brown de-calcified sediments in mid and lower slope positions do not appear to be the product of human activity, an exploratory trench site was chosen at the centre of this transect.

Transect 1F

Transect 1F is 275m long across two shallow dry valleys to the north of transect 1E. Valley soils were calcareous, very shallow and commonly less than 25cm deep (Fig 27).

Transect 1G

Transect 1G is 225m long across predicted class 2 colluvium. Valley soils were over 50cm deep throughout this broad valley, with deep chalky colluvium up to 80cm deep recorded at auger sites 6-7 (Fig 28). The presence of deep light brown chalky colluvium was distinctly different from the shallow dark brown calcareous and flinty material elsewhere in catchment 1 and suggests colluvial fan deposition (Bell 1986; Allen 1991). The centre of this transect was designated for an exploratory trench.

Catchment 1 : Summary

Apart from shallow calcareous colluvium in transect 1B, the only substantial lower slope and valley edge material revealed by the auger transects in catchment 1 were Charity series soils, with de-calcified silty colluvium derived from these units deposited in the small tributary valleys floors. It was difficult to prove the anthropogenic origin of either the colluvial soils or underlying drift deposits according to simple field criteria, therefore an exploratory trench was chosen along transects 1E. In the broad central valley colluvium was commonly shallow calcareous and flinty. The presence of deep chalky colluvium in transect 1G appeared to be anomalous and an exploratory trench was chosen in the centre of transect 1G.

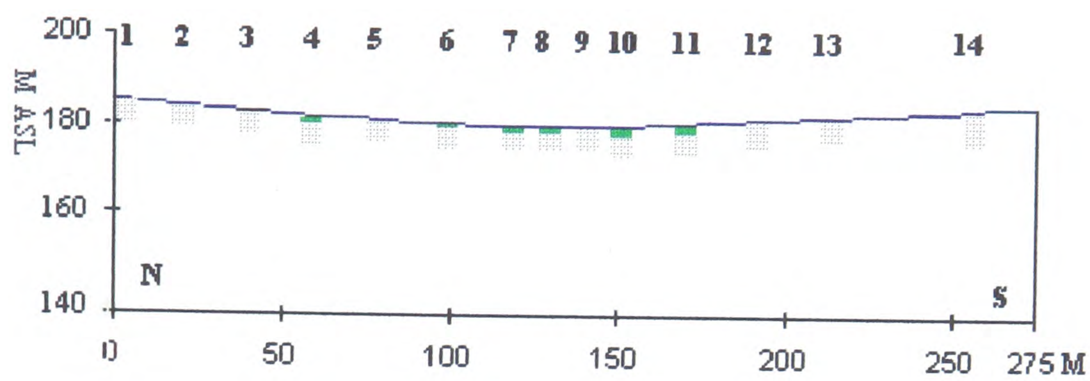


Figure 27 Transect 1F

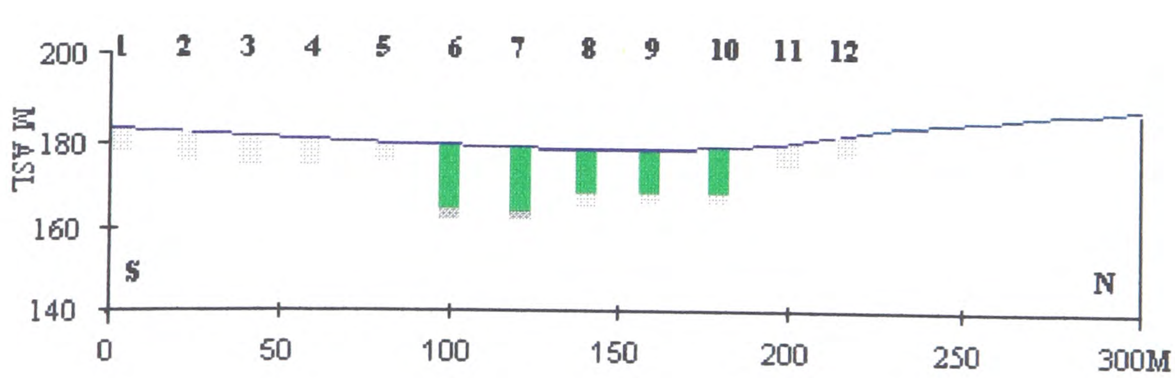


Figure 28 Transect 1G

The dry valley at Transect 1G

Catchment Two

Colluvium was predicted in association with a small and isolated patch of ancient fields in the upper part of this large catchment. Transects in catchment 2 were oriented across both the upper and the lower valley and smaller east-facing tributary dry valleys. The auger surveys in this catchment had the purpose of both testing the model prediction and whether the assertion that colluvium was absent around the Seven Barrows (Bradley 1975; Richards 1986) was true for the rest of the catchment.

Transect 2A

Transect 2A is only 50m long with auger sites spaced at 25m intervals across a small dry valley east of the Seven Barrows cemetery (Fig 29). In the centre of the valley colluvium up to 75cm deep, with a sandy horizon containing charcoal at 50-55cm was recorded.

Transect 2B

Transect 2B is some 300m further down-slope on the same dry valley as transect 2A (Fig 30). Two auger holes located in neighbouring dry valleys revealed an absence of colluvium with valley soils less than 25cm deep. A shallow pit was excavated where augering was difficult and revealed shallow chalky rubble.

Transect 2C

Transect 2C lies some 500m up-slope from transect 2A across the same dry valley. A short 50 m transect revealed valley soils less than 25cm thick (Fig 31).

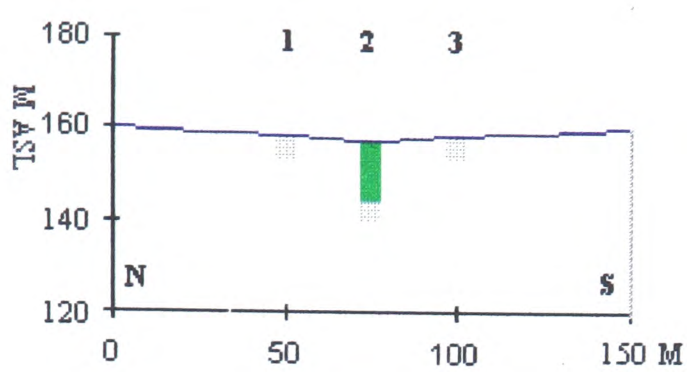


Figure 29 Transect 2A

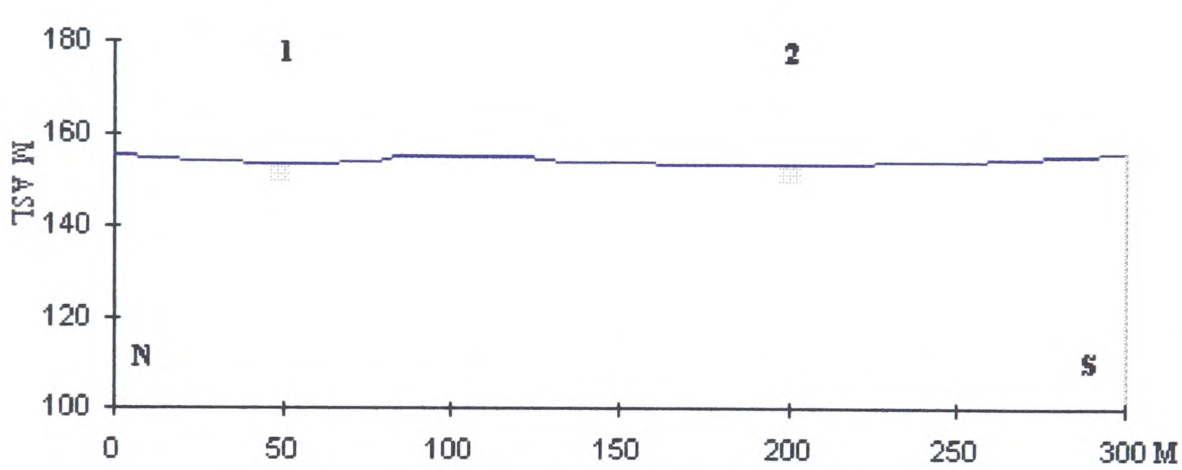


Figure 30 Transect 2B

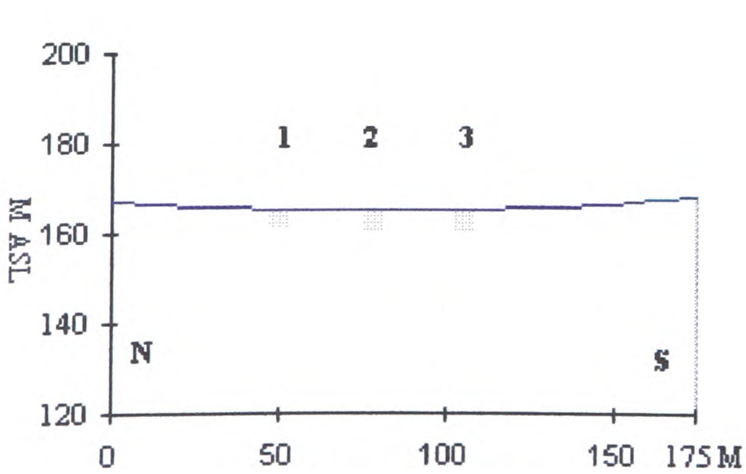


Figure 31 Transect 2C

Transect 2D

Transect 2D is 250m long and lies across the flatter part of the lower valley where this tributary joins the central valley (Fig 32). Soils were very flinty with shallow colluvium less than 30 cm deep recorded in only one of the auger holes. Pit 2D was dug in the centre of the flat-bottomed valley along this transect. This revealed very flinty Coombe series soils less than 35cm thick with no artefacts.

Transect 2E

Transect 2E is 50m long across a small dry valley below Idlebush Hill. The soils of the hillslopes are extremely shallow and chalky and soils were only 25cm thick in the valley floor (Fig 33).

Transect 2F

Transect 2F is oriented east-west and follows a gently sloping valley for 525m, south of transect 2E (Fig 34). The purpose here was to investigate the prospect of colluvial deposition below the long slopes characteristic of this catchment. Shallow Icknield soils were recorded for the length of the transect with a complete absence of colluvium.

Transect 2G

Transect 2G is only 50m long in the centre of a dry valley in the lower landscape below Idlebush Hill (Fig 35). There were only two auger holes, spaced at 50m, and both revealed less than 20 cm of flinty colluvium. A small pit, P2G, was centred in the middle of this transect. Archaeo-colluvium was predicted in this valley though both the pit and auger holes revealed less than 20cm of chalky soil above chalk bedrock with no artefacts.

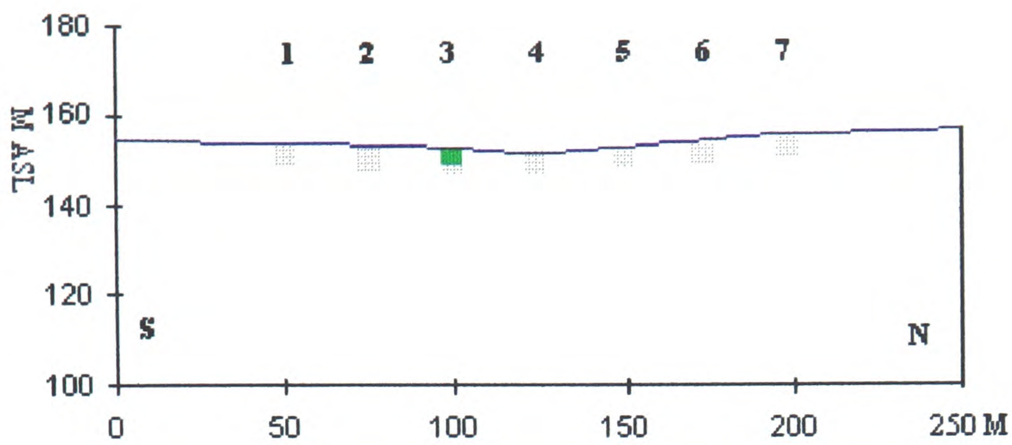


Figure 32 Transect 2D

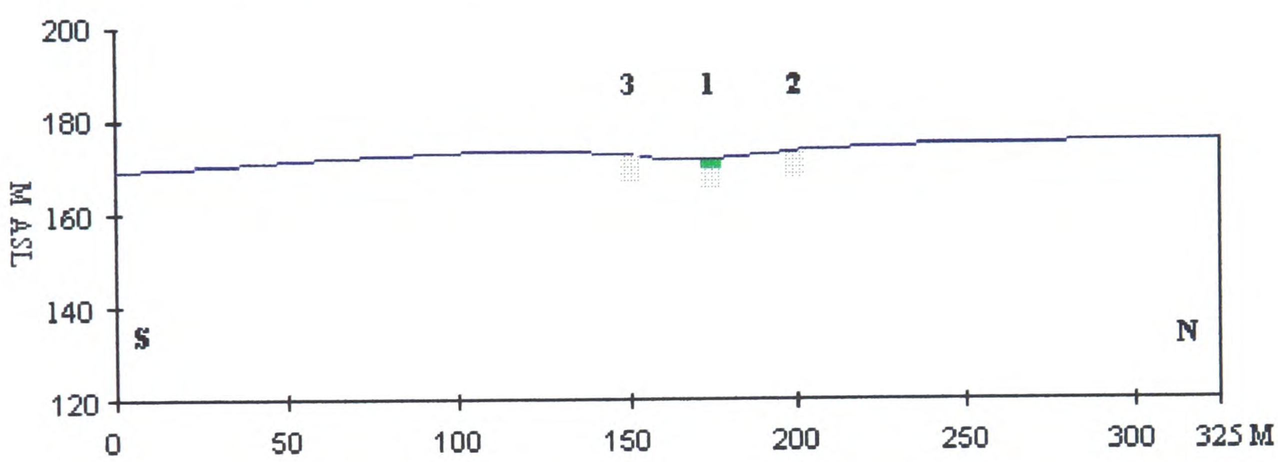


Figure 33 Transect 2E

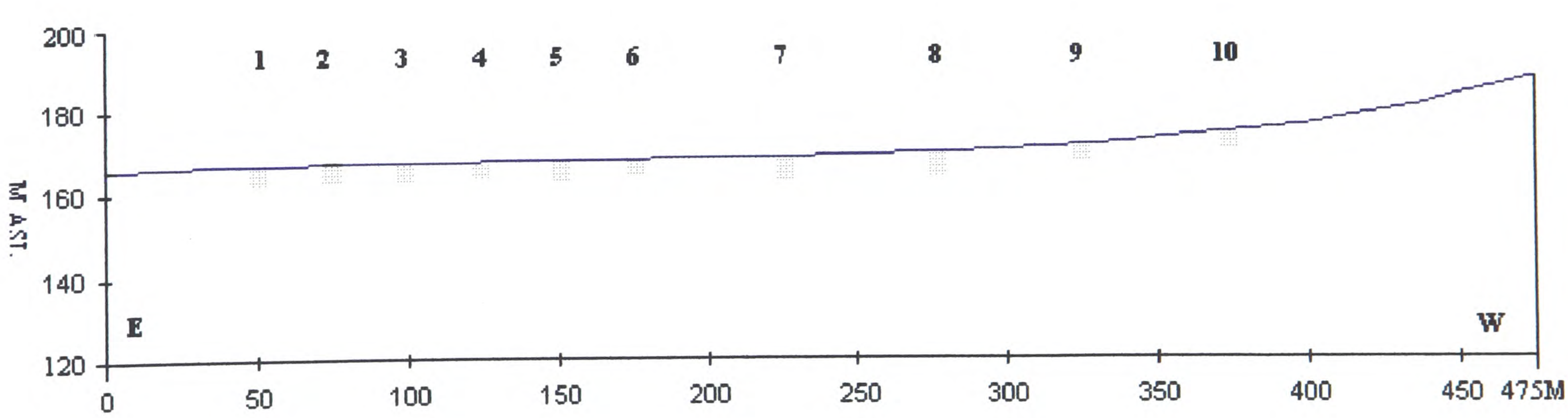


Figure 34 Transect 2F

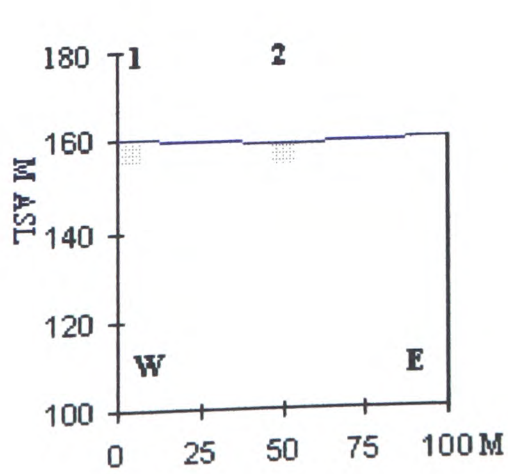


Figure 35 Transect 2G

Transect 2H

Transect 2H is 325m long across the only predicted colluvium in upper part of catchment 2. Throughout the transect soils were extremely shallow with depths of less than 25cm recorded in the valley floor (Fig 36). Despite the presence of the only block of ancient fields in this catchment, there was a complete absence of colluvial soils even in the valley bottom.

Transect 2I

Transect 2I is a very short transect across one of the main tributary dry valleys in the mid-upper catchment which drains west-facing slopes. There were three holes in and around the centre of the valley which revealed extremely shallow soils (Fig 37).

Pit 2J

Pit 2J was dug within the Seven Barrows cemetery between the cluster of round barrows. The valley soils here were extremely flinty and less than 40cm thick above chalk bedrock Again there were no artefacts (Appendix 1).

Catchment 2 : Summary

Soils were very chalky and shallow across both the slopes and the valley floors of catchment 2, confirming and extending earlier observations about the absence of colluvium both in and around the Seven Barrows region. The survey also showed significantly that considerable removal of soils from the surrounding slopes has occurred. In the only predicted site in the upper catchment, below Idlebush Hill, colluvium was completely absent. The only site where colluvium was recorded was confined to the centre of transect 2A, which given the broad absence of colluvium and valley soils throughout the rest of the catchment might be considered anomalous.

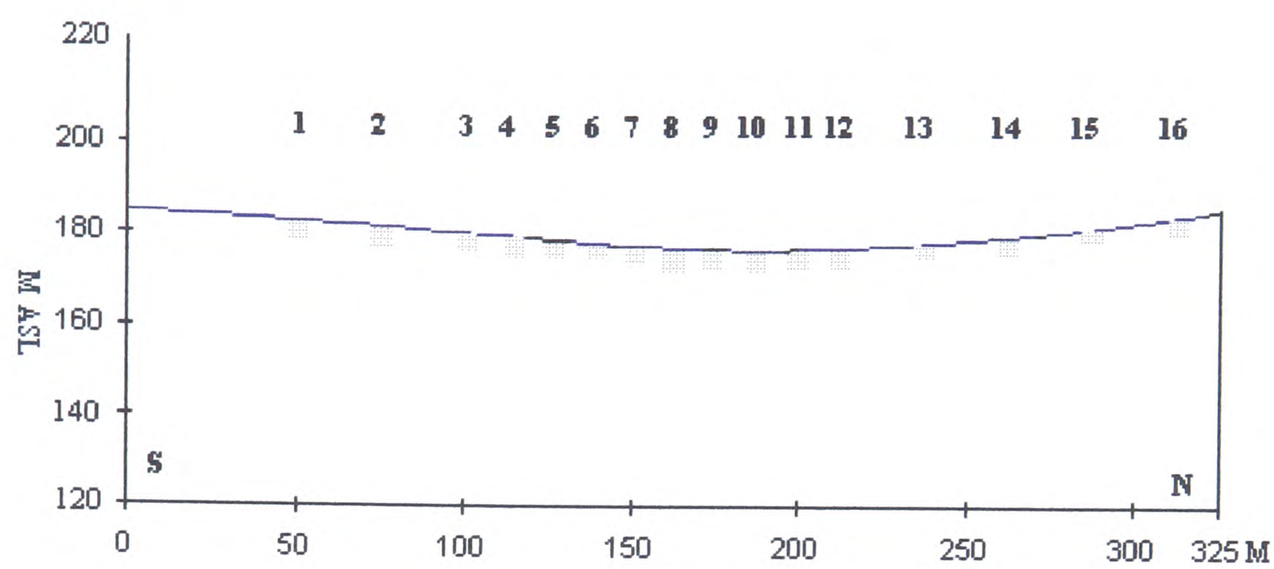


Figure 36 Transect 2H

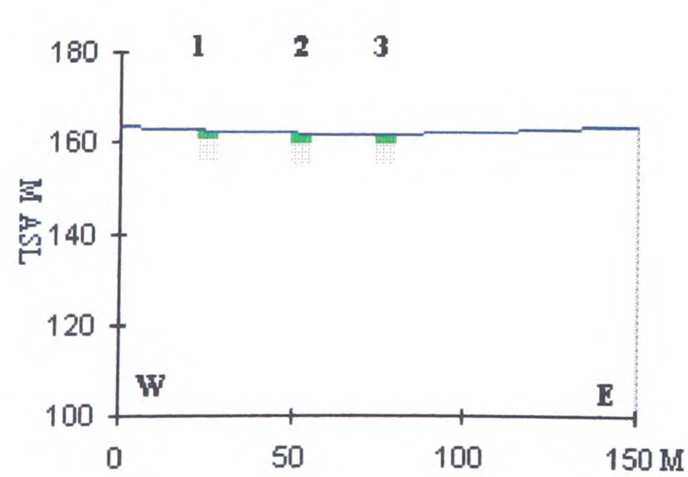


Figure 37 Transect 2I

Catchment 3

There was only one transect in this small catchment which is uniformly occupied by soils derived from Clay with flints. A small patch of ancient fields exists in the upper part of this steep sided dry valley and there were no sites of predicted colluvium. To check the accuracy of the model, a transect was established through the centre of the catchment with auger holes spaced at 25m intervals (Fig 38). Some 40cm of dark loam and large flints were shown to occupy the narrow valley centre. The absence of ancient fields and presence of shallow and flinty valley soils ruled this catchment out as a site for any further colluvial investigation.

Catchment 4

Transects in catchment 4 were oriented across both the main trunk and east-facing tributary valleys. A large block of ancient fields occupies most of the southern half of this catchment and colluvium was predicted along all adjacent valley floors and edges. Catchment 4 possessed the largest concentration of predicted colluvial sites across the Berkshire Downs due to the widespread distribution of ancient field systems, chalk soils and east-facing slopes. Small second-class predicted sites exist in the upper catchment. The soils of the lower slopes and valleys include Charity series, soils derived from drift units and Clay with flints. It is worth noting that there are only very small patches of Clay with flints on the hillcrests within this catchment though the presence of soils derived from them on the lower slopes implies that much larger Clay with flint patches must have once existed.

Transect 4A

Transect 4A is 300m long across predicted colluvium and both a tributary and main dry valley south of Stancombe Farm (Fig 39). Auger holes in the bottom of both valleys revealed silty and flinty non-calcareous colluvium, between 60cm and 80cm deep, in areas mapped as Charity soils.

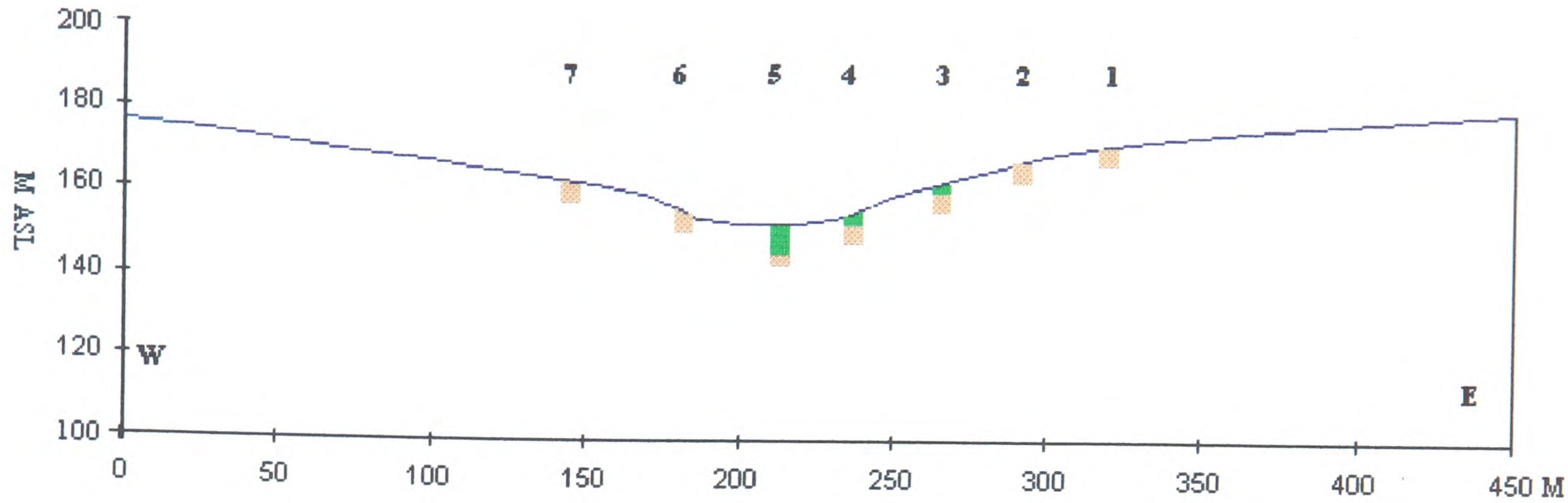


Figure 38 Transect 3

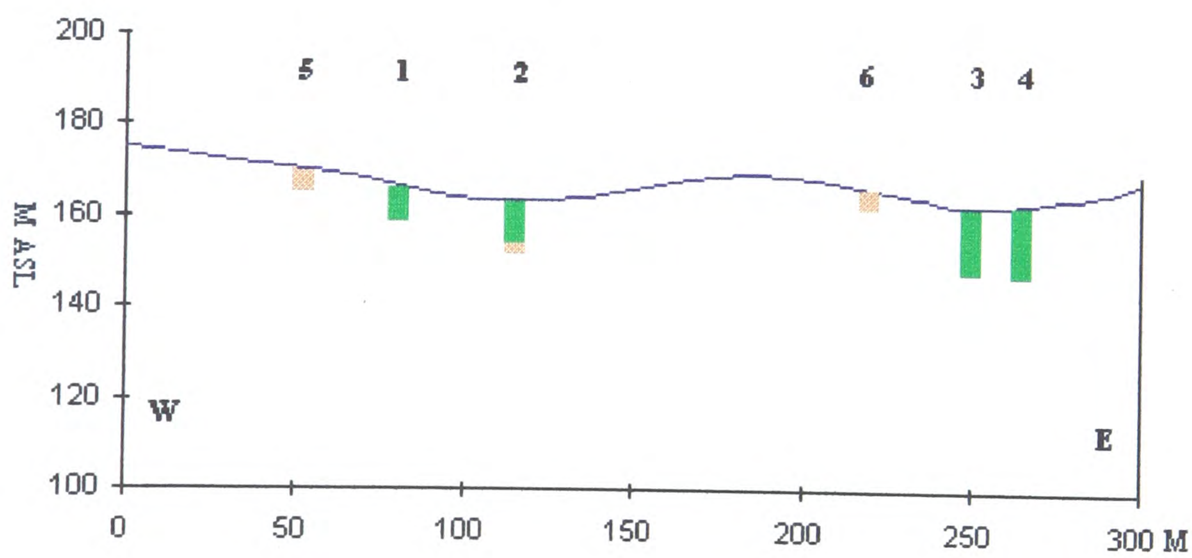


Figure 39 Transect 4A

Transect 4B

Transect 4B was aligned west-east for 300m between the mid and lower slope above Stancombe Farm near to predicted colluvium and within a small block of extant field lynchets (Fig 40). The first auger hole was within the lower of the cross-field lynchets and revealed light brown chalky colluvium to a depth of 95cm. At two sites 50m and 100m further down-slope (auger sites 2 and 3), small pits were excavated as large flints prevented augering. These revealed flinty colluvium to 55cm over flinty drift to 70cm above Chalk. Further down-slope, soils were extremely flinty preventing any effective estimate of colluvial depth. While colluvium in the upper part of this transect was about 55cm deep, the main feature of soils along this transect was the presence of deep flinty material.

Transect 4C

Transect 4C is 150m long and aligned down an east-facing slope about 300m west of transect 4B. In the mid and lower section of this transect Roman pottery was noted in the surface soil (Fig 41). Chalky Icknield soils were recorded in the upper part of the transect but further down-slope at auger sites 3 and 5, pits were excavated where flints prevented augering. These revealed up to 60cm of dark brown flinty loam over chalk. Pieces of Roman tile were also noted at a depth of 50 cm in pit 4C5. Further down slope brown flinty loam was 60cm deep above a thin layer of Clay with flints and chalk at 80cm. This transect revealed archaeo-colluvium with the presence of deep loamy colluvium and both surface and buried artefacts. A trench site was chosen adjacent to auger site 6.

Transect 4D

Transect 4D was aligned south-north for 175m from mid to lower slope across predicted colluvium in a tributary dry valley north of transects 4B and 4C (Fig 42). Thin chalky soils were common in the upper part of this transect with deeper flinty soils on the mid and lower slopes. Pits were excavated at auger sites 4,6 and 7 revealing shallow colluvium over silty drift and flints to depths of 60cm. On the edge of the dry valley thin de-calcified silty soils are 35cm

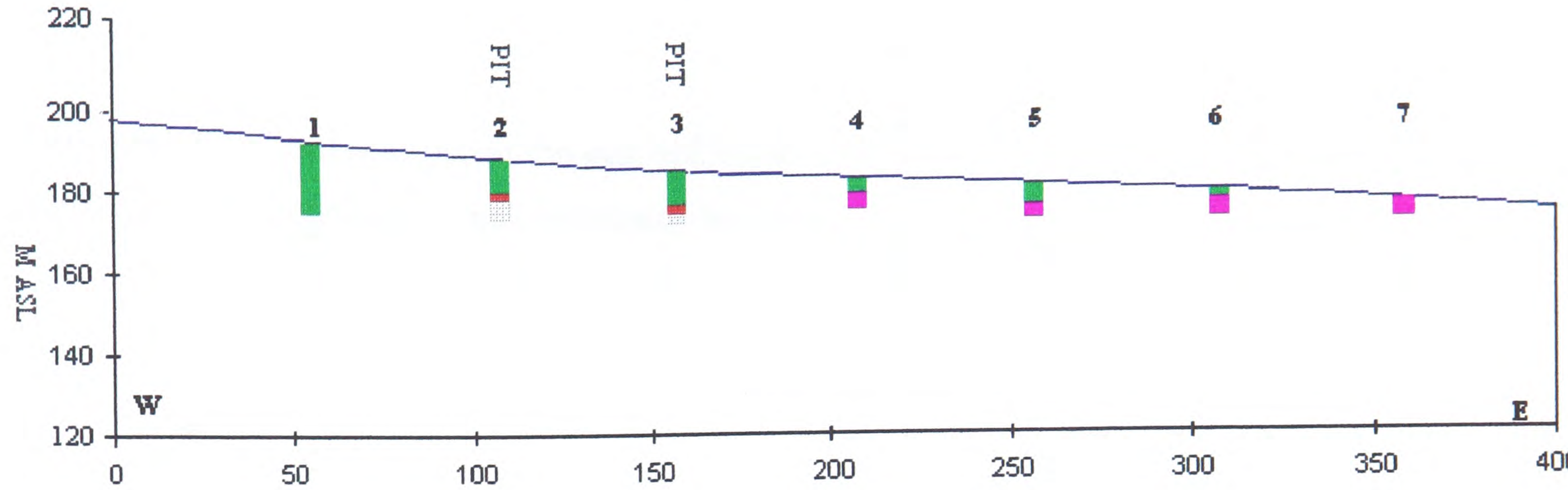


Figure 40 Transect 4B

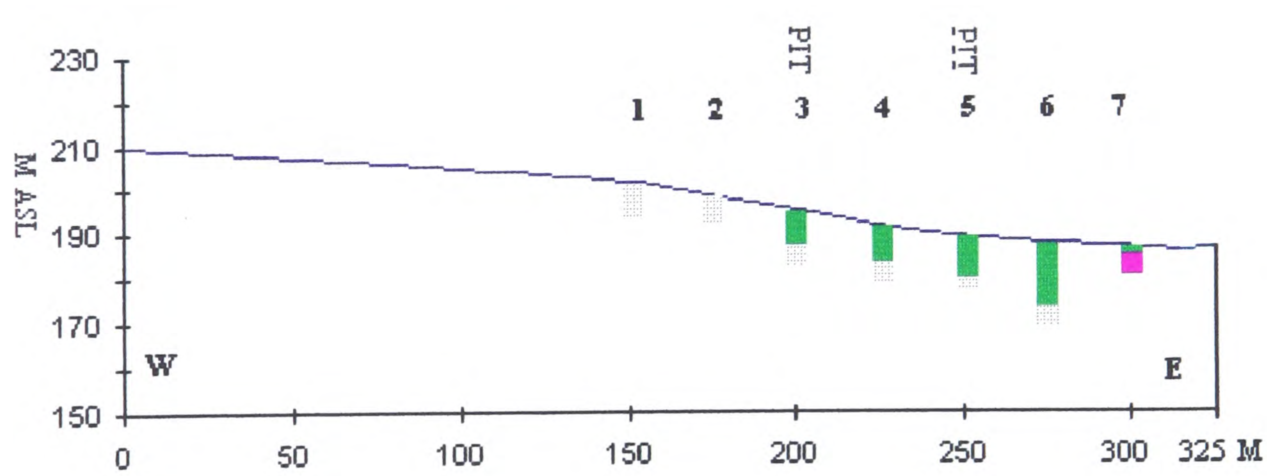


Figure 41 Transect 4C

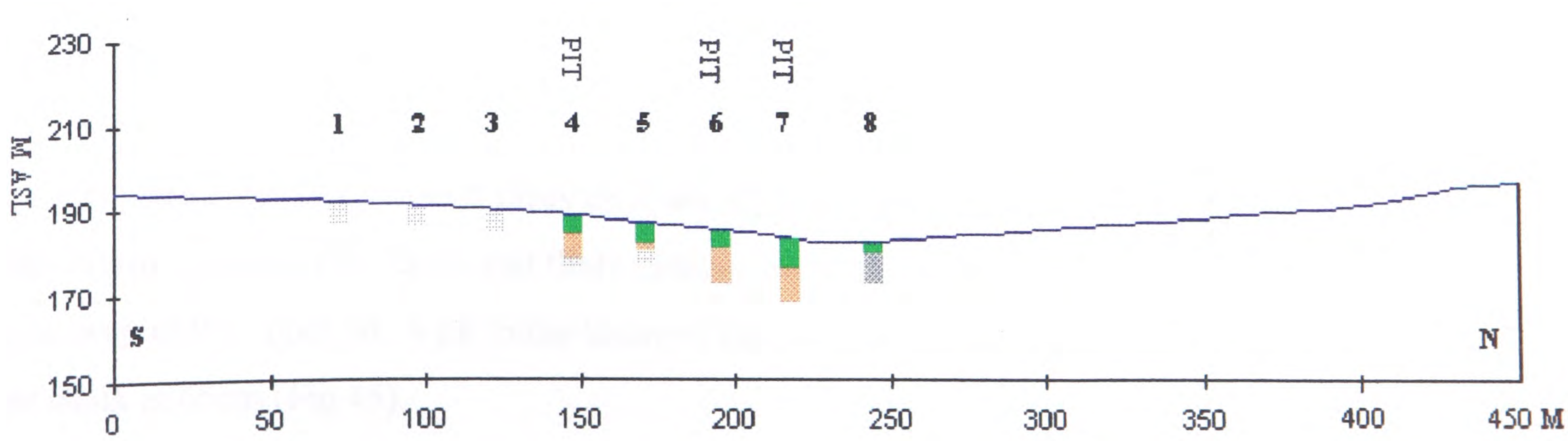


Figure 42 Transect 4D

deep over Coombe deposits. De-calcified soils along this did not appear to be colluvial and an exploratory trench was not designated for this transect. Thin flinty calcareous colluvium was confined to the centre of the tributary valley.

Transects 4E - G extended across the east and lower west-facing lower slopes of the main trunk valley in catchment 4, south of Stancombe Farm.

Transect 4E1

Transect 4E1 is 250m long and extended across both sides of the main valley to investigate whether colluvium was present where predicted - on the east-facing slopes, and absent on the steeper west-facing slopes (Fig 43). Shallow Icknield soils were common across the length of the transect with very shallow colluvium in the valley centre. Two auger holes on the opposite slope also revealed an absence of colluvium.

Transect 4E2

Two auger holes were dug in a small tributary valley 100m south of transect 4E. Flints prevented augering and a pit was dug at the lower of the auger sites (Fig 44). This revealed dark brown chalky colluvium over lighter brown silty Charity soil with chalk at 65cm. An exploratory trench was chosen for this site.

Transect 4F

Two pits were excavated through flinty deposits, 80m apart, in the centre of a tributary dry valley north of transect 4E. Silty and flinty colluvium overlies silty drift at 50cm with chalk 70cm deep in the upper pit. A pit in the lower of the two sites revealed flinty silty colluvium over chalk at 65cm (Fig 45).

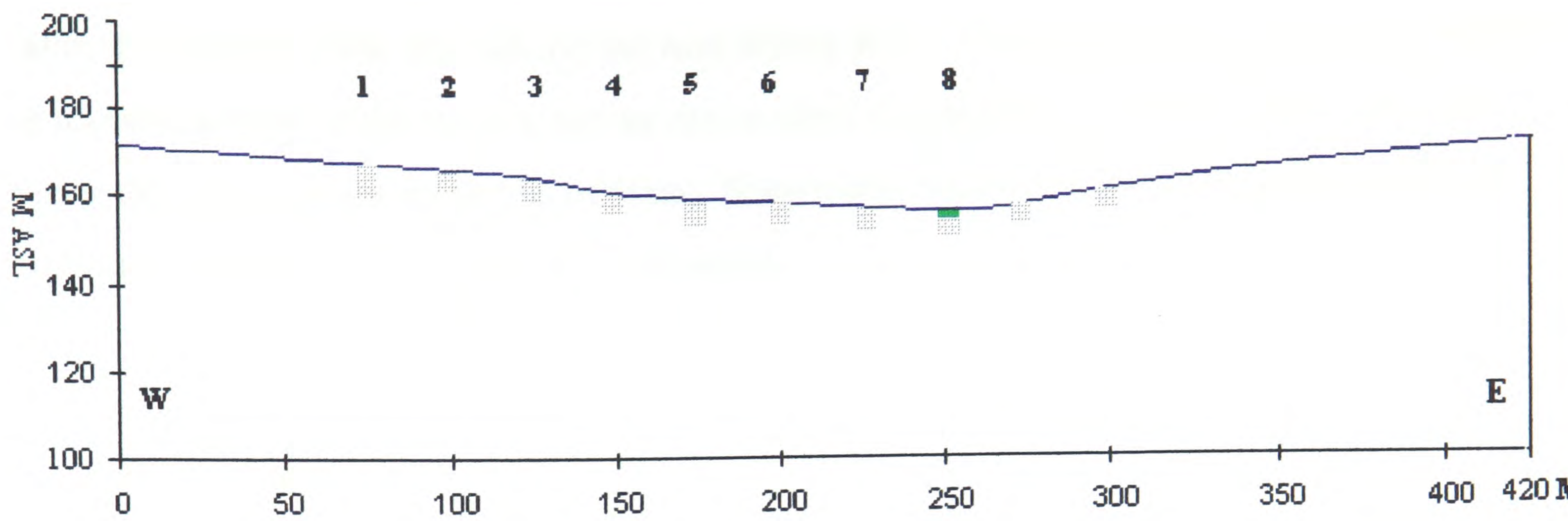


Figure 43 Transect 4E1

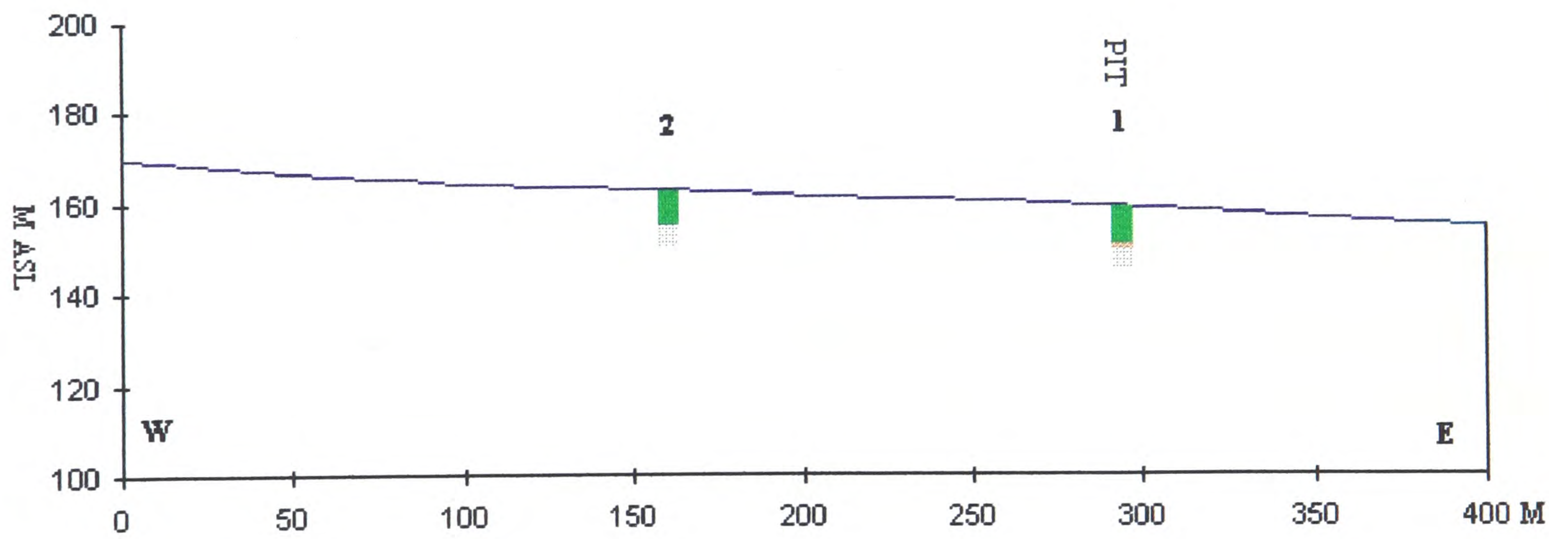


Figure 44 Transect 4E2

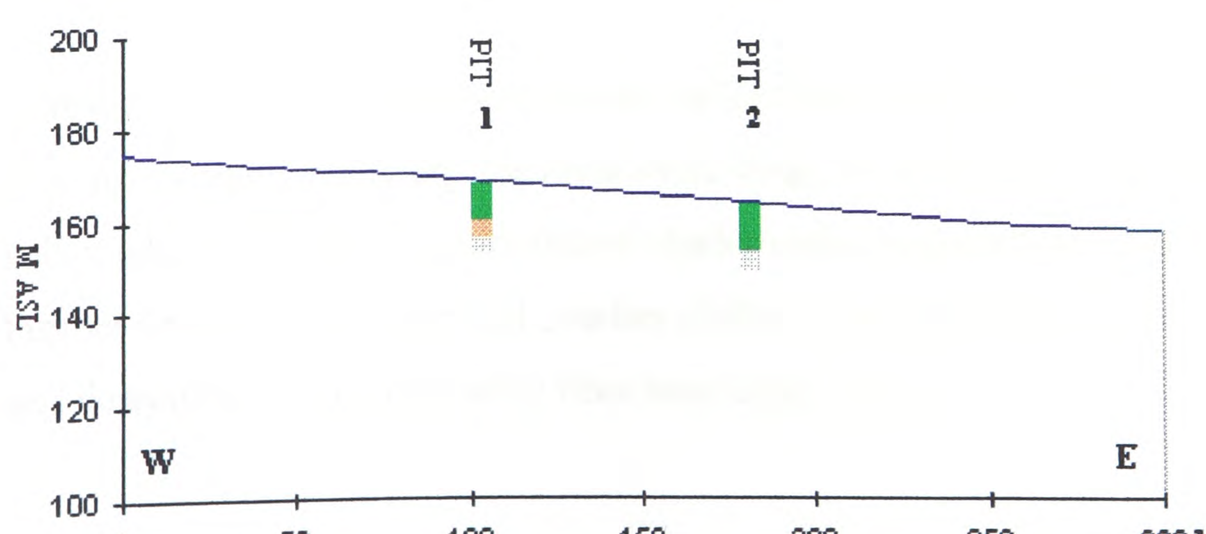


Figure 45 Transect 4F

Transect 4G

Transect 4G extended from the lower east-facing slope above the main valley to the west-facing slope opposite (Fig 46). Surface soil was very flinty and three pits were excavated in the valley floor and at 25m intervals on the east-facing slope. The upper of the three pits revealed an Icknield profile while the pits further down-slope revealed de-calcified flinty colluvium over a thin clay horizon to depths of 50cm. Soils were shallow on the west-facing slope. An exploratory trench was designated for pit site 2.

Two transects (T4H and T4I) were establsihed in the upper part of catchment 4 across a tributary dry valley in a region where a very small area of archaeo-colluvium was predicted.

Transect T4H

Transect T4H is only 75m long and oriented down a south-facing slope above a large tributary dry valley at Green Down (Fig 47). The two northern-most holes revealed shallow chalky Icknield soils while the soils of the valley floor were calcareous loams some 40cm deep. The valley floor at this site was designated for an exploratory trench.

Transect T4I

Transect T4I is 125m long between the valley floor and lower slope at the junction of the east flowing tributary valley and the main trunk valley of catchment 4. In the valley floor and valley edge up to 70cm of dark brown chalky colluvium overlies Coombe deposits (Fig. 48). Further up-slope flinty material overlies shallow clay and chalk at about 45cm. A trench site was designated within the valley floor near auger site 2.

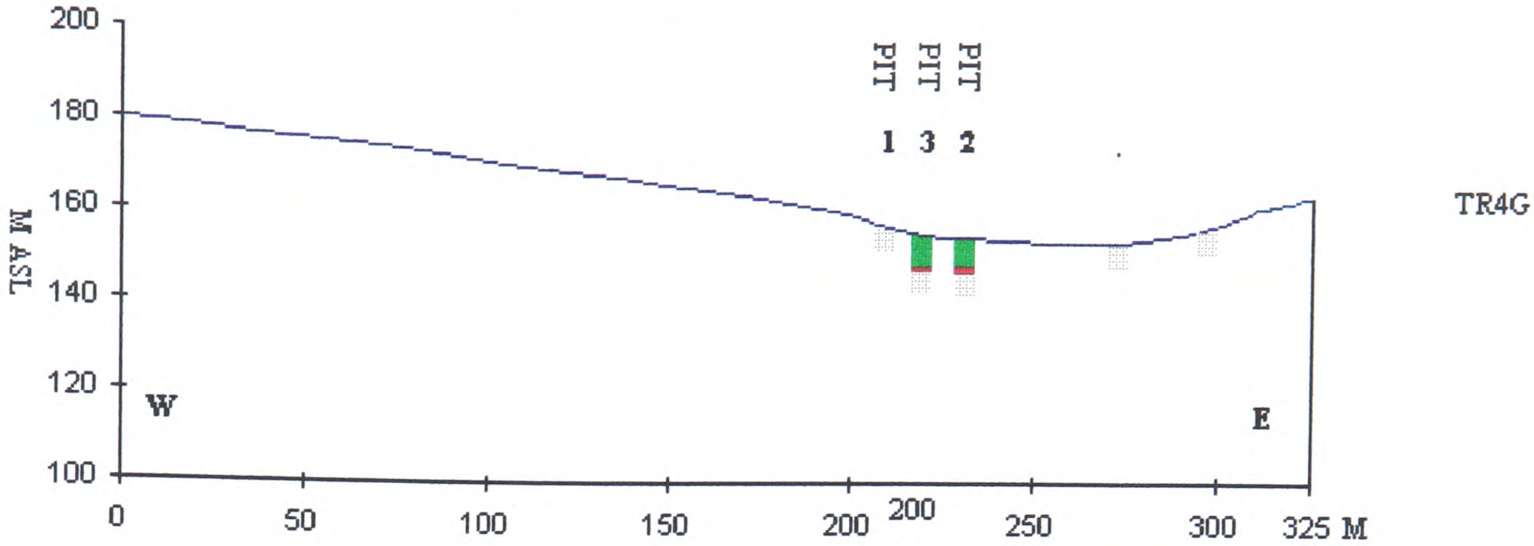


Figure 46 Transect 4G

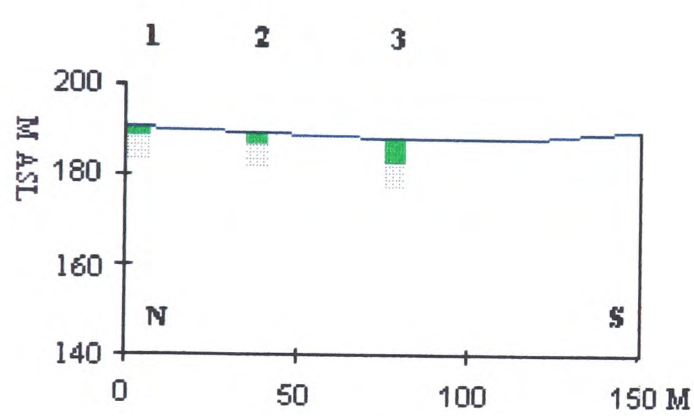


Figure 47 Transect 4H

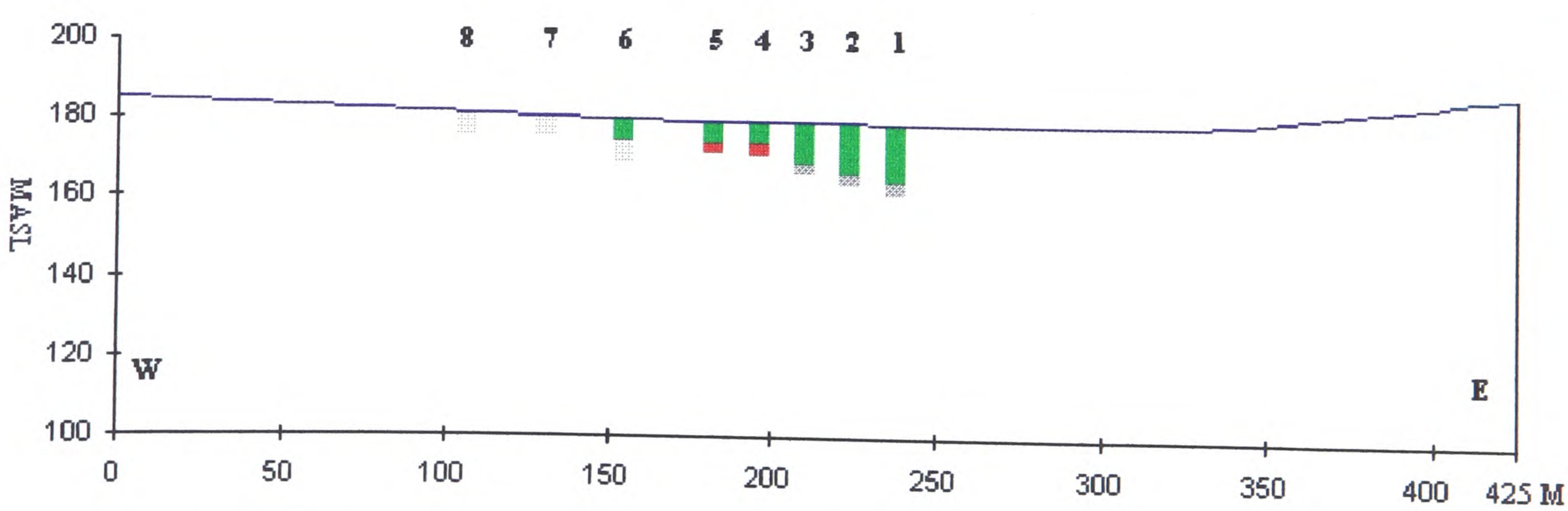


Figure 48 Transect 4I

KEY TO VALLEY PROFILES

Colluvium

Chalk bedrock/ shallow Icknield soils

Coombe deposits

Charity/drift soils

Clay with flints

Flinty(impenetrable)

Pleistocene Sands

SCALE (CM)

0
25
50
75
100

Catchment 4 : Summary

The valley soils of catchment 4 all contain colluvium with the exception of that traversed by transect 4D. The colluvium found in the tributary valleys of the mid and upper catchment is commonly shallow, dark brown and calcareous with some flints. This type of material was clearly anthropogenic along transect 4C. The de-calcified silty soils over silty drift found in transect 4D by contrast did not appear colluvial. In the main valley, deeper flinty colluvium was recorded often above Clay with flints or flinty drift deposits. The argument that the Charity soils in the mid and lower slope in this catchment might be the product of ancient cultivation is more convincing here than in catchment 1. The soils investigated within the Charity units complied more closely with the broad classification of colluvium (Avery 1980) and exploratory trench sites were chosen within these units (Transects 4C, 4E2, 4I).

The presence of both large flinty deposits, remnant Clay with flints and flinty drift in the lower landscape derived from these units implies that this catchment had a much larger distribution of clay soils than the very small patches which currently exist. The colluvial prediction appears to be accurate in the lower half of the catchment, though the model fails in the valley floor at Transect 4D where there is no colluvium and at Transect 4I where colluvium is common.

Catchment 5

Catchment 5 is surrounded by Clay with flints and blocks of fields which occupy mid and lower slopes. Unmapped soils formed on Reading Beds and solution holes were also noted in road cuttings and small quarries in mid-catchment. Class 2 colluvium is predicted in the upper catchment and a small patch of class one colluvium is predicted below fields in mid-catchment.

Transect 5A

Transect 5A is 150m long across a dry valley floor in the upper catchment with auger holes spaced at 25m intervals (Fig 49). On the west-facing slopes, soils are silty, de-calcified and less than 40 cm deep. Colluvium in the valleys is composed of de-calcified flinty silt about 60cm deep over reddish-brown silty drift and Chalk at about 90cm (auger sites 1 and 2). The valley was relatively narrow and less than 70m wide with shallow silty soils above Clay with flints occupying the east-facing slopes. The presence of flinty colluvium here corresponds with the model prediction. An exploratory trench site was chosen in the middle of this transect.

Transect 5B

Three irregularly spaced auger holes were dug at 100m and 50m intervals along a north-south transect up the main valley in mid-catchment (Fig 50). In the southern-most auger hole a pit was excavated revealing up to 60cm of flinty calcareous colluvium which overlies brown silty material and a sandy horizon between 70 and 75cm. The source of these buried sands would appear to be an unmapped Pleistocene sand deposit just above the valley on the east-facing slope. The other two auger holes revealed 50cm of flinty calcareous colluvium above chalk. An exploratory trench site was designated for this region adjacent to auger site 1.

Transect 5C

Transect 5C is 200m long and oriented from west to east across both sides of this asymmetric dry valley about 50m north of the end of transect 5B. The soils of the east-facing slopes confirmed the presence of Pleistocene sand deposits to depths of 75cm (soil sites 1-3). In the centre of the valley, silty chalky colluvium exists as predicted by the model although it is barely 50cm deep. On the other side of the valley, colluvium was absent and soils were uniformly shallow and chalky (Fig 51).

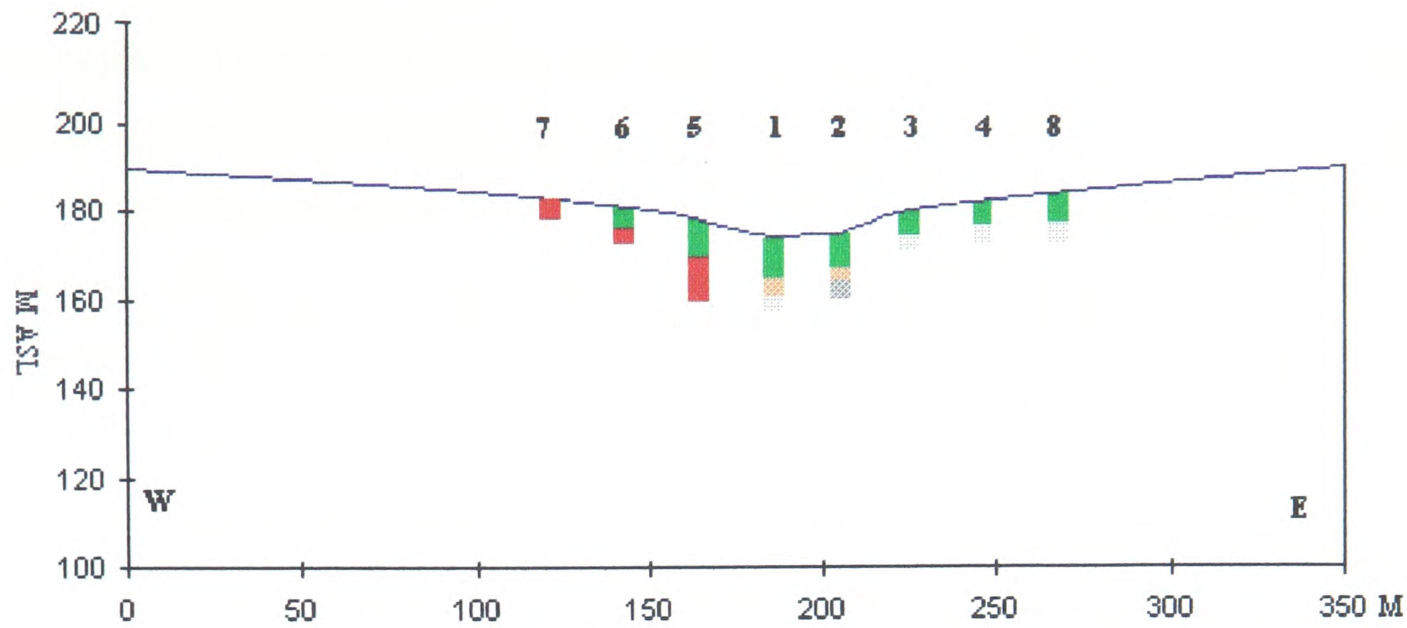


Figure 49 Transect 5A

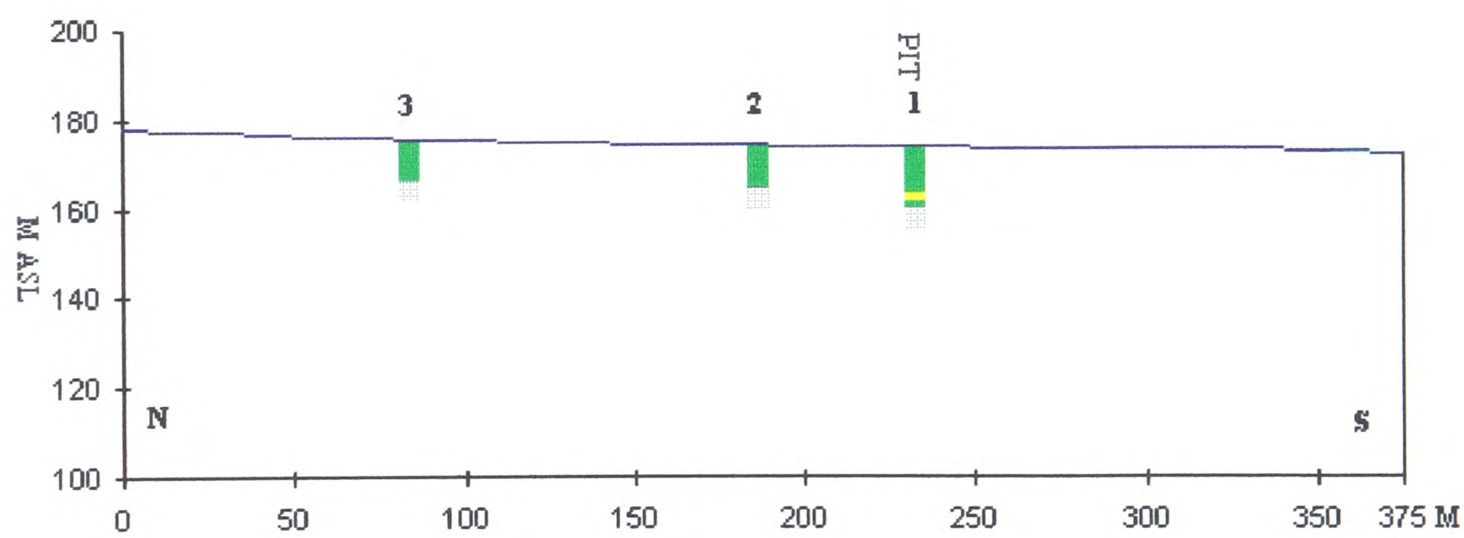


Figure 50 Transect 5B

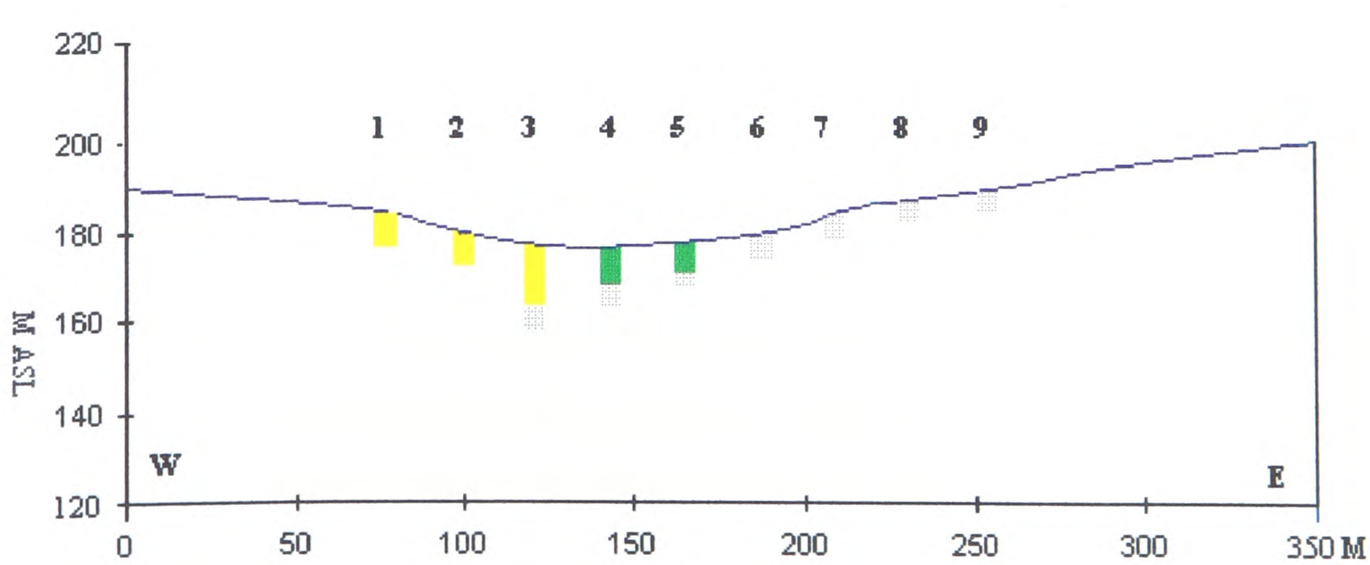


Figure 51 Transect 5C

Catchment Five : Summary

The presence of large areas of Clay with flints, soils derived from silty drift and unmapped patches of Pleistocene sands produced colluvium of varied composition in this catchment. Deep de-calcified flinty soils were common in predicted areas in the upper catchment while calcareous flinty soils with sandy lenses were characteristic of the valley sediments in mid-catchment. Both upper and mid-catchment sites were chosen for exploratory trenches.

Catchment Six

In Catchment 6, Clay with flints occupy most of the western half of the catchment. Colluvium was predicted below the only block of fields which occupy east-facing slopes in mid-catchment.

Transect 6A

Transect 6A is 550m long and aligned west to east across the main trunk valley and a smaller tributary valley facing to the west in the upper part of catchment 6 (Fig 52). Colluvium in the main trunk valley is generally de-calcified, up to 65cm deep above reddish brown de-calcified silty drift (auger sites 10-14). In the tributary valley, the flinty and de-calcified colluvium was about 50-70cm deep over similar drift material (auger sites 2-6). Colluvium was therefore found in this location as predicted and an exploratory trench was designated at auger site 13.

Transect 6B

Transect 6B was across a small valley of Clay with flints near Fawley in the lower catchment. The auger survey found shallow rubbly colluvium (less than 40cm) over Clay with flints, confirming the absence of colluvium indicated by the model (Fig 53).

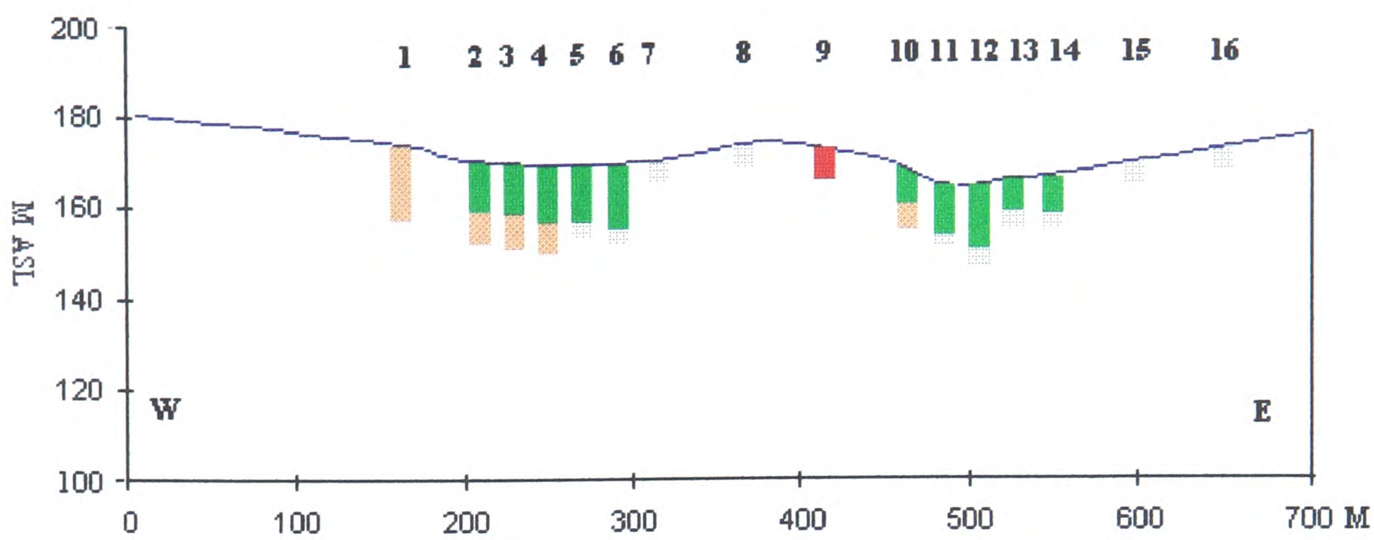


Figure 52 Transect 6A

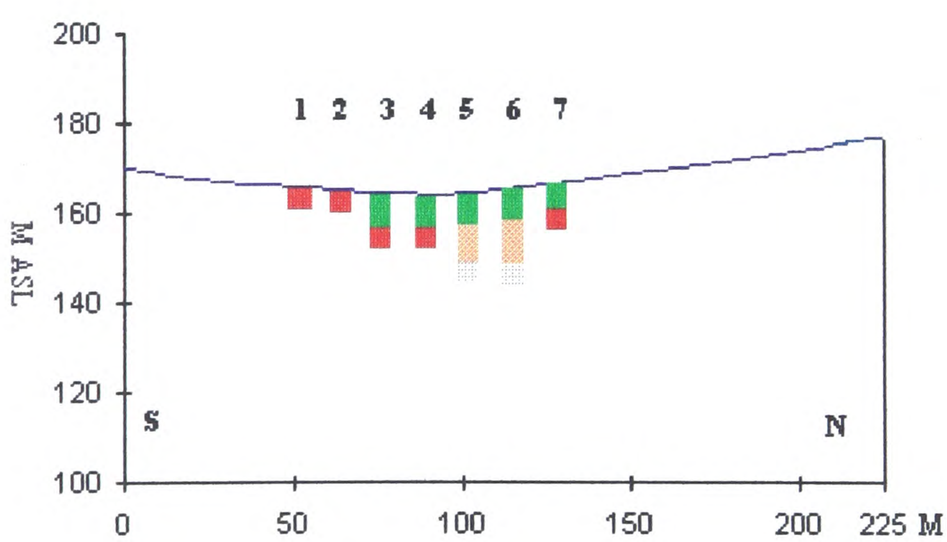


Figure 53 Transect 6B

KEY TO VALLEY PROFILES

Colluvium

Chalk bedrock/ shallow Icknield soils

Coombe deposits

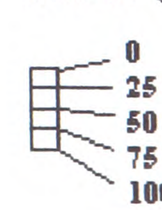
Charity/drift soils

Clay with flints

Flinty(impenetrable)

Pleistocene Sands

SCALE (CM)



Catchment 6 : Summary

The colluvium in the upper part of catchment 6 is relatively deep over valley soils derived from Clay with flints and silty drift. In mid-catchment where Clay with flints are more widespread there are no ancient fields and colluvium is thin.

Catchment Seven

Catchment 7 has a relatively large proportion of ancient fields though few have an easterly aspect. Only a small patch of second class colluvium was predicted in the mid section of this catchment

Transect 7A

Three auger holes along a short transect 50m long at the confluence of two large dry valleys in the upper catchment revealed light brown slightly flinty de-calcified colluvium up to 70cm deep over Clay with flints (Fig 54). The presence of de-calcified colluvium in this dry valley proved the model inaccurate at this site and also that Clay with flints were more widespread than was indicated by the soil maps.

Transect 7B

At Transect 7B, to the east of the Wantage - Hungerford Road, deep mid-brown uniform silts 1-1.2m thick were encountered at the lower end of a 120m transect (auger sites 5-8). The uniform and un-stratified appearance of these silty deposits suggest that this material is relatively modern (Fig 55).

Catchment 7 : Summary

Colluvium was not predicted by the model in catchment 7 although it appears relatively thick and de-calcified in the upper part of this catchment. This is despite the fact that, according to the soil maps, much of the mid and lower slopes are occupied by chalk soils. Once again the resolution of the Soil Survey data appears limited for colluvial prediction at this scale.

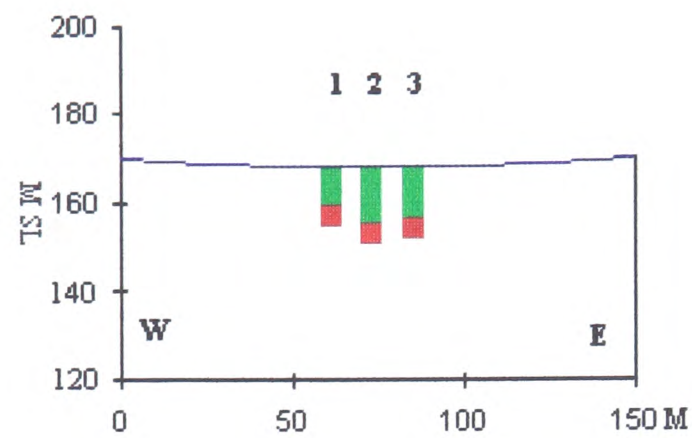


Figure 54 Transect 7A

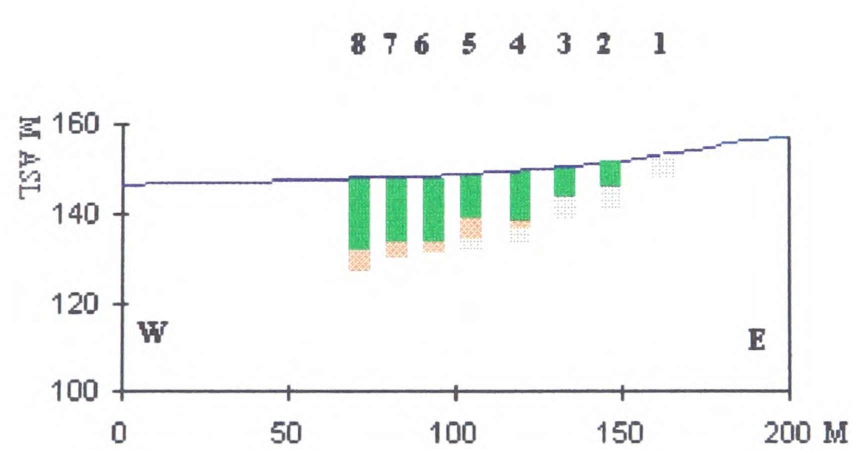


Figure 55 Transect 7B

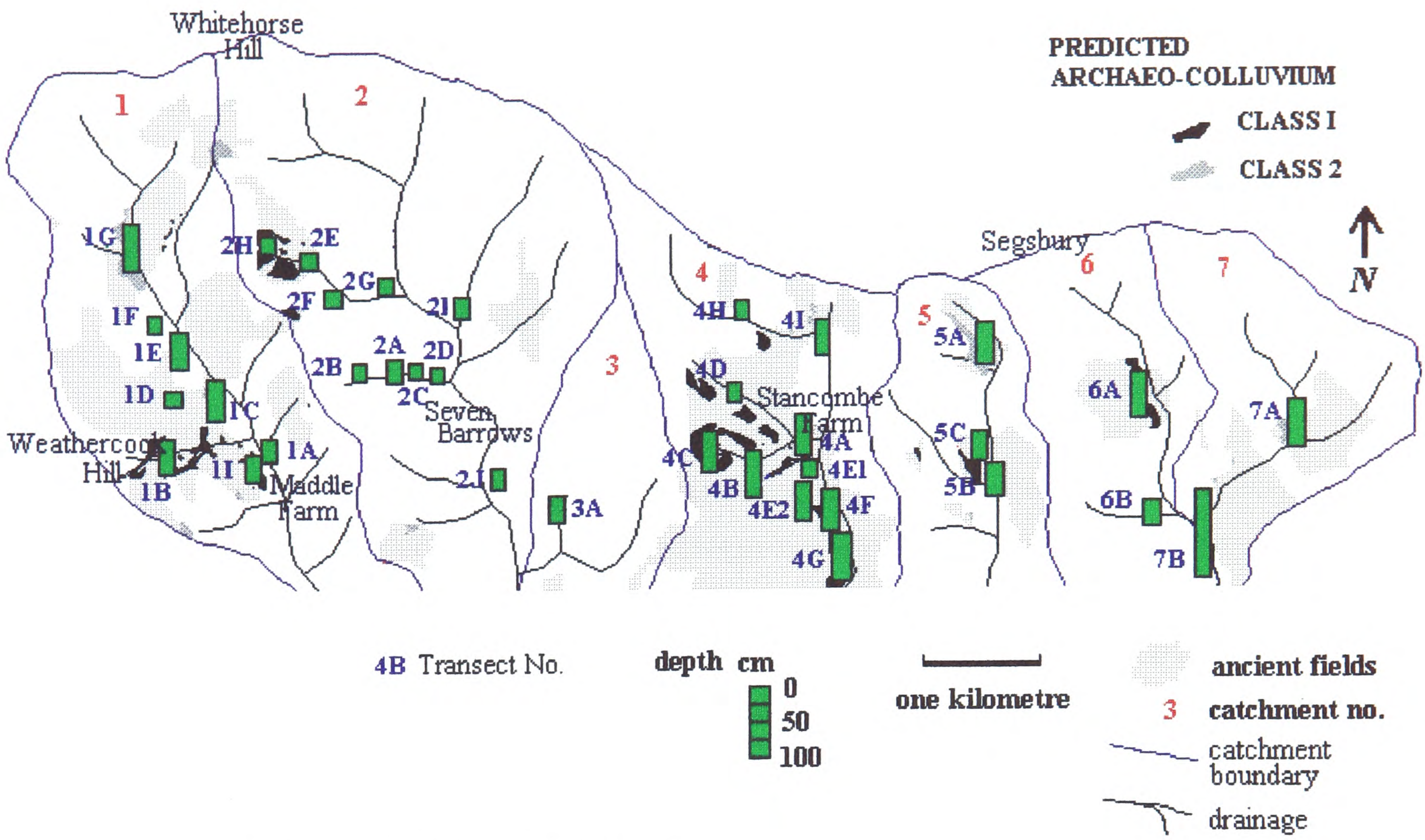


Figure 56 Colluvial thickness on the Berkshire Downs

8.2.1 Colluvial Thickness Summary

The auger survey across the Berkshire Downs indicates that colluvium is of variable thickness in the western catchments and is thicker toward the east (Fig. 56). In catchment 1 colluvium in small chalky tributaries and the main broad chalky valley is less than 30cm deep. Some thicker de-calcified colluvium derived from Charity soils exists in valley edge sites and in one transect in the upper catchment deep chalky fill was located.

In catchment 2, the colluvium is absent with valley soils consistently less than 25cm thick. In catchment 3, narrow valley deposits are shallow and very flinty. In catchment 4 colluvium is deep and flinty in the main valley reflecting the preservation of de-calcified colluvium derived from Clay with flints. In the tributary valleys of this catchment, colluvium is thin and calcareous. Catchment 5 presents a mix of colluvial material derived from Clay with flints, silty drift, superficial sands and chalky parent material while the colluvium in catchment 6 seems to be derived predominantly from Clay with flints. Catchment 7 is also surrounded by these heavier soils with correspondingly deep de-calcified valley sediments.

The completion of the first phase of field checking revealed the thickness and composition of likely archaeo-colluvium at both predicted and non-predicted sites. Based on the results from the valley transects, the predictive model does not appear to be accurate across the entire project area, though a full evaluation is dependant on the dating and composition of the colluvium from the exploratory trench programme. A prominent result of the soil sampling was the discovery of numerous unmapped clay patches and soil variants reflecting the coarse resolution of the Soil Survey maps at a local scale. It is also worth emphasising that the wide variety of valley material as eroded or reworked deposits such as the Charity and Winchester soils in some cases made distinction difficult between reworked peri-glacial material, anthropogenic sediments and more recent colluvium. For this reason the closer examination and dating of these soils is critical before characterising them as archaeo-colluvium.

8.3 Phase 2 : RESULTS OF THE TRENCH PROGRAMME : PHASE 2

In the first phase, colluvial deposits were identified according to generalised field criteria across the Berkshire Downs. Because the primary purpose of the model is to locate a specific class of ancient colluvium, a second phase of sampling was undertaken to verify the archaeology, age and general stratigraphy of the colluvium. A series of exploratory trenches and pits were dug where colluvium was identified as relatively thick and appeared "ancient" during Phase 1 according to the method outlined in section 7.3.1. (Fig 57). Each trench was hand excavated, sampled for datable artefacts, stratigraphically recorded and drawn. The location of artefacts, commonly pottery sherds was plotted and at 9 trenches soil cores were taken for dating by Optically Stimulated Luminescence. Trenches were also excavated at three non predicted sites 1E, 4H and 7, to gain some measure of whether colluvial material discovered during soil augering might be ancient at sites not chosen by the model. Some smaller pits were dug to confirm the absence of colluvium.

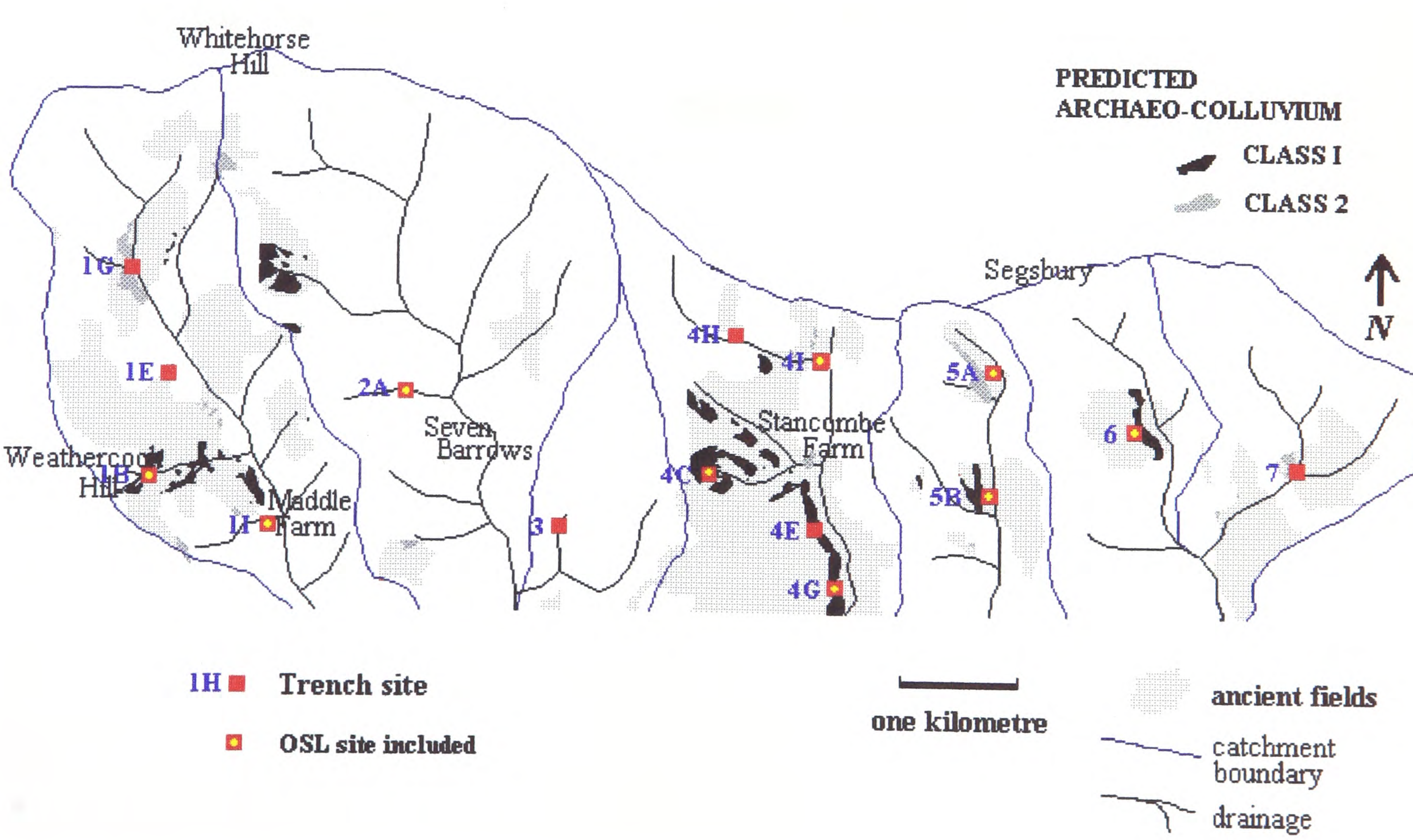
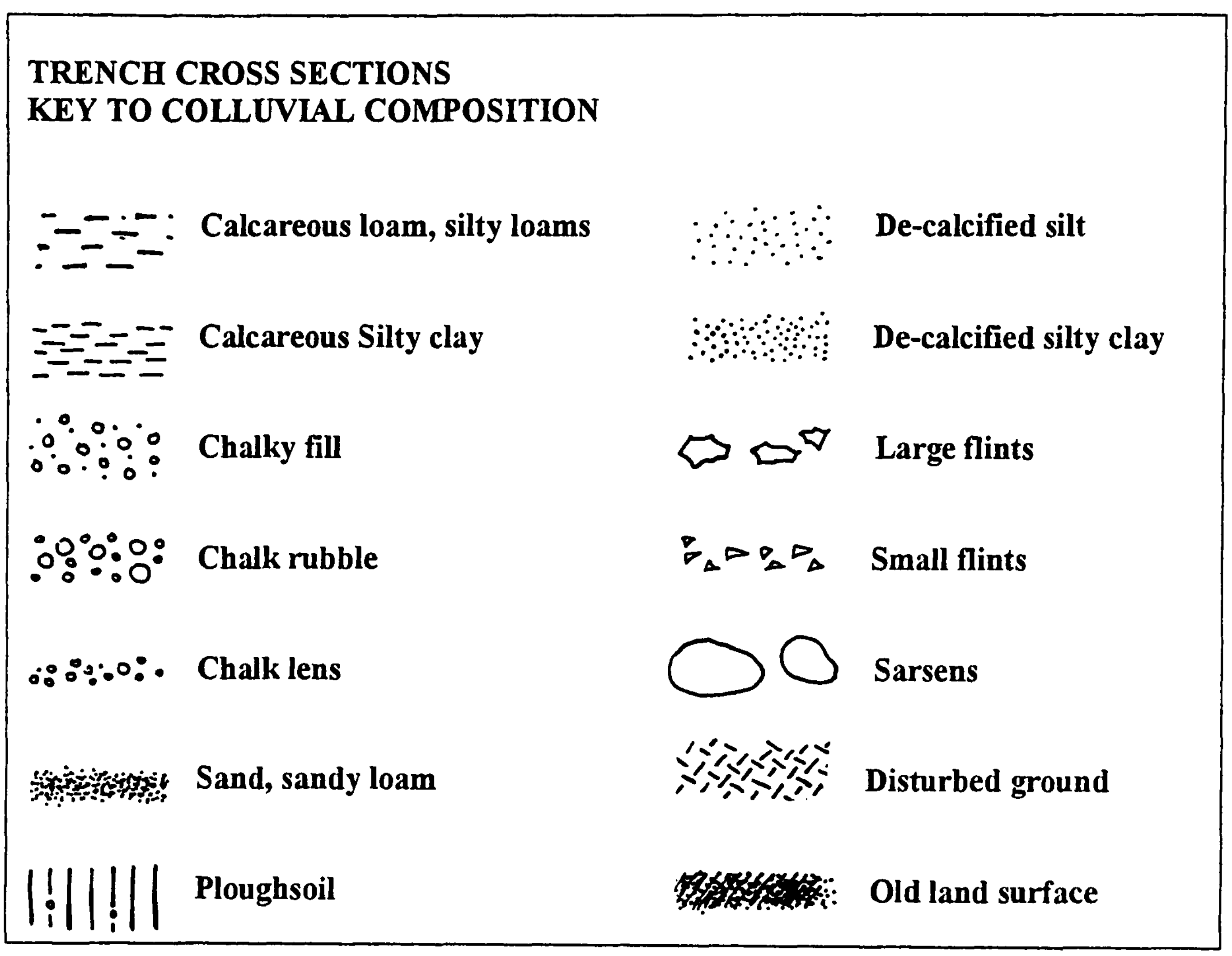


Figure 57 Trench and OSL sites


TRENCH CROSS SECTIONS
KEY TO COLLUVIAL COMPOSITION
Calcareous loam, silty loams
De-calcified silt
Calcareous Silty clay
De-calcified silty clay
Chalky fill
Large flints
Chalk rubble
Small flints
Chalk lens
Sarsens
Sand, sandy loam
Disturbed ground
Ploughsoil
Old land surface

Trench 1B

Trench 1B is located in a small east-facing valley, in a mid-slope position below Weathercock Hill, where colluvial sediments were found during augering along transect 1B. A maize crop prevented sampling in the centre of the valley. Weathercock Hill is the site of a Late Bronze Age settlement which was excavated by Bowden *et al.* (1991) and from which several hundred prehistoric sherds were recovered. Although trench 1B is 300m below this pottery scatter its proximity was not however reflected in the amount of prehistoric artefacts found during trench excavation and recording. Several Romano-British sherds were found within chalk lenses and among flints at the bottom of the profile allowing the colluvium, a *terminus post quem*, date to this period (Fig 58).

Colluvium was 50cm deep above Chalk bedrock and was composed of 4 main horizons.

1) A deep earthy ploughsoil exists to a depth of 25cm.
2) Below this was a mid-brown organic calcareous silty loam
3) Two chalky gravel lenses lie about 30-35cm deep at the south and north end of the trench. A piece of Roman pottery was found in the southern lens.
4) At the base of the profile were large groups of angular flints with no evidence of clay enrichment or old land surfaces. Two pieces of Roman pottery were found among the basal flints on the surface of the chalk parent material.

Although colluvium is shallow, the presence of two lenses of chalky gravels with entrained Roman pottery implies phases of Romano-British cultivation in which soils were ploughed to bedrock. An OSL soil sample was taken at the base of the trench at depth of 30cm.

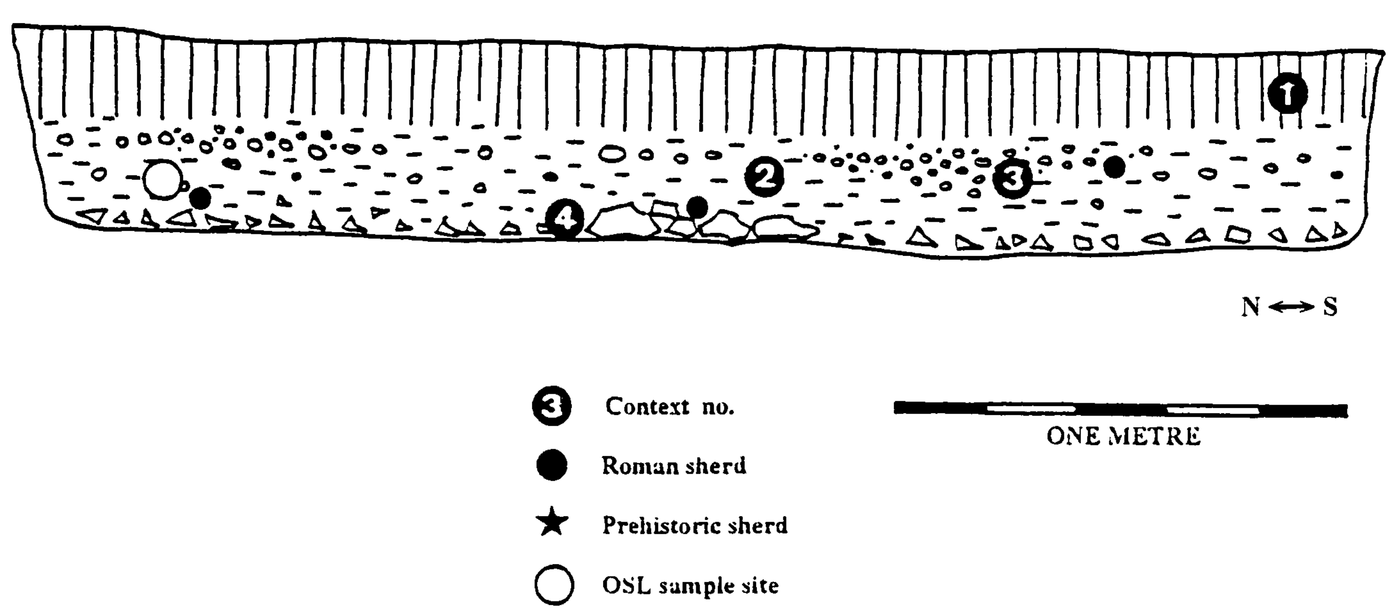


Figure 58 Trench 1B

Trench 1E

Trench 1E is located in mid-catchment in a gentle east-facing tributary valley below the large Charity soil units formed on bench-like landforms on the western slopes of catchment 1. Although it is not at a site chosen by the model, colluvium derived from these superficial units was noted during augering in transect 1E. It was decided to investigate whether colluvium associated with these soils could be dated or attributed to human activity. Colluvium here was tentatively given a Roman date based on the presence of Roman roof tile fragment associated with brown silty colluvium in mid profile (Fig 59).

There were five horizons.

1) A dark brown silty ploughsoil to 20cm
2) A uniform de-calcified brown silty clay to 34cm in which a Roman roof tile fragment with nail hole was found.
3) A layer of small-medium angular flints occupy a layer between 35-45cm across the profile.
4) Chalky gravels within a dark brown clay loam thicken towards the northern end of the trench.
5) A de-calcified brown silty clay thickens to the south. There is no evidence of an old land surface and the basal horizon overlies Coombe deposits.

While the earliest colluvium derived from the Charity soils at this site might (tentatively) be derived from Roman cultivation there was no such evidence from the Charity soils and silty parent material on the nearby slopes. It is not possible to completely dismiss these units as archaeo-colluvium (a prospect which was discussed in section 6.2.6), though the evidence from auger survey, examination of their composition and absence of any traces of archaeology suggest that the silty drift on which the Charity soils exist in this catchment are peri-glacial or reworked superficial material of Holocene age.

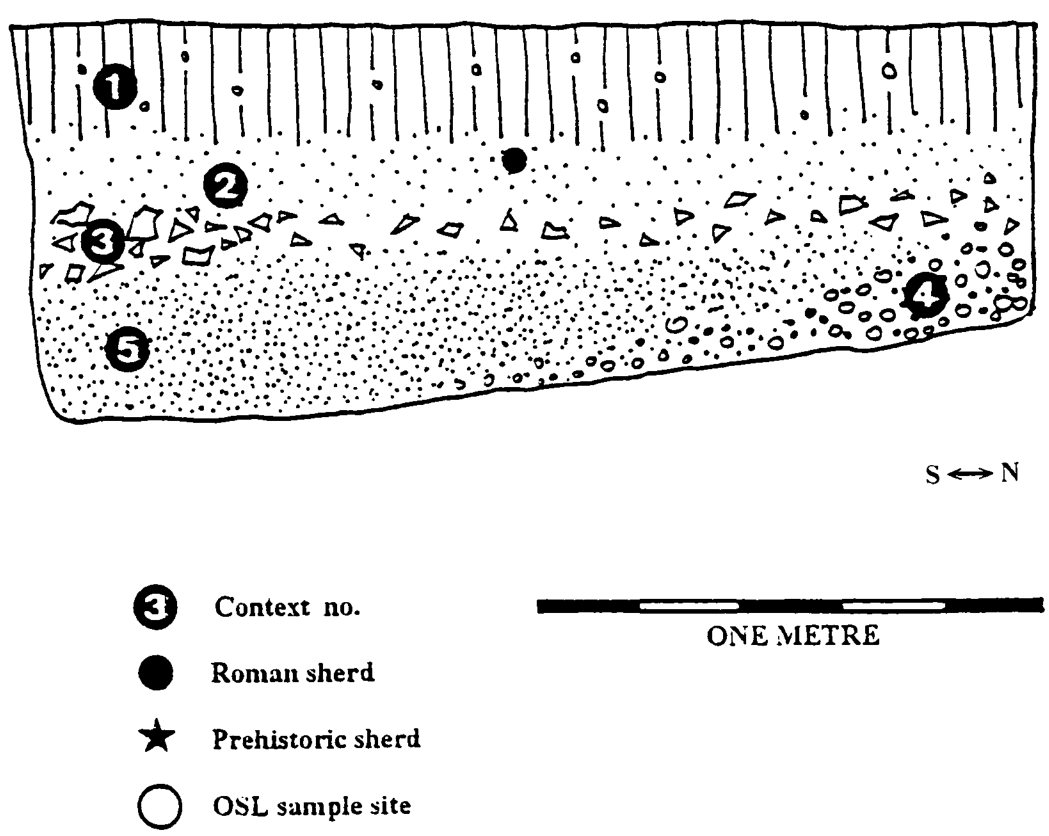


Figure 59 Trench 1E

Trench 1G

Trench 1G is located in a valley floor in the upper part of catchment 1 where colluvium was predicted by the model. The auger survey indicated chalky soils up to 80cm deep within a small section of transect 1G near the confluence of two small tributary dry valleys. It was difficult to discern Coombe deposits from what might have been chalky colluvium during the auger survey so it was decided to further investigate the depth, composition and presence of artefacts of this valley material. The trench revealed colluvium much deeper than indicated during the auger survey with 165cm of chalky fill (over twice the depth of any other colluvial profile in the project area). The presence of Iron Age pottery at 110cm allows a terminus post given date of the colluvium at earliest to this period (Fig 60).

There were five main colluvial layers :

1) A dark brown calcareous loamy ploughsoil to 35cm.
2) A dark mid-brown slightly clayey calcareous silt with common chalk and flints between 35 and 56cm. A piece of Roman pottery was found at the top of this horizon.
3) A layer of angular flints was recorded between 56 and 72cm.
4) A deep very calcareous layer of yellowish-brown chalky fill extends from 72-145cm. Within this deep horizon two pieces of prehistoric coarse-ware were found at depths of 92cm and 110 cm.
5) Below the chalky fill at the base of the profile, some 15cm thick, is a very dark brown moist fine-medium textured sandy horizon with common organic content and occasional charcoal. The presence of this dark basal horizon suggests localised waterlogged conditions and the possible presence of a pond or feature consistent with a past high water-table.

During the auger survey and early stages of trench excavation it was difficult, on the basis of colour and composition to easily distinguish the chalky fill at this site from Coombe parent material. The presence of artefacts however confirmed its anthropogenic origin. On the basis of the auger survey throughout catchment 1, which proved that colluvium was commonly less than 30cm deep, the unusually deep chalky colluvium at trench 1G site implies a localised fan deposit. This exemplifies the fact that in discrete hollows or depressions colluvium may reach these depths, though their distribution on the Berkshire Downs appears to be sporadic.

Trench 1G

Profile

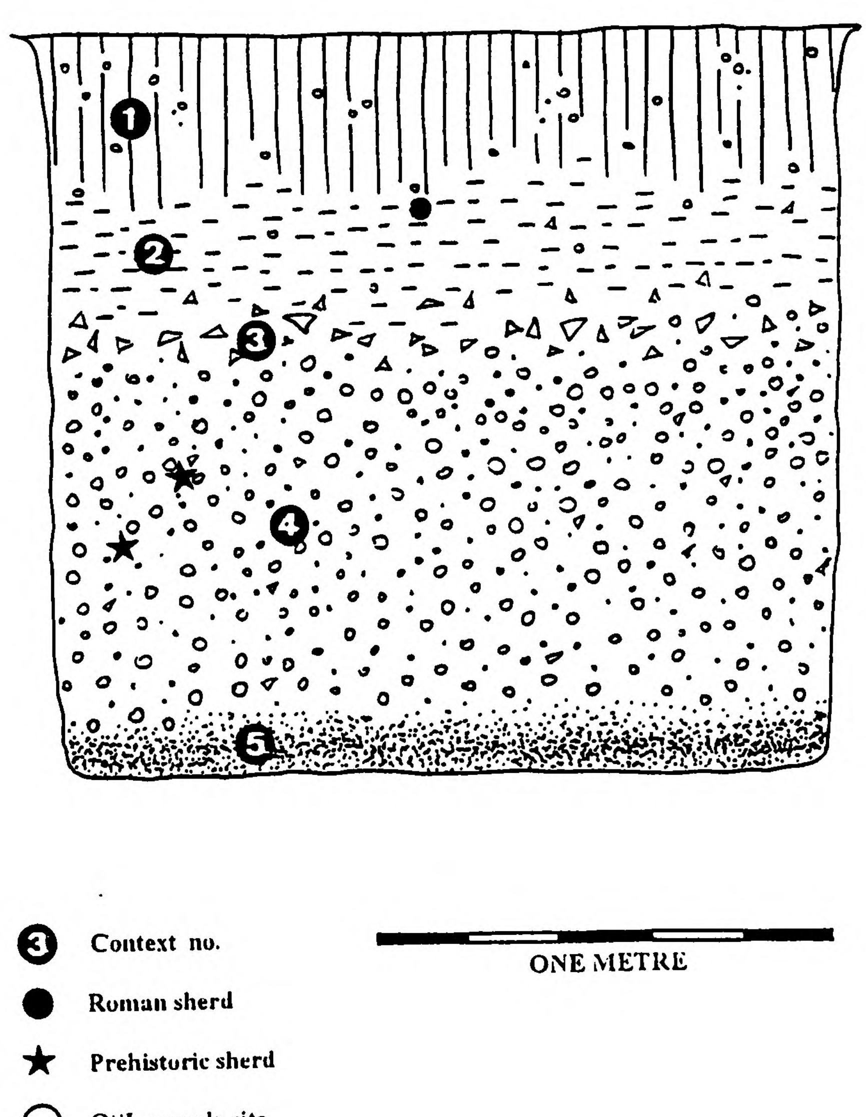


Figure 60 Trench 1G

Trench 1I

A small exploratory pit some 1m long was excavated at the base of a west facing slope at a site predicted by the model about 500m south of Maddle Farm. A small piece of Iron Age coarse-ware at a depth of 50cm enabled a *terminus post quem* date for the colluvium at this site (Fig 61).

There were four main colluvial layers.

1). A dark brown earthy silt loam ploughsoil to 18cm.
2).A reddish-brown fine de-calcified sandy light clay becoming more clayey with depth containing chalk and platy flints to 65cm. A piece of Iron Age coarse-ware was found at a depth of 50cm.
3). A layer of flint rubble above chalk bedrock.

The composition, colour and de-calcified colluvium within this pit suggests that it was derived from Clay with flints which cap the hillcrest above this site. An OSL soil sample was taken at a depth of 46cm and as close as possible to the Iron Age sherd findspot.

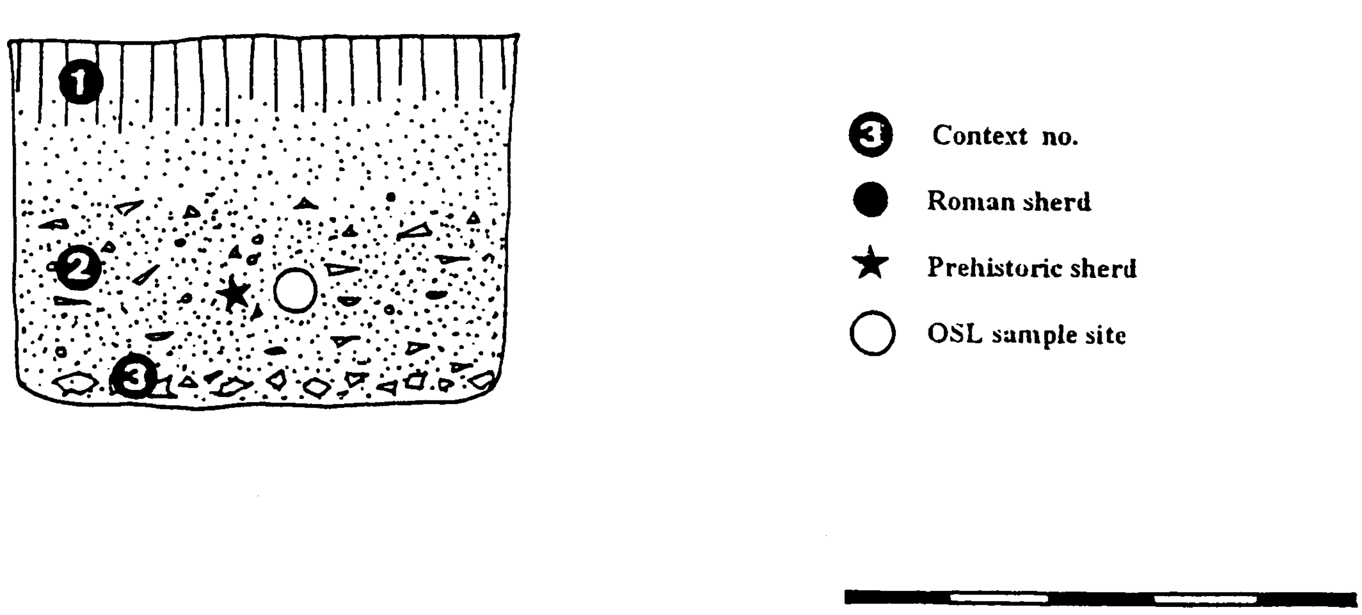


Figure 61 Trench 1I

Trench 2A

A pit was excavated at transect 2A where valley soils were found to be deepest in a gentle tributary valley on the western side of catchment 2 (Fig 62). The purpose of this site was to investigate whether the conspicuously shallow colluvium might be dated by recovery of artefacts or by the OSL technique. Less than 40cm of flinty valley (Coombe series) soils was noted with absence of any artefacts. A soil core was taken at the base of the profile for OSL dating.

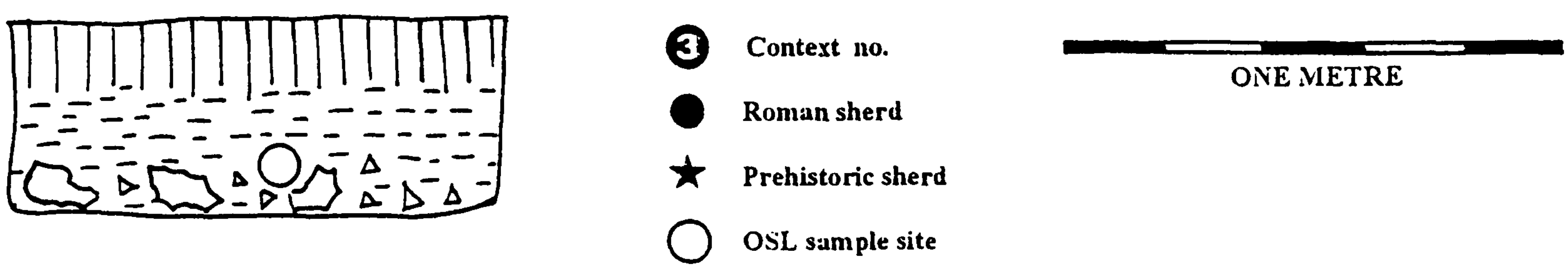


Figure 62 Trench 2A

Trench 3

A small exploratory pit along auger transect 3 proved the absence of colluvium in this catchment as predicted by the model. Shallow flinty soils some 30cm deep above large nodular flints overlies Clay with flints at about 40cm. This site is included as a type description of valley soils at sites where colluvium is absent (Fig 63).

Figure 63 Trench 3

Catchment 4 contains the largest concentration of predicted sites and the presence of archaeo-colluvium was proven by the augering programme.

Trench 4C

Trench 4C is located on the lower slope of an east-facing tributary some 200m west of Stancombe farm (Fig 64). During the auger survey in transect 4C both the auger holes and small pits revealed surface and subsurface artefacts.

There were 6 horizons.

1) At the northern end of the trench, a thick disturbed layer of dark brown loamy topsoil contains both Roman and modern pottery, including glass and plastic.
2) A layer of dark organic ploughsoil less than 15cm thick extends across the top of the profile.
3) A very thin layer of chalky granules forms a layer at 18-20 cm below the ploughsoil.
4) A discontinuous lens of chalky gravel rubble about 1-1.5m long, forms a layer in mid profile at about 20-30cm.
5) Below and around the chalky lens is a thicker calcareous dark silty loam from about 30-45cm with occasional flints.
6) A layer of large angular flints form the basal layer from about 45-50cm.

Roman and prehistoric pottery and artefacts are scattered throughout the profile although there is a general stratification of older material at the base of the profile giving the colluvium a *terminus post quem* of Iron Age date. Roman pottery which includes grey ware and New Forest, Samian ware and beige fine wares were recorded along with metal boot cleats, nails and a hinge. Sheep bones were also recovered particularly at the base of the profile. The presence of both thin and thicker chalky lenses containing Roman artefacts indicate episodes of soil thinning during this period.

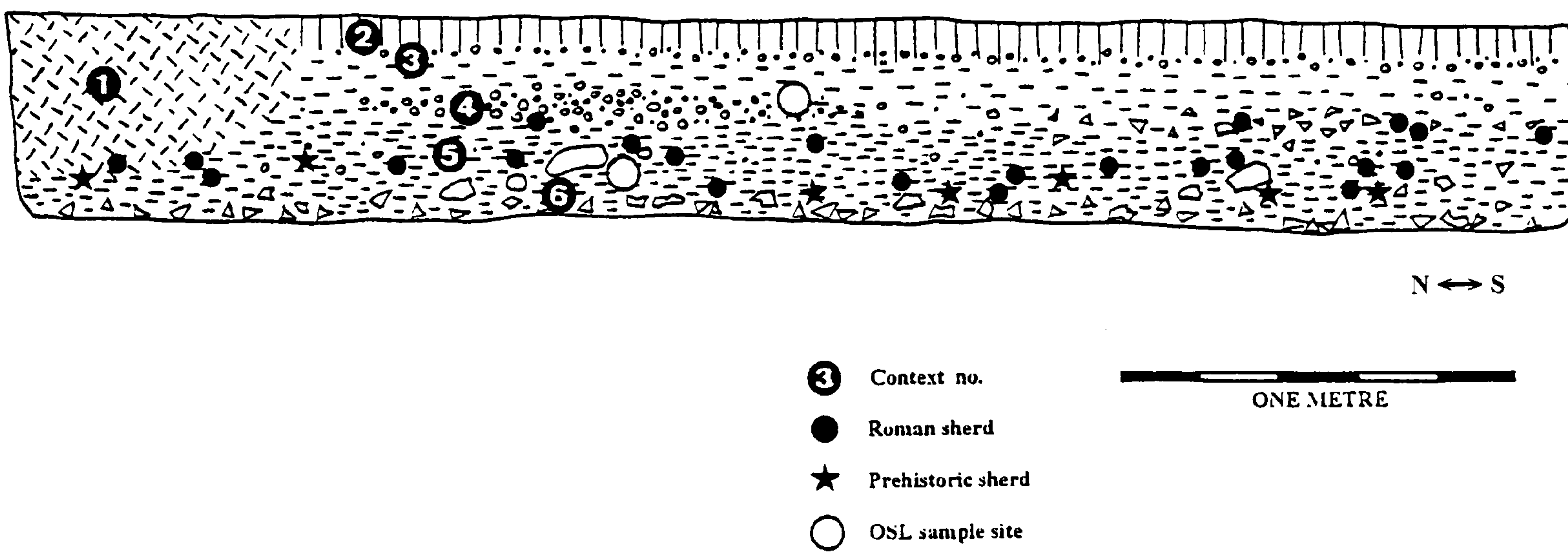


Figure 64 Trench 4C

Towards the base of the profile black coarse-ware of nominal Iron Age-Romano-British age were found. One piece of black coarse-ware of Middle Iron Age date was recovered from the base of the trench. In total 30 pieces of pottery were recovered of which 23 pieces were Roman, five were Late Iron Age-Roman and two pieces were of Middle-Late Iron Age. Brief pottery descriptions and co-ordinates for each sherd are shown Appendix 1.

The existence of such a high density of Roman and pre-Roman pottery in this lower slope position would appear to originate from a previously unrecognised site up-slope, a prospect which would merit closer aerial photo interpretation, field survey and colluvial trenching. The field survey conducted as part of the Maddle Farm survey did not sample this area, presumably because it was under crop. The cultivated fields in the immediate vicinity of the trench site are popular with metal detectorists who recover Roman coins and metalwork. A Roman villa site (Money 1887) is recorded some 600m south of the trench and while a suggested source of the pottery, it is unlikely that such a quantity of Roman and pre-Roman material would be the product of manuring or off-site remains as the villa site is both too far away and located in a neighbouring sub-catchment (Fig 65). All other trenches sampled for pottery across the Berkshire Downs produced low recovery rates (3-4 sherds/trench).

There are well preserved field lynchets up to 2.5m high less than 200m to the south and immediately up-slope from this trench is a ring ditch site, together with numerous irregular rises and undulations which are suggestive of settlement features. A prehistoric settlement is recorded about 400m to the south (Berkshire SMR), though again in a position unlikely to be shedding material into this valley. Trench C was located in one of the largest patches of predicted archaeo-colluvium producing the most encouraging archaeological discovery of the survey.

OSL soil samples were taken at depths of 20cm and 31cm although sampling was difficult due to the presence of large flints and chalk nodules. In colluvial soils less than 40cm deep it was feared that OSL dates may be unreliable due to mixing of sediments. The amount of pottery found at this site however provided reliable evidence of an Iron Age date for the earliest sediments.

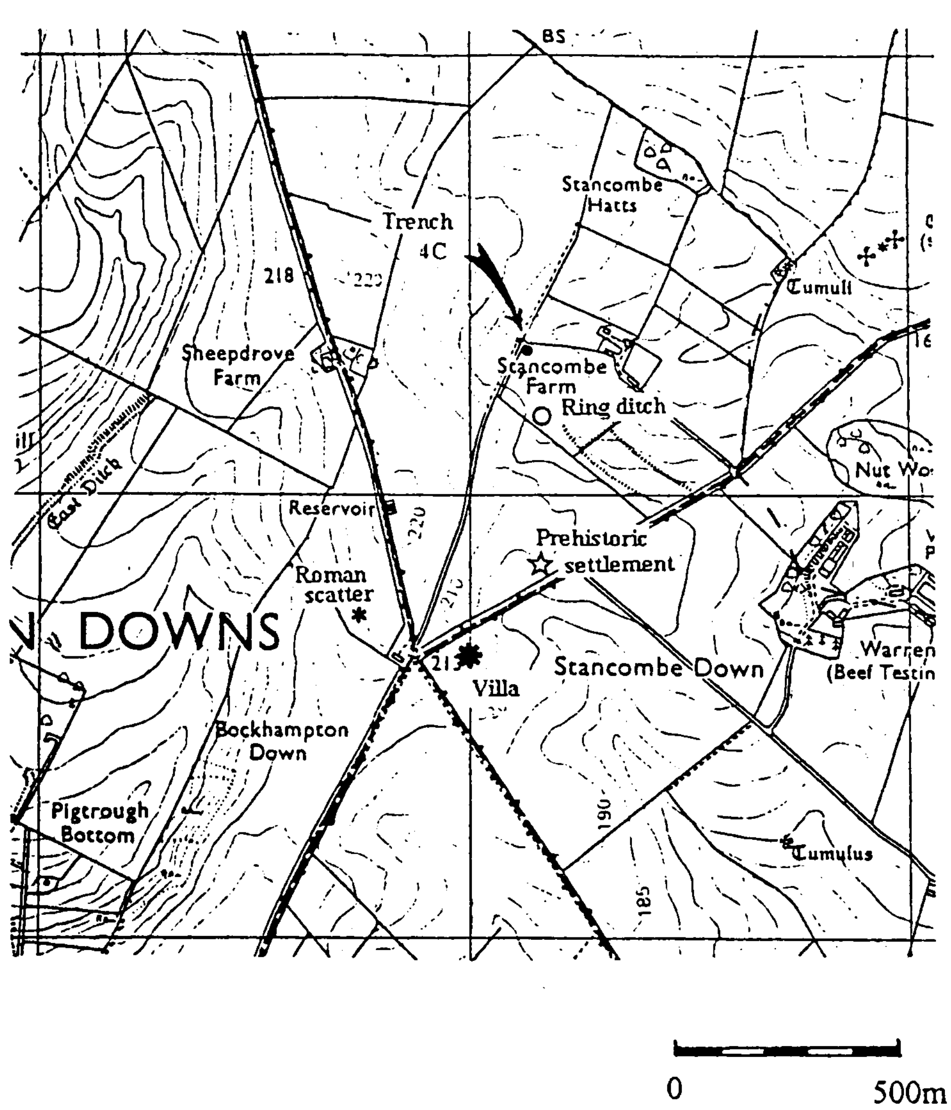


Figure 65 Area surrounding possible settlement site near Trench 4C

Trench 4E

Trench 4E is located in a small tributary valley above the central dry valley in catchment 4 at a predicted site and where a pit excavation in transect 4E had revealed 50cm of colluvium.
The presence of discontinuous chalky gravel lenses with Roman pottery implies episodes of Roman soil thinning. No prehistoric pottery sherds were recovered and based on recovery of pottery in the basal flints, a *terminus post quem* of Roman date was assigned (Fig 66).

There were seven main colluvial layers.

1). Ploughsoil of fine silty loam to a depth of 10-15cm.
2). Large angular flints in a layer between 10 and 22cm depth within which a rim of Roman pottery was found.
3). A well structured dark calcareous silty loam to 40cm.
4). At the western end a layer of chalky gravel thins toward the middle of the trench. A small piece of Roman tile was found within this lens.
5). A dark brown calcareous silty horizon from about 40-50cm in which.
6) A layer of small platy flints which directly overlie the chalk bedrock. A piece of Roman pottery and tile was found within these flints.
7) At either end of the trench are irregular depressions or gutters in the bedrock filed with chalky gravels and larger cobbles.

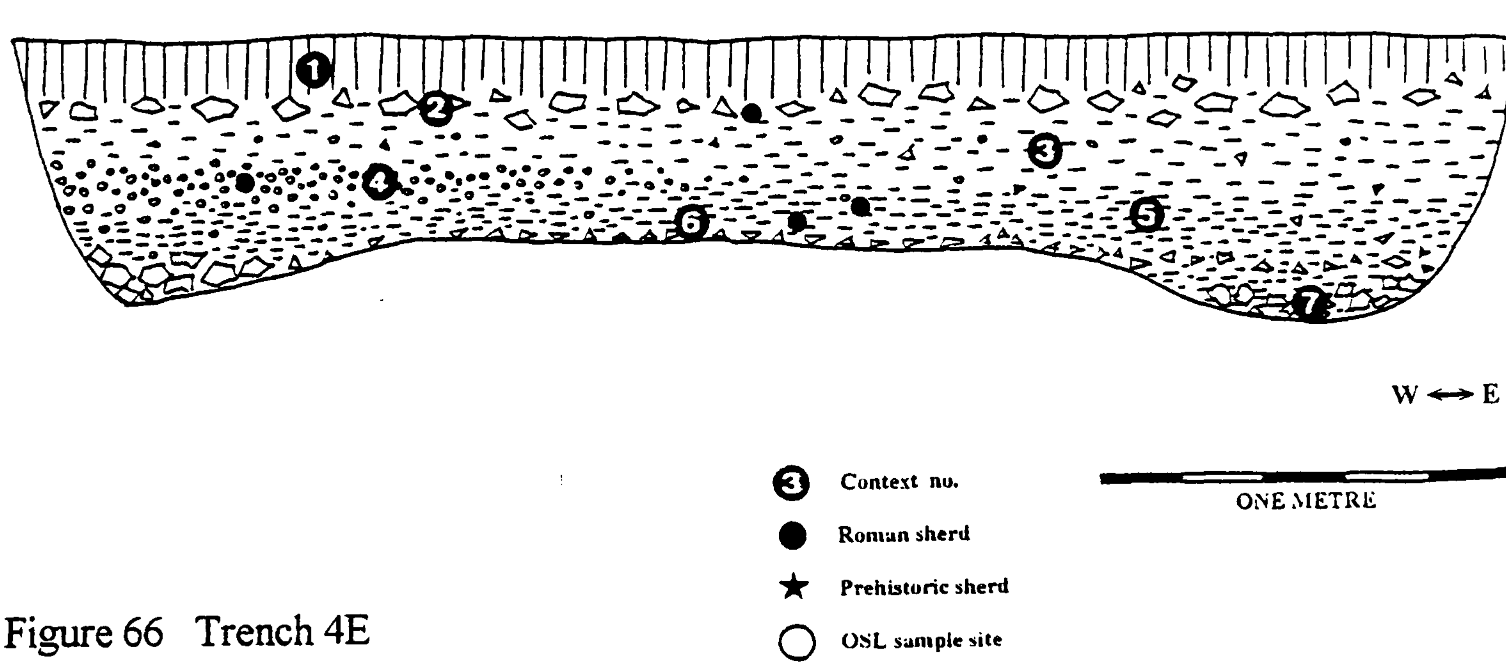


Figure 66 Trench 4E

Trench 4G

Trench 4G is located at one of the predicted sites in the main trunk valley of catchment 4 in (what were mapped as) Charity soils at the base of a relatively steep east-facing slope (Fig 67). The presence of flinty colluvium was confirmed here during the augering programme.

There were seven horizons within the colluvium.

1) A dark loamy topsoil with common flints in which a small piece of Roman tile was found.
2) A flinty horizon at 25-35cm.
3) A brown silty loam from about 30cm to 40cm.
4) A well-sorted layer of smaller platy flints lies between 40cm and 50cm. Within this layer, a sherd of Late Iron Age-Roman and of Middle Iron Age - pottery were recorded.
5) A de-calcified brown silty clay lies between 50-60cm.
6) At the base of the profile, some 15cm thick, is a reddish-brown light clay which was interpreted to be a truncated palaeosol.
7) Within a depression at the western end of the trench, a scatter of sarsen boulders lie above chalk bedrock within a dark silty clay matrix. The depth of colluvium reached 90cm at the western end of the trench and it is possible that this represents part of the Bronze Age East Garston Ditch (Ford 1982) which has been mapped in the vicinity. Trench 4I also appears to intersect this feature in the same valley further north. The presence of sarsen stones implying field clearance supports the notion that this is part of a linear boundary.

The flinty profile and preserved land surface recorded in this trench suggests that older flinty soils of the surrounding slopes have been stripped and deposited in the main valley, sealing the original clay rich Holocene brown earth soils. The presence of Iron Age pottery in a layer of smaller platy flints at about 40cm depth above the old land surface indicates deposition dating (*terminus post quem*) to at least the Iron Age.

Two soil cores were sampled for OSL dating adjacent the Middle Iron Age sherd at a depth of 40cm and within the old land surface at 65cm.

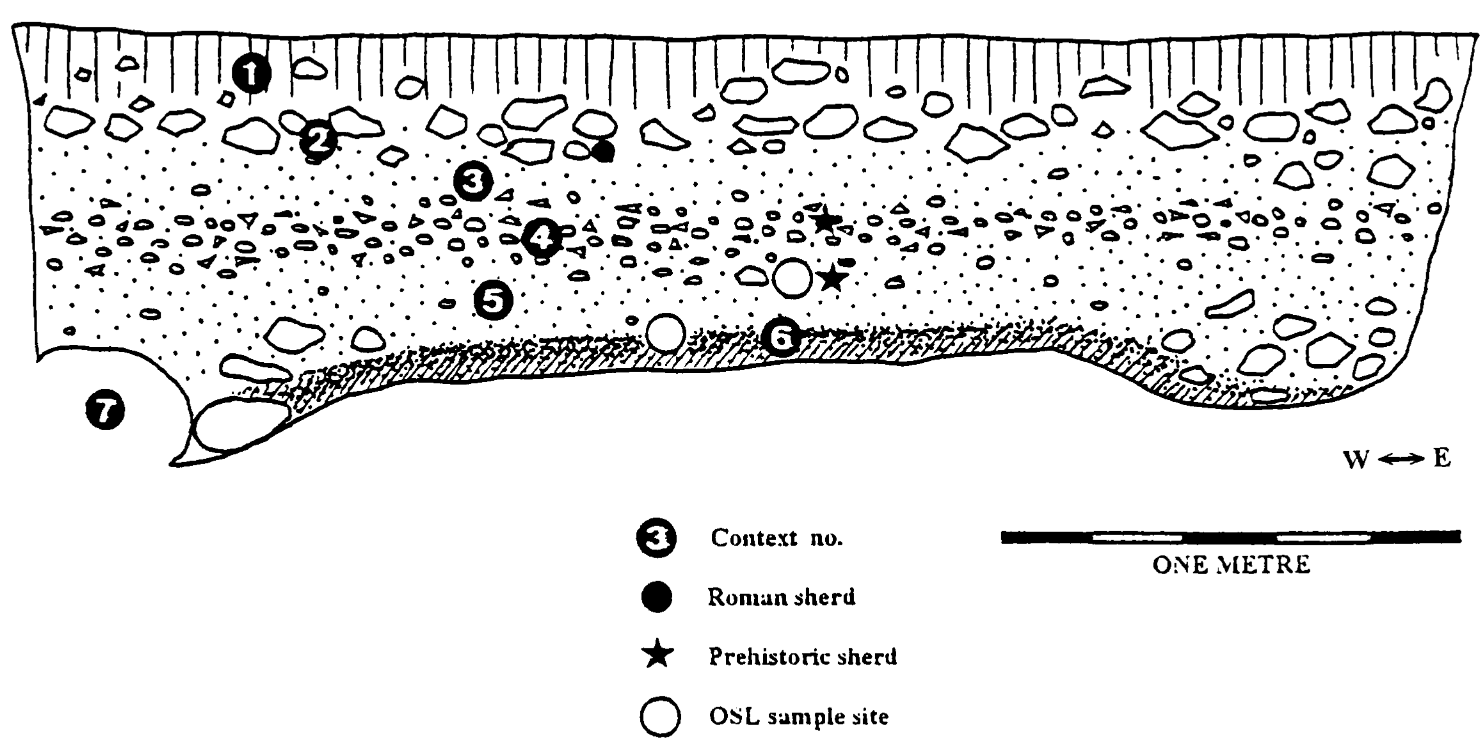


Figure 67 Trench 4G

Trench 4H

Trench 4H was excavated below a large block of ancient fields in a tributary in the upper part of catchment four at a site excluded from the predictive model because of its' southerly aspect (Fig 68). This trench site was chosen below a large block of ancient fields in a location which might otherwise have appeared prospective for archaeo-colluvium using simple field observation. The trench is between 35cm to 37cm deep above chalk bedrock.

There were four main layers.

1). A very dark organic ploughsoil to about 12cm.
2). A thin layer of chalky rubble between 10 and 15cm.
3). A dry and well structured calcareous silty clay horizon from 15-30cm.
4). A basal layer of rounded chalk gravel with some minor clay enrichment lies above the chalk bedrock. The profile was very shallow and colluvial phases were barely discernible. A small fragment of modern glass and a piece of tile was found at a depth of 20cm.

At this trench it might be concluded that despite the presence of ancient fields substantial colluvium is absent. The thin colluvium which does exist is archaeologically sterile. As colluvium was not predicted here trench 4H proved the model accurate.

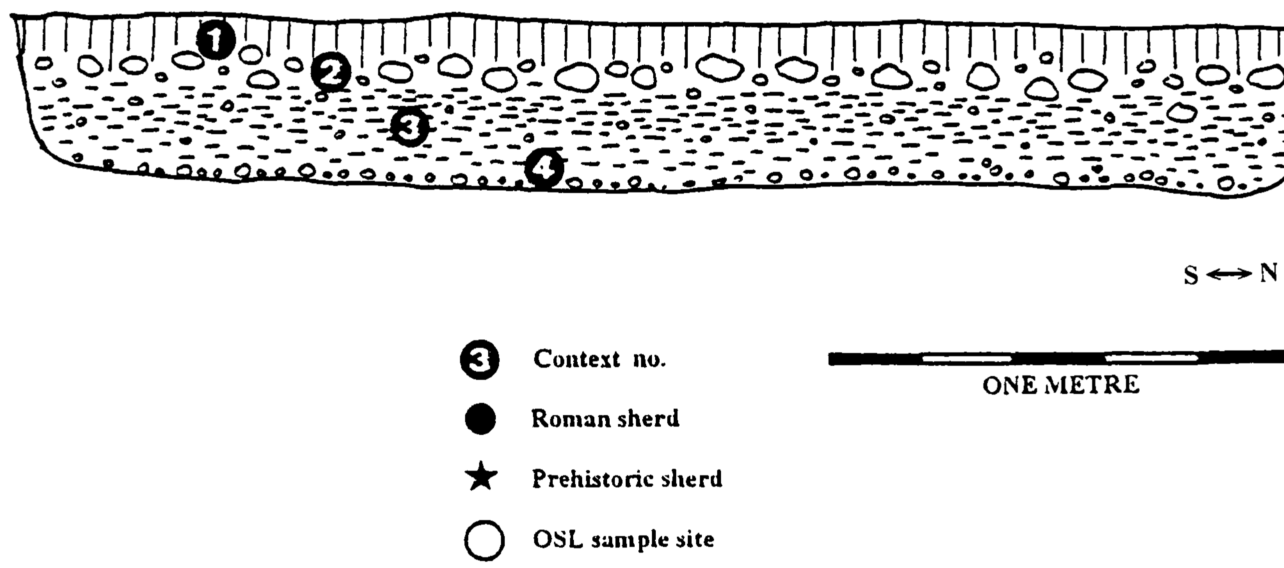


Figure 68 Trench 4H

Trench 4I

Trench 4I is located at the confluence of dry valleys in the upper catchment where absence of fields precluded its selection by the model, although augering at transect 4I revealed colluvium to depths of 70cm. The base of the trench plunges to a deep gutter at the eastern end above Combe parent material. The colluvium can be given a terminus post Iron Age given date according to recovery of coarse black pottery at a depth of 38cm (Fig 69).

There were five 5 layers identified within the colluvium.

1) A ploughsoil of chalky and flinty dark organic silty loam about 15cm deep.
2) A continous layer of chalky gravel lies between 15 and 22cm deep at the base of which a piece of Roman grey ware was recovered.
3) A well structured brown calcareous silty loam horizon with occasional flints extends from 22-38cm within which a piece of black Iron Age pottery was found.
4) A layer of chalk rubble and large angular flints occupies the basal material from about 38-45cm.
5) From 48-80cm a deep gutter at the western end of the trench is filled with large flints and chalky rubble. It is most likely that trench 4I intersected the edge of the ancient East Garston Ditch which has been dated to the Late Bronze Age (Ford 1982) and extends from south to north, bisecting the main valley north of Stancombe Farm.

Unlike trench 4H, some 400m to the west which proved the model accurate for the absence of colluvium, trench 4I revealed the presence of colluvium and dateable artefacts in what was also expected to be a region of little colluvium. The model therefore appears to fail at trench 4I.

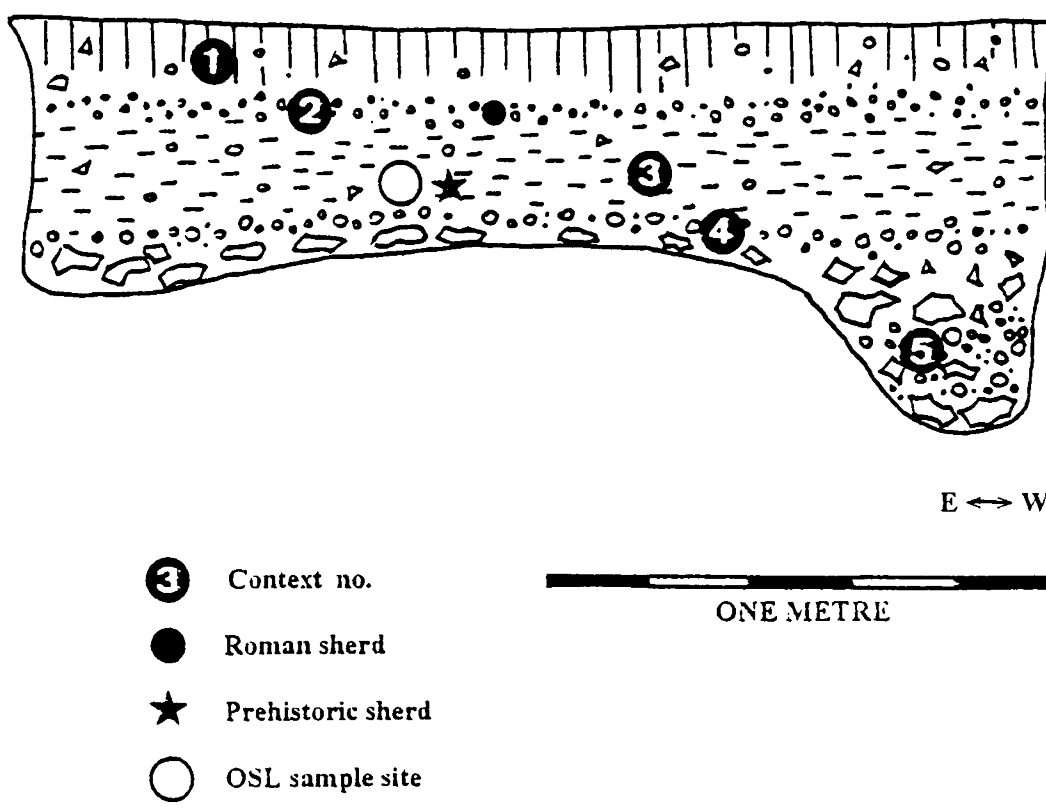


Figure 69 Trench 4I

Trench 5A

Catchment 5 has prominent cappings of Clay with flints occupying many of the hillcrests and upper slopes. Trench 5A is located in the main valley floor in the upper part of catchment 5 where colluvium was predicted by the model (Fig. 70). What became clear during the auger survey (transect 5A) and the excavation of this trench was that Clay with flints occupy all of the landscape in this part of the catchment. According to the model criteria, erosion and accumulated valley deposits should be thin within landscapes where Clay with flints are common. Trench 5A was excavated to test this assumption.

There were 6 main horizons.

1) A fine silty ploughsoil to 15cm.
2) A layer of large flints from a depth of 15-25cm within a matrix of a dark de-calcified brown silty loam.
3) The western half of the trench was composed of a yellowish brown de-calcified light silty clay to a depth of 35cm.
4) A discontinuous zone of smaller flints to the east of the trench at depth of 40-55cm.
5) A yellowish-brown de-calcified silty clay, becoming more clayey with depth contains occasional flints and small flecks of charcoal between 35 and 65cm. One Roman sherd was recorded at a depth of 39cm. A sherd of coarse textured brown - black pottery of mid-late Iron Age date was recovered at a depth of 38cm and a sherd of fine textured black Middle Iron Age pottery (of sooty fabric) was recovered at a depth of 55cm.
6) At the base of the profile were small platy flints within a silty clay matrix.

The overall depth of this profile and the presence of deep de-calcified colluvium indicated that substantial deposition is possible from surrounding clay soils. On the basis of the recovered pottery the earliest colluvium here might be ascribed a Middle Iron Age date. A soil core was taken for OSL dating at a depth of 52cm near the findspot of the Middle Iron Age sherd.

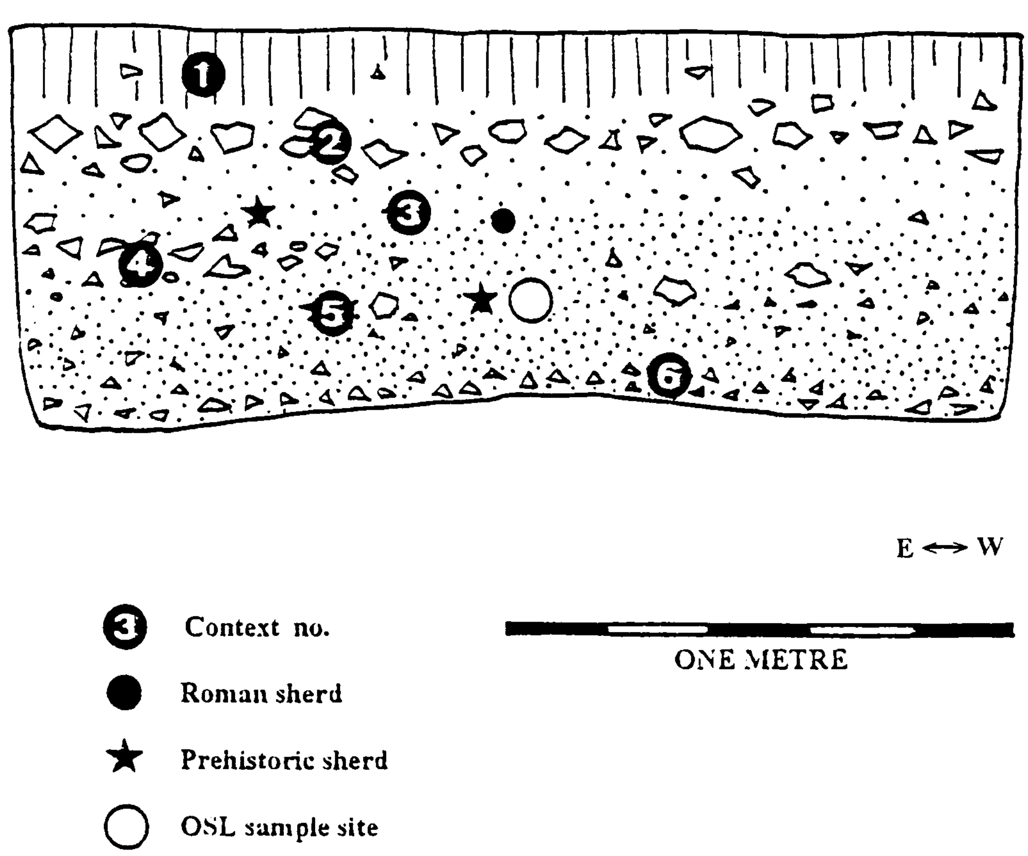


Figure 70 Trench 5A

Trench 5B

Trench 5B is located further down the main valley near Warren Wood at a site predicted by the model (Fig 71). The trench is between 44cm and 55cm deep above Coombe deposits and solution gutters. From the auger survey and local observation of Pleistocene sand units, solution features and Reading beds it appears that the local soils are more complex than is shown by the Soil Survey Map.

There were seven colluvial horizons ;

(1) A shallow dark loamy topsoil to 15cm.
(2) A fine sandy loam with flints and chalk gravel between 15 and 22cm.
(3) A thin layer of medium textured sand is discontinuous at about 25cm.
(4) From 22-40cm was a well structured earthy mid-brown sandy loam. A piece of Roman tile was found at a depth of 32cm.
(5) A thick layer of large nodular flints occupies the basal horizon from about 40-50cm.
(6) At the western end the colluvium is a tan reddish brown fine silty clay above a solution feature which is exposed in the base of the trench
(7) At the eastern end the trench deepens with the depression filled with large flints.

The widespread occurrence of solution holes and Reading Bed sandstone in this part of the Berkshire Downs is evident in the reddish soil colour at the western end of the trench and in the bottom of the trench. Only a small piece of Roman tile was recovered from the trench which might permit (at earliest) a Roman date to be ascribed to the shallow colluvium at this site. The results from the two trenches in catchment 5 show the local inaccuracies of the soils survey maps and the presence of colluvium in landscapes surrounded by Clay with flints, contrary to the assumptions of the model. An OSL soil sample was taken at 34cm depth.

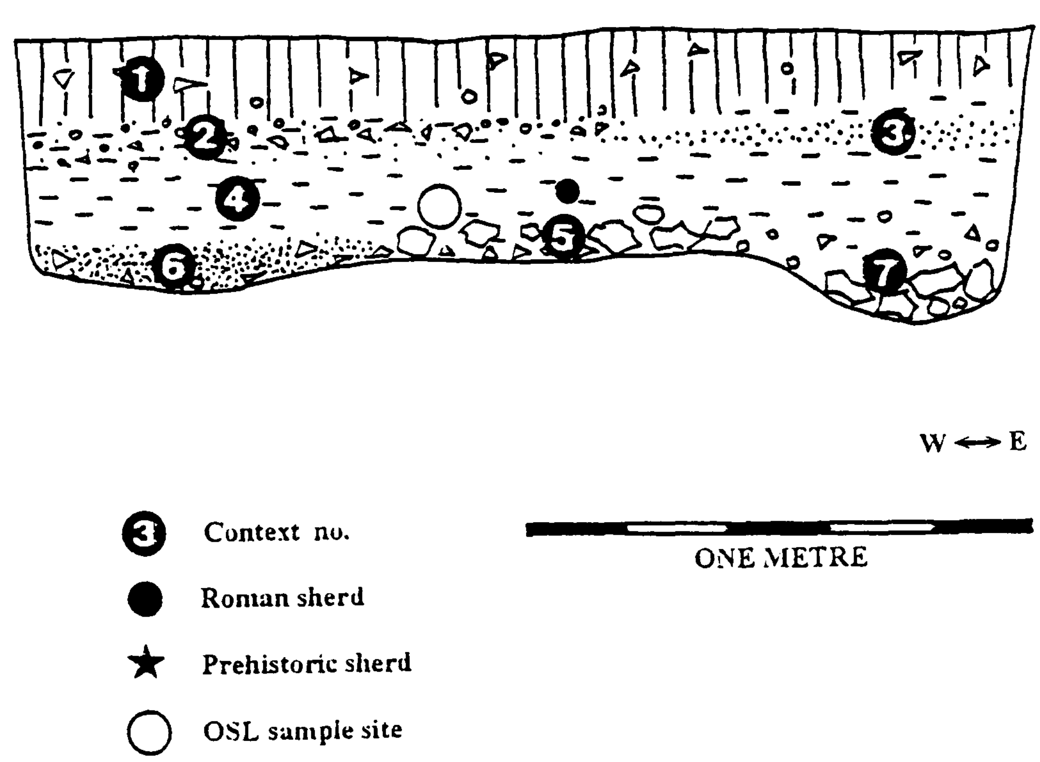


Figure 71   Trench 5B

Trench 6

Trench 6 is located at the confluence of several large valleys which contain both Clay with flints and chalk soils in an area of ancient fields and gentle slopes (less than 2 degrees) not selected by the model. Valley soils were found to be up to 60cm deep during the soil augering transect. An exploratory trench was excavated in the westerly tributary dry valley (Fig 72).

There were 6 layers within the colluvium.

1) A dark chalky fine sandy loam ploughsoil to 0cm.
2) A continous chalk gravel horizon at 10-15cm
3) Between 15 and 28cm a silty loam denotes a buried cultivation horizon.
4) Two small and discontinuous chalk gravel lenses exists at a depth of about 30-35cm. Two small sherds of Roman grey ware were found within these lenses.
5) Between 35 and 50cm a horizon of de-calcified silty clay denotes a lower buried cultivation horizon in which a small Roman sherd was found
6) At 50-60cm is a flinty basal horizon layer within which a square iron nail was found .
7) From 60 -90cm is reddish-brown fine de-calcified silty clay drift derived from surrounding Clay with flints.

Two cultivation layers were broadly discernible within the profile in layers 3 and 5. Within the upper of the two layers small pieces of Roman pottery were recorded giving the colluvium a *terminus post quem* date of this period. No prehistoric pottery was recovered during trench excavation. The presence of chalky lenses above de-calcified colluvium demonstrates cultivation of thin chalky soils following stripping of an earlier silty soil cover. As the relative age and origin of the colluvium and underlying silty drift parent material was difficult to discern in the field a soil core for OSL dating was taken within the lower material at 80cm.

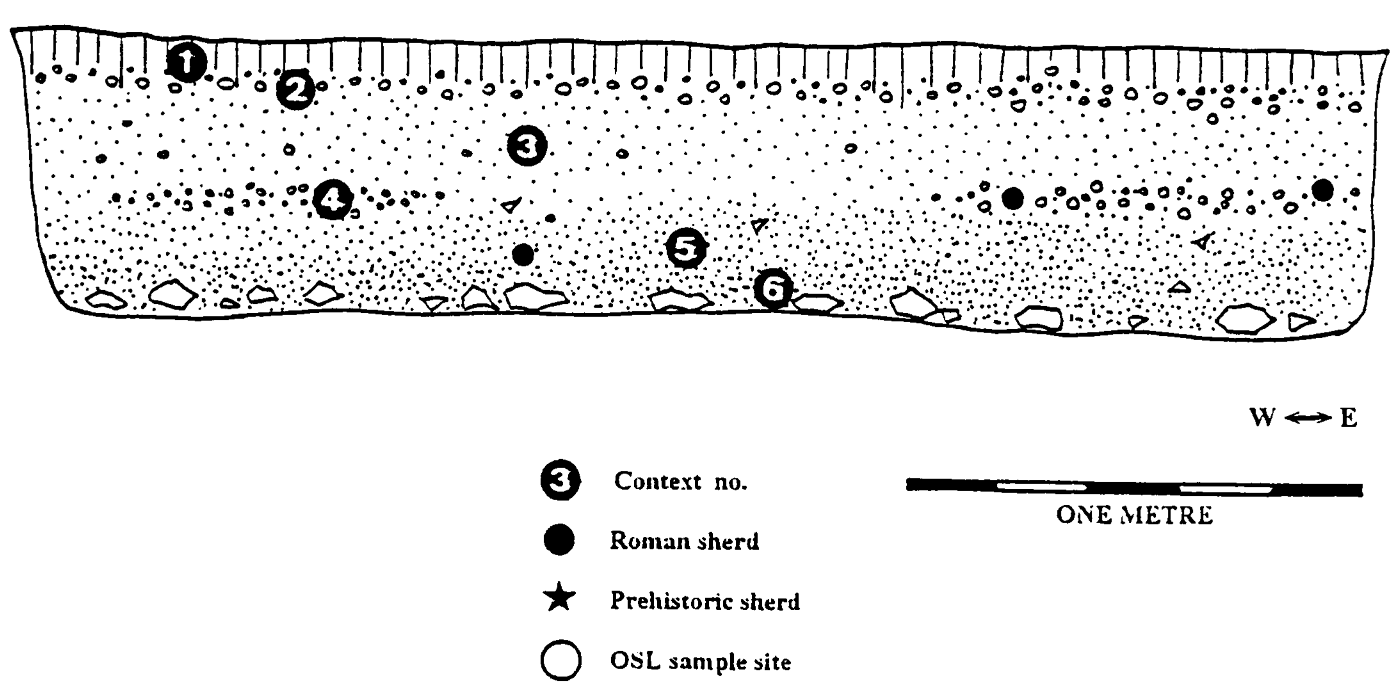


Figure 72 Trench 6

Trench 7

Trench 7 is located at the confluence of two dry valleys where augering revealed deep silty colluvium in transect 7 (Fig 73). The colluvium at this site is de-calcified and silty, derived from surrounding Clay with flints or silty drift in the lower slopes. This again highlights the inaccuracy of Soil Survey mapping as the soils of the mid and lower slopes in this catchment are represented as chalk soils on the soils map. There are three colluvial layers which were archaeologically sterile. The texture and composition of the colluvium is however similar to trench 6 and it might therefore be tentatively classed as similar archae-colluvial material.

The three layers were ;

1) Brown loamy ploughsoil to 15cm.
2) A discontinuous horizon of small flints and chalk gravels 10-20cm.
3) A dark brown de-calcified silty clay loam from 20-40cm.
4) A reddish-brown de-calcified slightly flinty light clay to 70cm.

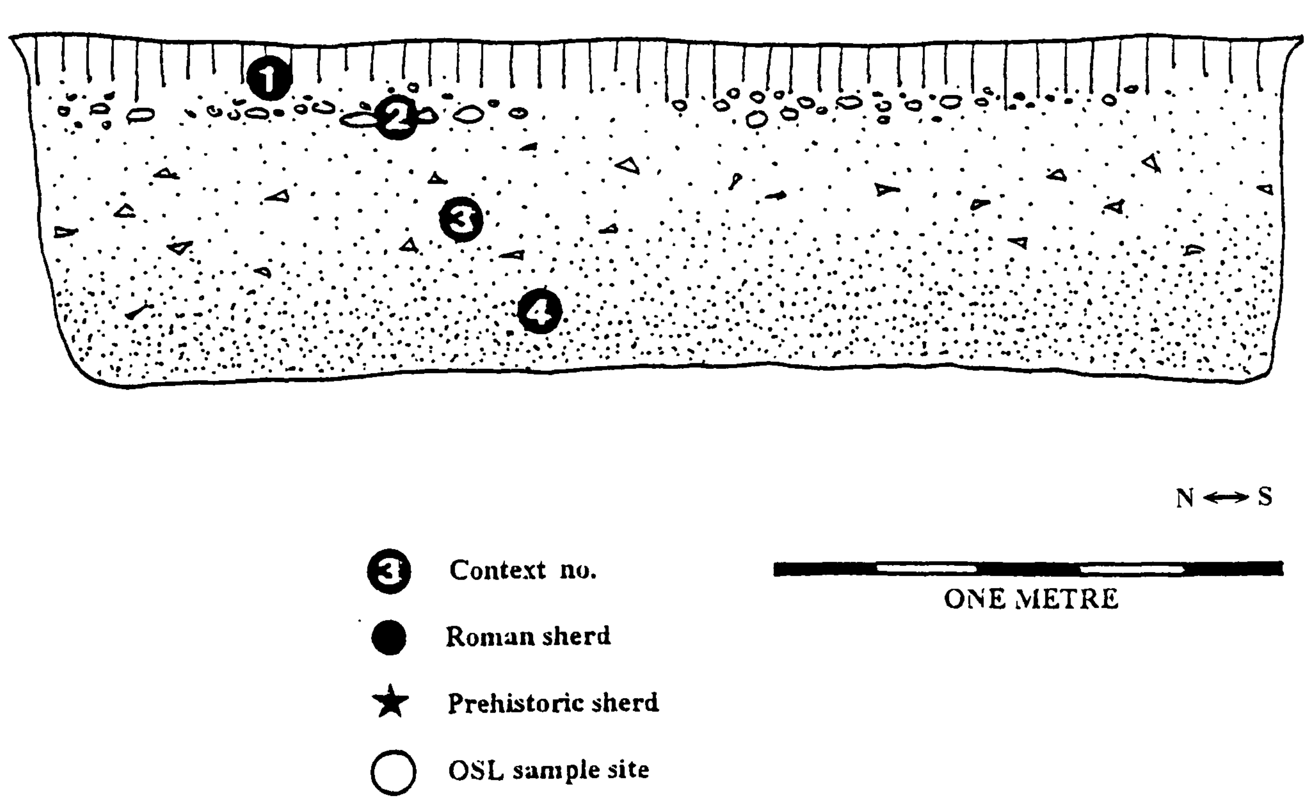


Figure 73 Trench 7

8.4 OSL RESULTS

Samples for Optically Stimulated Luminescence dating were taken from nine trench sites shown in Fig 57. Sampling locations are shown in each trench cross-section. OSL field collection and laboratory method is described in Chapter 7.4. and results which include Eqivalent Dose (ED) and Annual Dose values and OSL dates are shown in Table 8.

Sample No.	**Colluvial description**	**Pottery dating**	**Equivalent Dose (Gy)**	**Dose rate (Gy/000yr)**	**OSL Date** ***Years before present*** **(BP)**	**Comments**
T1B	Shallow calcareous	*IA/RB*	–		Low IRSL	Difficult preparation
T1I	De-calcified silty	*IA/RB*	–		700±200BP	Low light/too much scatter/unreliable date
T2A	Shallow calcareous	*nil*	–		Low IRSL	Difficult preparation
T4C	Shallow calcareous	*MIA/RB*	–		Unbleached	Low ED, low light too young
T4G(I) (2)	Old land surface, Deep flinty de-calcified	*IA/RB*	4.19±0.6 4.93±0.112	1.942 1.934	1600BP 2100 ± 250BP	Successful Successful
T4I	Shallow calcareous	*IA/RB*	13.1±0.785	1.028	8400±2000BP	High error due to intercept and water uptake error.
T5A	De-calcified flinty-silty	*MIA*	6.82±0.123	1.536	2864± 701BP	Successful but high error
T5B	Shallow calcareous	*RB*	–		Low IRSL	Difficult preparation
T6A	De-calcified silty drift	*RB*	33.2±0.943	1.372	12-14000BP	Successful

Table 8 OSL results

Six out of the 10 samples yielded dates which ranged between 14,000BP (years before present) and 700BP while the remaining four failed either in preparation or because of a low luminescence signal. Of the six dates achieved, four corresponded broadly with the expected age range. Successful dates were achieved at T4G (x2) and T5A, which correlated well with recovered pottery and T6A in deep silty drift.

The Late Iron Age date (2,100BP) for the old land surface at the base of trench 4G is younger than might be expected. Late Iron Age truncation of these basal soils would be very late in prehistory, given the evidence from truncated Neolithic and Bronze Age sequences elsewhere on the Chalkland (Section 3.2.2). The OSL date of the flinty colluvium adjacent to the Romano-British sherd of 1,600BP, some 20cm above the old land surface has reasonable correspondence. The second successful sample site was T5A in which Mid Iron Age pottery and an OSL date of 2,864BP gave reasonable correspondence. The remaining successful sample was at trench 6 where the OSL sample was taken below colluvium in archaeologically sterile silty sediments and gave a date of 12-14,000BP. This would correlate well with the late glacial period suggesting that these silty drift deposits are solifluction or re-worked peri-glacial sediments. The similarity in composition and appearance of the material in trench 6 with deposits of silty drift encountered in auger holes in catchment 1 and catchment 4 present the likelihood that they are all of similar peri-glacial rather than anthropogenic origin.

The sample at trench T4I contained Iron Age pottery and an OSL date of 8,400BP. This is well outside the age range for any soils derived from ancient cultivation. The sample at T4I may not have been fully drained of radioactive charge when it was last exposed and therefore retains a residual signal. The sample at trench T1I produced a date of 700BP which is certainly much younger than expected and corresponds poorly with the recovered Iron Age pottery. This sample yielded a very weak light signal suggesting that the sediment was not sufficiently bleached.

The remaining samples, T1B, T2A, T4C and T5B all failed to produce dates. These trench sites where all characterised by shallow, flinty and calcareous colluvium, often less than 50cm thick. Preparation problems, particularly with samples 1B, 2A and 5B were common. The poor OSL success rate and sample preparation problems which seem to be a feature of the dry valley soils in the project area are discussed in the following section.

8.5 COMPOSITION OF ARCHAEO-COLLUVIUM

While the dating of the colluvium was the primary aim of the trench survey, soil stratigraphy was recorded and some conclusions were made about colluvial composition and erosional processes. For the most part, colluvial sequences were too shallow to identify more than one or two discrete land use phases, which in some of the trenches could be broadly dated by entrained pottery. Colluvial composition has been included in the trench descriptions as well as a brief interpretation of land use phases which have been summarised in Table 9.

Five main categories of colluvial deposit were identified from the trench and transect surveys.

1) Relatively shallow well-structured dark coloured calcareous clay loam with common chalky lenses and flints usually linked with smaller tributary dry valleys.
2) Deep de-calcified and nodular flinty deposits usually associated with main trunk valleys.
3) Deposits of deep chalky fill.
4) Reddish-brown de-calcified silty clays
5) Reddish-brown de-calcified uniform silts

Trench no.	Colluvium description	Colluvial source/parent material
1B	Shallow calcareous	Chalk
1E	De-calcified silty	Silty drift
1G	Deep chalky fill	Chalk
1I	De-calcified silty	Clay with flints
4A	De-calcified silty	Silty drift
4C	Shallow calcareous	Chalk
4E	Shallow calcareous	Chalk
4G	Deep de-calcified flinty	Clay with flints
4I	Shallow calcareous	Chalk
5A	Deep de-calcified silty/flinty	Silty drift
5B	Shallow brown calcareous	Chalk
6A	De-calcified silty	Silty drift
7	De-calcified silty	Clay with flints

Table 9 Composition of archaeo-colluvium.

The range of colluvial deposits complies with the categories identified by Bell (1986) which are summarised in Chapter 2. The deeper flinty deposits in the central valleys of catchments 4 and 5 for example represent the product of erosion from surrounding Clay with flint cappings deposited under high energy events. It is has been suggested that the main valleys are the repositories of what were much more widespread silty and flinty soils - now represented by very small patches in catchment 4 for example. The amount of silty drift on the lower slopes of this catchment (revealed in transects 4D - 4G) also implies much more widespread distribution of non-calcareous soils on the slopes of this catchment in the past. The absence of buried soil profiles in all but one of the trenches (T4G) implies that the earliest soils have been stripped from the landscape. This is supported by the absence of any preserved old land surfaces below all but one of the round barrows and ring ditches examined on the Berkshire Downs (Richards 1986). Indeed the presence of much of the prehistoric pottery on the base of the trench profiles implies complete thinning to bedrock by ploughing during this period.

The preservation of the darker calcareous colluvium with chalky lenses such as at T1B, T4C and T4E, T4I and T5B exists in the smaller tributary valleys and sites in upper catchment positions above the main vallies (Fig. 74). Chalky lenses also occur in the upper profile above de-calcified colluvium in trench 6A. It is possible to broadly associate some of the Roman pottery with some of the thin chalky layers and suggest that they are the product of Roman cultivation during a period when soils were already thin and chalky. These are shown in the trench summaries in Figure 75. The depth of uniform chalky fill of Iron Age date at T1G also suggests a rapid erosion event of soils already thinned to bedrock .

Flinty colluvium of the main valley axes, dark shallower calcareous deposits and deep chalky fill appear common in the western part of the project area. To the centre and east, colluvium is uniformly de-calcified and derived from either Clay with flints, lower slope silty drift or Pleistocene sands. These colluvial deposits are in general thicker than those of the catchments to the west with the absence of prehistoric pottery suggesting that these areas were exploited during the Roman period. Colluvial composition forms part of the discussion on the distribution of these deposits in a synthesis of the colluviual results and archaeology in Chapter 10.

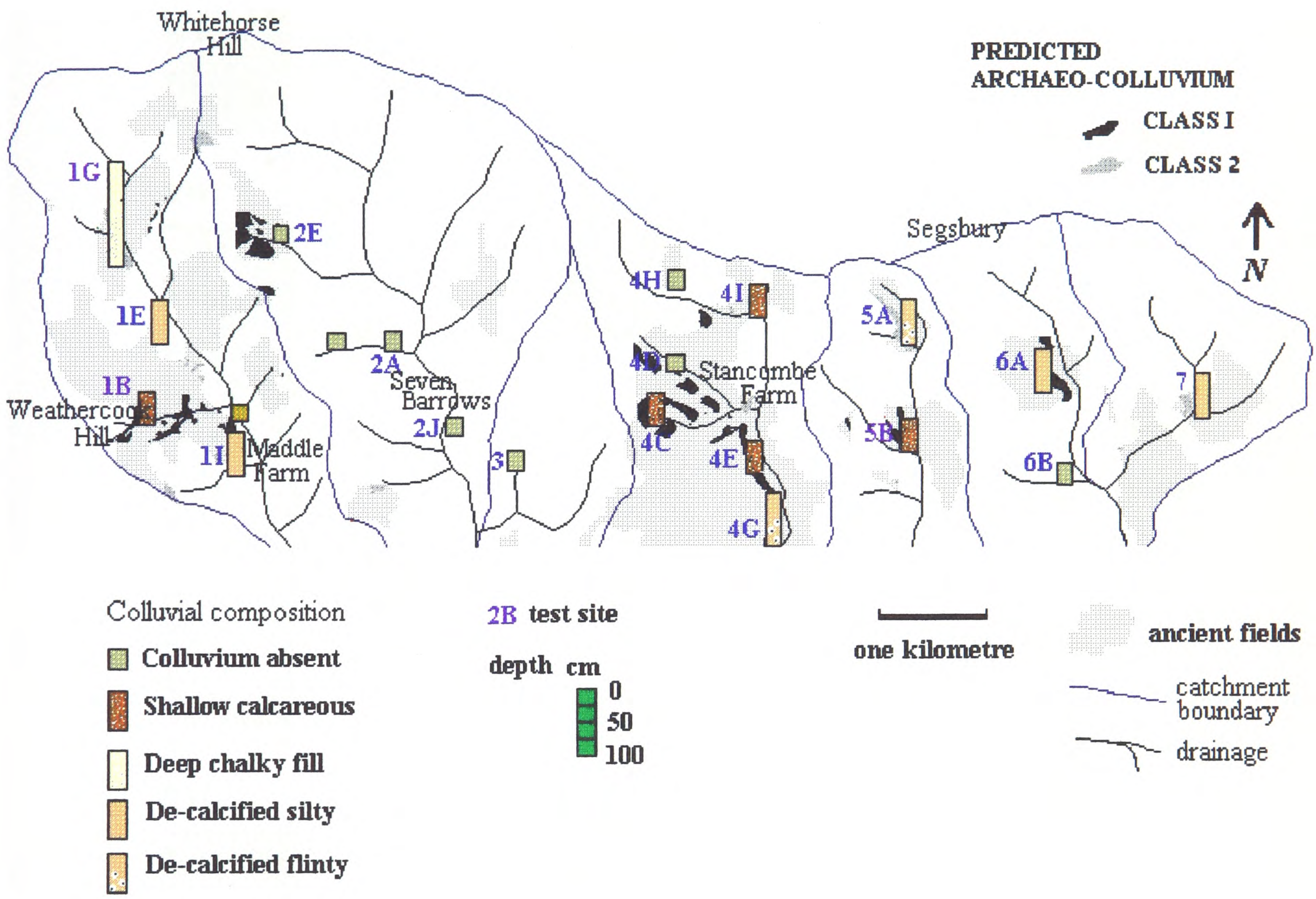


Figure 74 Composition of archaeo-colluvium

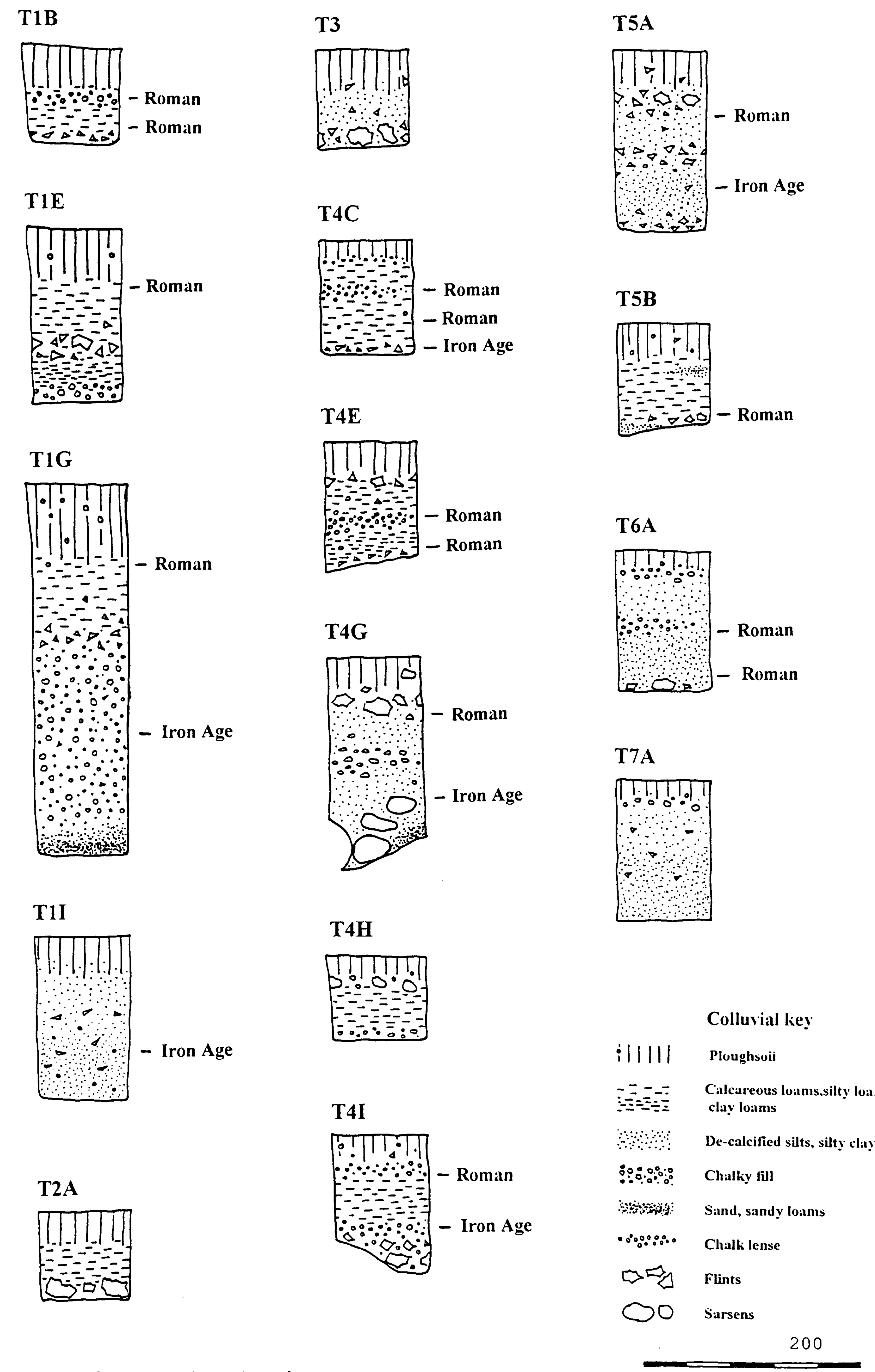


Figure 75 Summary of trench sections

8.6 SUMMARY OF FIELD-WORK RESULTS

The extensive survey of valley and valley edge soils and sediments from 35 transects and the detailed excavation and examination of 15 target trenches or pits has revealed something of the pattern of archaeo-colluvium across the Berkshire Downs. Thirteen of the 15 trench sites revealed colluvium with entrained artefacts and two trenches confirmed the absence of colluvium. Eleven of the thirteen colluvial trenches therefore succesfully yielded archaeo-colluvium and though for the most part the sequences were shallow, it was possible to identify some broad stratigraphic and compositional information.

Pottery of prehistoric age was found at seven trenches and Romano-British pottery at nine trenches. With such a frequency of Roman and prehistoric artefacts throughout the colluvium of the Berkshire Downs it would be reasonable to conclude that colluvium found association with ancient fields at other sites would yield a similar frequency of artefacts. Appendix 1 contains a full register of pottery finds and descriptions. Table 10 presents all the transect, trench and dating results which are summarised in Figure 76.

Prehistoric colluvium occurs predominantly in catchments 1 and 4 in association with the largest concentration of ancient fields. The earliest colluvium (Mid Iron Age) however was found in trench 5A. Roman colluvium was common in catchments 1 and 4 with prehistoric colluvium less common towards the east in catchments 5,6 and 7. Thin or absent colluvium occurs prominently throughout catchment 2, and the smaller catchment 3, though there are sub-catchments in catchments 1,4, and 6 where colluvium is also absent. The deepest sequence of colluvium was at trench 1G where chalky fill and buried alluvium was up to 165 cm deep.

A more thorough examination of the success of the model and the implications of the distribution of colluvium on the land use history of the Berkshire Downs follow in the next chapter. A total of 21 sites were chosen from which the success of the model might be evaluated. The model also produced a number of indirect conclusions as a result of the field-checking programme:

- Numerous unmapped Clay with flints and Reading Beds were found during phase 1 confirming the notion that colluvium may be influenced by geological and drift units too small to be represented on available Soil Surveys maps.

- Sampling within the Charity soils and associated silty parent material revealed a mix of soils derived from both anthropogenic and peri-glacial parent material, confirming the assumption made in Chapter 5 that they were of undifferentiated age and origin. Notably, the large Charity units of Catchment 1 were archaeologically sterile and could be classified as peri-glacial while the colluvium of the lower valley in catchment 4 contained artefacts and might be classified as anthropogenic.

- Archaeo-colluvium in some of the valleys provided sequences which showed datable episodes of soil thinning as well as deposition of material from soils now absent from the Berkshire Downs.

- Several observations were made about soil cover and colluvial thickness in relation to relative relief. In general, the shorter slope-length and more irregular dissection of the eastern catchments carries thicker soils and thicker colluvial deposits.

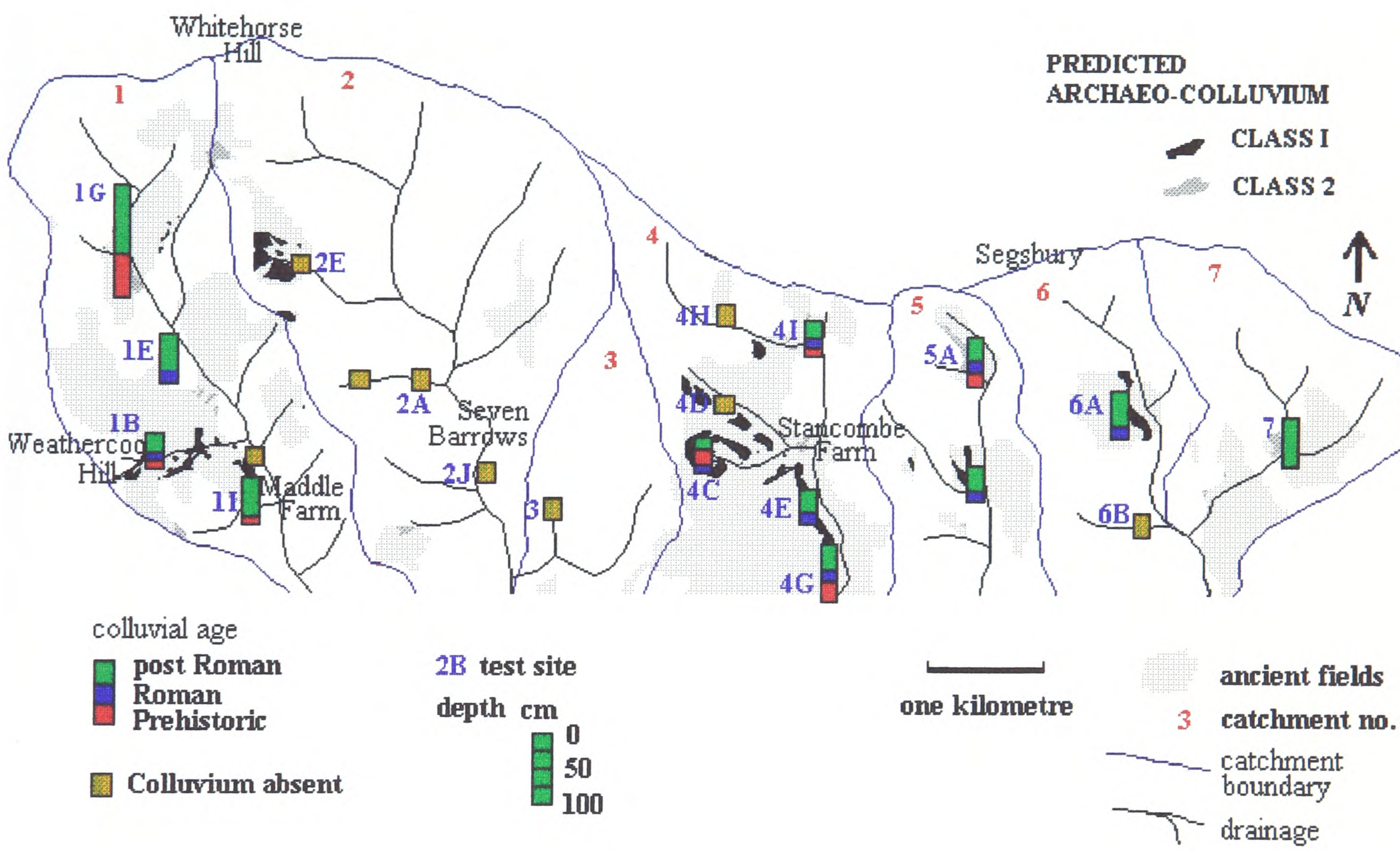


Figure 76 Distribution and age of archaeo-colluvium

Preliminary Transects	**Auger holes**	**PITS**	**Test pits or trenches**	**Colluvial depth (cm)**	**Presence of Archaeo-colluvium** + or none	**OSL dates**	**Ceramic dating**	**Model success** **Success / fail**
1A	35	5	P1A	30	none	Fail	nil	+
1B	16	-	T1B	50	+		*R-B*	+
1C	13	-						
1D	7	1						
1E	12		T1E	65	+		*R-B*	-
1F	14							
1G	12		T1G	170	+		*IA,R-B*	+
		1	P1I	65	+	**700BP**	*IA*	+
2A	3	2	P2A	30	none	**Fail**	*nil*	+
2B	3	1	P2B	25	none		*nil*	+
2C	3							
2D	6	2						
2E	4	1	P2E	25	none		*nil*	-
2F	10	1						
2G	2	1						
2H	6	1						
2I	3	1					*nil*	+
2J		1	P2J	30	none			
3	5	1	P3	30	none		*nil*	+
4A	4							
4B	7	2						
4C	7	2	T4C	50	+	**Fail**	*MIA,R-B.*	+
4D	7	3	T4D	25	none			-
4E	9	1						
4E(b)	-	2	T4E	50	+		*R-B*	+
4F	2	1						
4G	3	3	T4G	80	+	(a)**1600BP** (b)**2100BP**	*IA-RB* *IA*	+
4H	3		T4H	30	undated		*nil*	+
4I	5		T4I	50	none	**8400BP**	*IA,R-B*	-
5A	8	3	T5A	70	+	**2864BP**	*MIA,R-B*	+
5B	4	1	T5B	50	+	**Fail**	*R-B*	+
5C	6	-						
6A	16	1	T6A	65	+	**12-14000BP**	*R-B*	+
6B	6	1	P6B	35	none		*nil*	+
7A	3		T7A	70	undated		*nil*	-
7B	6							
Total	264	29	21			10		15 6

Table 10 Summary of Field results

CHAPTER NINE

EVALUATING THE MODEL and METHODS

9.1 ACCURACY OF THE MODEL

9.1.1 Interpreting the model results

Test sites included both colluvial trenches in which artefacts and OSL samples were taken and shallow pits, which confirmed the absence of colluvium. From a preliminary phase of 35 auger transects, 264 auger holes and 29 pits, 21 final test sites, (13 trenches and 8 pits) were chosen from which the composition and age of archaeo-colluvium was determined and the success of the model might be evaluated. The results have been summarised in the final two columns of Table 10 which shows the success (+) of failure (-) of the model at each test site. The success of the model was measured according to one of four possible outcomes where archaeo-colluvium was either ;

- Found where predicted
- Absent where it was predicted to be absent
- Absent where it was predicted or
- Present where it was predicted to be absent.

Of the 21 test sites there were 15 successes and six failures. The 15 successful sites can be divided between nine sites which proved the presence of archaeo-colluvium and six which proved its absence. The six failures, shown in italics in table 11 below, can be divided into three where archaeo-colluvium was absent where expected and two sites where archaeo-colluvium was found where not predicted.

	ABSENT	PRESENT
Archaeo-colluvium predicted	*P2E, T4D, P1A*	T1B,T1G, P1I, T4I,T4C, T4E, T4G, T5A, T5B, T6A, T7A
Archaeo-colluvium not predicted	P2A, P2J, 3, T4H, T6B	*T1E, T1I T4I,*

Table 11 Summary of model success.

The test sites were distributed in both the main predicted and non-predicted areas although non-predicted areas to the east were less well surveyed. There is a slight bias therefore in favour of field checking the predicted areas. Field checking proved the prediction to be successful at 71% of the sites.

The success or failure of the model is represented in Fig 77. Those areas predicted according to the model can be seen in black and grey on the map. Test sites where archaeo-colluvium was predicted within these areas are numbered in green, while sites where it was predicted to be absent are numbered in red. The actual presence or absence of archaeo-colluvium is shown by green or red columns respectively. By noting the correspondence of predicted sites with the actual colluvial results a pattern of model success can be interpreted. Figure 77 shows the 15 sites where colluvium was found as predicted and six where prediction failed. The map therefore shows that substantial and ancient colluvium can be seen at 11 sites, nine of which were predicted by the model. Those in which colluvium was found against the prediction were at trench sites 1E, 1I and 4I. The Seven Barrows catchment was conspicuous for the absence of colluvium. Alternately the map shows sites where colluvium was predicted but was found to be absent, notably at sites 1A, 2E and 4D.

Given the reconnaissance approach adopted, it is re-iterated that the model does not distinguish absolutely between the complete presence and absence of ancient colluvium but within the aims of the project locates prominent deposits. Although the distribution of colluvium across southern Britain is observed to be complex, a systematic method of site prediction such as that presented by the model appears to provide a useful first approximation.

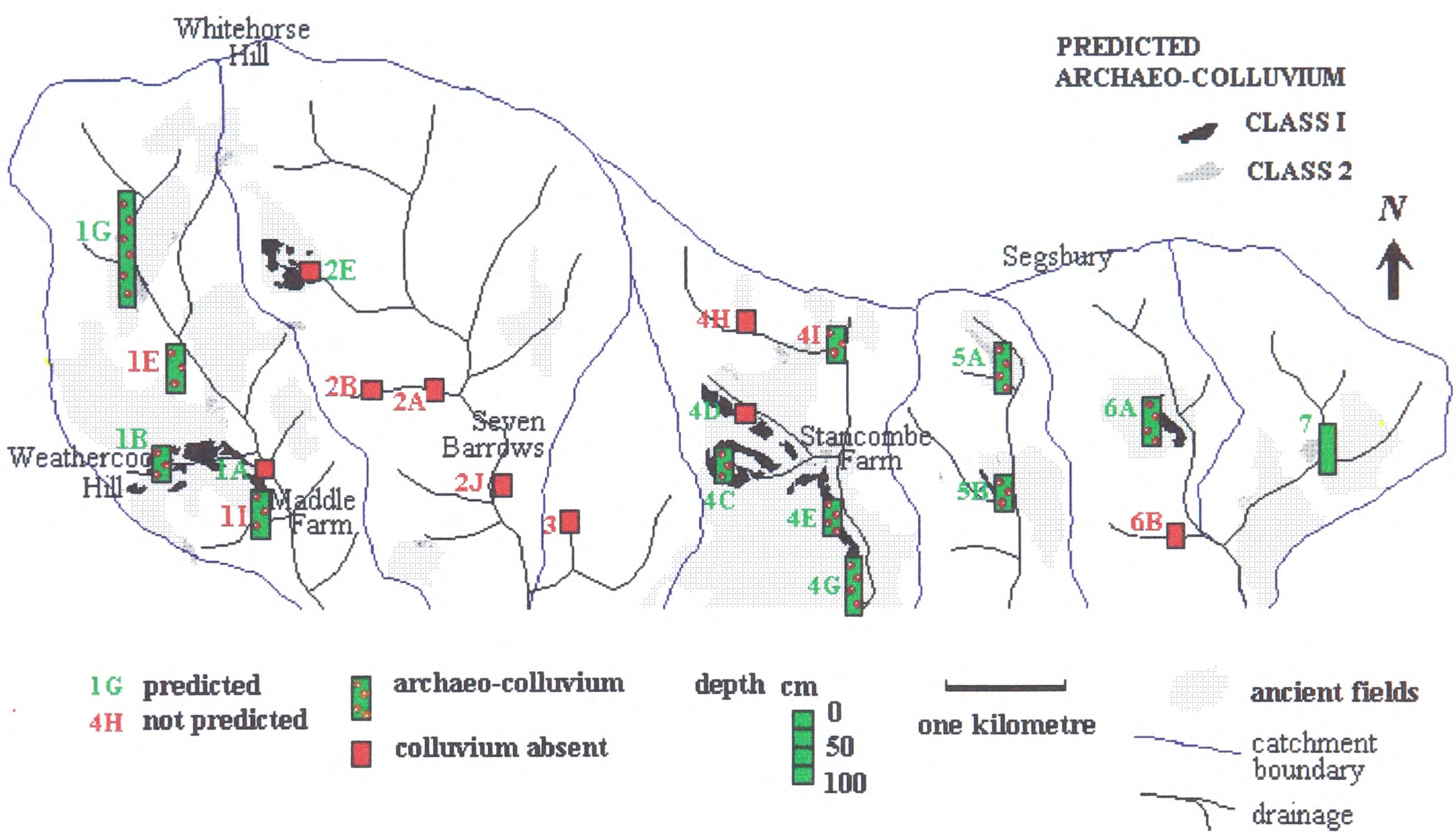


Figure 77 Accuracy of archaeo-colluvial prediction

9.2 SUPPORT FOR THE MODEL ASSUMPTIONS

9.2.1 Presence of colluvium below ancient fields

If the relationship of fields to colluvium is considered in isolation of any of the other model parameters, there are 16 out of 21 test sites which are located below fields, four of which are devoid of colluvium (Fig 77). These are site 1A in the wide valley near Maddle Farm, site 2E in the upper part of Catchment 2 and sites 4D and 4H in open chalk valleys in catchment 4. An encouraging proportion of test sites (75%) suggest a link between colluvium and ancient fields.

The remaining five test sites not located below fields are all devoid of colluvium. The absence of fields and colluvium in Catchment 2 and Catchment 3 provides strong negative evidence of the field and colluvium link, a pattern which is discussed further in the next chapter. While recognising that 21 test sites is not a comprehensive sample, the colluvial results nevertheless provide some support for the assumption that ancient fields might be used to locate archaeo-colluvium. To summarise, 75% of the test sites near fields contain datable colluvium while 100% of trenches away from fields have no colluvium.

9.2.2 Ancient fields produce archaeology

Of the 12 test sites below ancient fields which produced colluvium (above), 11 produced ancient sherds or artefacts. Trench 7A was the only site at which the colluvium below ancient fields was archaeologically sterile. In other words datable archaeology was present within colluvium at 90% of the sites where colluvium was recorded below ancient fields. It would seem reasonable to conclude that wherever colluvium is preserved below ancient fields there is a strong likelihood it will contain evidence of ancient human activity. Even though the recovery of prehistoric and Roman sherds was sparse across the Berkshire Downs (Gaffney and Tingle 1989), the results of the field checking support the view that manuring on cultivated fields has been widespread and that artefacts distributed by this manuring process are contained within datable sequences of colluvium in relatively close proximity. The exception at trench 7A is perhaps an acceptable anomaly be due to the fact that (in a landscape where pottery is sparse) absence of artefacts in one trench might be expected.

9.2.3 Fields on Clay with flint soils produce little colluvium.

There were five trenches within catchments surrounded by Clay with flint soils. Two of these sites, 3A and 6B had shallow colluvium in valleys without ancient fields while sites 5A, 6A and 7A, located in the mixed chalk and clay catchments revealed deep and de-calcified silty or flinty colluvium. Catchment 4 is occupied predominantly by chalk soils, yet the colluvium of the main valley is de-calcified and flinty implying that (at some time in the past) Clay with flints were the source of these valley sediments (Section 8.5). The field evidence therefore seems to suggest that deeper flinty and de-calcified colluvium is better preserved in association with Clay with flints than in chalk valleys where sequences are uniformly shallow. The assumption that Clay with flint landscapes produce little colluvium appears to have been contradicted by the field results.

9.2.4 Colluvium is more prominent on east-facing slopes.

The accumulation of colluvium on the east-facing slopes of asymmetric Chalkland valleys was one of the prominent assumptions of the model. There were seven auger transects which extended across both the west and eastern slopes ; 1A, 3, 4E1, 4G, 5A, 5C, and 6 (Fig 21). Colluvium was present exclusively on the east-facing slopes in all of these transects except numbers 3 and 6, where sediments were more evenly distributed in valleys which were notably less asymmetric.

9.2.5 Colluvium is confined to areas below the 500m buffer.

The 500m buffer zone chosen by the model to represent colluvial source areas and minimum slope length was not large enough to capture blocks of fields in catchment 1 some of which lay up to 1500m from the main valley. The prospect that colluvium lies below these fields in the mid-slopes is suggested by the position of several large Charity units in this part of the catchment. These deposits and associated soils were examined by auger transects (1C-E) and trench sampling (1E). The deep silty material on the slopes was found to be both devoid of archaeology and generally too uniform in composition to comply with the descriptions of colluvium provided by Avery (1980). These deposits were assumed to be superficial silty drift units of periglacial origin (Jarvis, 1973). While it was commonly difficult in the field to discern drift material from the overlying soils, the colluvium derived from this silty material appeared to be confined to narrow valleys with some tentative evidence from trench 1E that they are the product of Romano-British cultivation.

9.3 REASONS FOR INCONSISTENCIES OF THE MODEL

The choice of quite specific slope factors was clearly an oversimplification. Some lower slope deposition would be expected on fields of all slope and aspects. This was shown in catchment 7 where gentle slope (<2degrees) was the excluding factor although up to 70cm colluvium was found in the valleys. There were not enough test sites to check all slope and aspect combinations. It seems reasonable however to conclude that the general assumption that east-facing slopes on the asymmetric valleys of the Berkshire Downs produced more colluvium was borne out by field checking.

One of the limitations of the choice of 500m wide source and 200m wide receptor areas is that it was presumed that 500m would be large enough to represent areas of fields across which soils would be eroded to valley edges and valley floors. This does not account for movement of sediment into and out of these areas. The large blocks of fields in the midslope of catchment 1 were outside the 500m buffer zone for example. If, however, significant amounts of colluvium had been generated by these fields in this catchment (from up-slope of the 500m source area) there was no evidence in the form of deep colluvial deposits either in midslope or the valleys below (transects 1C, 1E and 1F).

The premise that preservation has occurred at about the same rate across the project area is difficult to evaluate, though it would seem that the western catchments have suffered removal of colluvium compared with the easterly catchments. This makes a comparison of land use history, on the basis of colluvial thickness unreliable.

The soils of the project area are more complex than the Soil Survey map revealed, something noted both during the transect survey and trench investigation. The presence of patchy Clay with flint soils, Pleistocene Sands, the sporadic distribution of Coombe deposits and the variable composition and origin of the Charity series emphasised the limitation of 1:63,360 scale soil maps for the localised field checking undertaken in this study.

The main results of the model evaluation might be summarised :

The main assumption of the model ; that ancient fields might be used to find ancient colluvium seems to be generally supported. The model appears to work in 71% of the trial localities and the correlation of archaeo-colluvium with fields and datable artefacts also proved encouragingly high. The model appeared to be less successful in the eastern part of the project area where assumptions based on asymmetric dry valleys and soil distribution appear less valid. The accuracy of soil mapping information, critical to the predictive process, also seems to be less accurate in the eastern part of the project area where Clay with flints occupy larger parts of the landscape than is evident on the Soil Survey map.

Given the complexity of colluvial formation processes the model provides a useful first approximation. The results of the field programme highlighted some of the inaccuracies of the model and yielded new information about soil, landscape and colluvial relationships which might be incorporated in a revised model. These include the fact that colluvium appears linked with Clay with flints, a feature contrary to the model prediction. The pattern of colluvial thickness and archaeological concentration across the Berkshire Downs will be used to develop ideas about ancient land-use and landscape relationships which are discussed in the next chapter.

9.4 OSL EVALUATION

9.4.1 Reasons for sample failure

The results of the OSL sampling programme (10 samples) produced four successful dates and six samples which failed either because of initial low sensitivity or, if final dates were achieved, they fell well outside the expected age range (Section 8.4). This was not a completely unexpected success-rate given the mixed results OSL dating seems to have achieved elsewhere in Chalkland settings (Rees-Jones and Tite1997).

The failure of the OSL samples on the Berkshire Downs might be attributed to a number of causes :

- Bleaching may be insufficient where rapid burial occurs so that exposure to light is short. This may also happen when deposition occurs in short pulses, or at night or during dull conditions.
- The processes of colluviation have been discussed in chapter 2. The mechanism by which these sediments have accumulated is complex, with episodes of soil movement likely to comprise events of different thickness and extent. Mixing of bleached and unbleached sediments may occur which causes a mixing of sediment of different luminescence signals, a feature which is particularly feasible in shallow colluvial profiles and chalk dry valley sediments.
- The capacity for the mineral fraction to be sufficiently bleached is influenced by the purity of felspars. The presence of flocculated clays, carbonate cement or weathered felspars also limits the sensitivity of felspars to bleaching. Failure of several samples after lengthy preparation attempts has been attributed to these factors.

9.4.2 Preparation problems

Whether a sample retains a luminescence signal (IRLS), implying that felspars were sufficiently exposed to light, cannot be determined without a lengthy preparation process in which the active mineral fraction is separated (Section 7.4.7). Most of the samples required repeated washing and de-flocculation using Calgon and sonic bath treatment - in some cases up to 10-15 times. Samples T4C, T4G, T4J and T5A were washed 10 times and yielded suitable IRSL values. Samples T1I, T4I and T6B yielded an IRSL signal after a second phase (10-12 times) of washing, while samples T1B, T2A and T5B failed to produce a suitable IRSL signal (above 200 counts per second) even after lengthy repeat washing and deflocculation procedures (Table 12).

It is also evident that calcium carbonate may persist despite washing in HCl (Rees-Jones 1996), and also that the fractionation method may yield a 2-11 micron sample composed of unsuitable flocculated felspars. It was the experience during this project, that felspars which were either clean, unweathered or devoid of carbonate cement were extremely difficult to isolate in samples taken from chalky colluvium.

Sample no.	**Colluvial Composition**	**Natural signal** initial washing **(cps)**	**Natural signal** second washing **(cps)**	**Final result / comments**
T1B	Shallow calcareous	20cps	20cps	FAIL - clay/carbonate flocculation
T1I	De-calcified silty	<20cps	1000cps	700±200BP Too young
T2A	Shallow calcareous	20cps	20cps	FAIL - clay/carbonate/flocculation
T4C	Shallow calcareous	450cps	n/a	Unbleached
T4G	De-calcified flinty	3000cps 3000cps	n/a	**1600±250BP** **2100±250BP**
T4I	Shallow calcareous	<20cps	500cps	**8400±2000BP** Too old
T5A	De-calcified silty	2700cps	n/a	**2864±701BP**
T5B	Shallow calcareous	200cps	160cps	FAIL – clay/carbonate flocculation
T6A	De-calcified silty	<30cps	3000cps	**12-14000BP**

Table 12 OSL IRSL sensitivity results

9.4.3 Interpretation of low IRSL sensitivity

Rees-Jones embarked on a programme of X-Ray diffraction and scanning electron microscopy (SEM) of 27 OSL samples from a range of environments in Britain to investigate the relationship of IRSL sensitivity to mineralogy and sediment condition. Based on examination of these samples it was her conclusion that IRSL sensitivity appears to occur without clear relationship to felspar content, though felspar weathering was a common factor (Rees-Jones 1996).

While her samples were taken from a range of alluvium, cave sediments and colluvium, it was unquestionably the samples from chalk settings which gave the most problems. These included two at Nettlebank, an Iron Age hillfort in Hampshire, one at Tower Hill (within the Berkshire Downs project area), two at the Uffington White Horse and two from a ditch near the Uffington hillfort, at the northern limit of the project area. Only the samples from the White Horse were successful in achieving realistic dates. There were two samples taken at this site, one of which was so difficult to prepare that an alternative method (fine-grained quartz IRSL) was tried. The two samples from the ditch at Nettlebank yielded strong IRSL signals but final dating was not possible due to insufficient bleaching. This was despite the fact that the mineral constituents, condition and size of grains appeared under SEM to be acceptable for OSL. Nettlebank is perhaps a slightly different case, being relatively deep ditch fill, compared with the shallower sediments of the Tower Hill lynchet and the samples from the Uffington White Horse and ditch.

At Tower Hill the sediment sample from a shallow lynchet (45cm deep) yielded an IRSL of less than 20 counts per second (cps) implying almost no luminescence. Mineral constituents under XRD were found to be dominated by calcium carbonate with grains stuck together, conglomeration of felspars and carbonate cement, even after successive phases of HCl washes. This demonstrates that even after a standard grain-size separation procedure, the 2-11 micron process does not necessarily isolate the proper mineral fraction, especially if the suspension is affected by cemented or flocculated grains.

Similarly, a programme of OSL dating of a linear ditch adjacent to the Uffington hillfort produced poor results, again interpreted to be a function of sediment bleaching. In total therefore, only one sample has been succesfully dated on Chalk out of seven attempts (using felspar) and a further one using the fine-grained quartz method.

A short programme of XRD investigation was undertaken for the colluvial samples on the Berkshire Downs to determine the reason for sample failure and low IRSL. There is a wide variety of colluvial types among the 9 sites which were sampled (Table 12). These ranged from shallow chalky colluvium, de-calcified silty sediment derived from drift material and possible peri-glacial parent material. XRD analysis proved that all samples were rich in both quartz and felspar and it appeared that weathering of felspars and masking by clay coating was neg;igible within the samples.

The problem samples, T1A, T2A, and T5B, failed to produce sufficient IRSL counts even after successive washes were examined under XRD. The failure of these samples despite abundant quartz and felspar could not easily be explained, though it is possible that during collection or preparation these samples were exposed to light or were contaminated by clay, iron coatings or felspar weathering which was not detected by XRD. The failed samples on the Berkshire Downs share similar characteristics with the Tower Hill sample (above) with respect to composition and depth. It is possible therefore that carbonate cement and felspar weathering are problems common to shallow calcareous colluvium on the Berkshire Downs. As has been mentioned, even if a sample yields abundant clean felspars or quartz it may not hold a luminescence signal for the reasons elucidated in 9.4.1.

Samples T1I, T4I and, T6A failed after initial preparation (<30 counts per second) but worked after successive washing (>500 cps). For these samples it was assumed that the mineral fraction was extremely "sticky" such that deflocculation required persistent washing sequences. Clearly the effectiveness of the washing process varies with the condition and contamination of the mineral fraction. It was decided, as time was limited, not to undertake an extensive programme of XRD and Scanning Electron Microscopy to examine the condition of the mineral grains for each of the problem samples, suffice to conclude, based on laboratory preparation problems and the previous work on IRSL sensitivity, that chalk soils are notoriously difficult to prepare and therefore to successfully date.

While the samples from the chalk settings failed however, de-calcified silty and flinty colluvium all yielded high IRSL sensitivity (samples T5A, T4G, T6A and T1I). Only T1I yielded an unreliable final date.

The specific properties of clays associated with chalk soils in suspension, their predisposition for flocculation and aggregate cementing of particles - factors which prevent the 2-11 micron fraction from being clean and easily separated - are properties of these samples which are difficult to measure and even more so to predict. Washing and preparing samples is part of the OSL technique which is time consuming and unavoidable. Even under Scanning Electron Microscopy and mineral analysis, the reason for success or otherwise of OSL samples can be difficult to interpret.

The growth of OSL as a technique is producing an expanding corpus of case studies which is contributing to a improved understanding of IRSL sensitivity in a range of settings. Apart from the homogenous thick loessic or alluvial settings where OSL appears to achieve best results, a range of environments have been tried in which the success of OSL is less predictable. While there are a large number of factors which contribute to the failure of OSL in any setting, it is the absence of any comprehensive predictive criteria which means that this technique still relies on a trial-and-error approach. It would appear, after the short programme of OSL work undertaken for this study (on both chalk and de-calcified samples) that the shallow calcareous sediments of dry valleys might be added to a list of colluvial settings for which OSL is an inappropriate dating technique.

9.4.4 OSL Conclusions

Some conclusions of the OSL programme on the Berkshire Downs are that the suitability of this technique for dating shallow colluvium on the Chalkland can be sub-divided according to the composition of the soils at individual sites. Deeper valley centre colluvium composed of de-calcified and silty or flinty material appears to be better suited to the OSL technique than the shallow calcareous dry valley soils. The latter chalky dry valley sediments, characterised as they are by a higher clay content and shallow depth, suggestive of both sediment mixing and a contaminated gamma signal, are the most obvious of a number of reasons why these samples failed. Both mineral techniques make the assumption that clean felspar and quartz are available in the samples. In some samples, such as that from Tower Hill (Rees-Jones 1996), felspars were almost absent, while in others the felspars are weathered, stuck to other constituents or masked by calcium carbonate. It is therefore a conclusion of this study, based on the poor success rate of OSL on the shallow chalky dry valleys and a corpus of similar results from the work of Rees-Jones, that OSL work in Chalkland settings might be more effectively focused on colluvium derived from Clay with flints or silty drift deposits.

9.5 EVALUATION OF THE ROLE OF GIS IN THE PROJECT

The theme of this project has been the use of past land use information super-imposed on the modern landscape for the purpose of predicting the distribution of ancient eroded soils. The spatial and temporal aspects of reconstructing past physical and cultural landscapes, comparing and using them in combination with the modern landscape presents a complex task. Archaeological landscape projects using GIS commonly rely on information derived from the modern landscape (Gaffney and Stancic 1991; Lock and Harris 1996). This is because information about past soils information is commonly absent. Nevertheless, these projects overlook the inaccuracies to which this might lead. This project departs from such a stance, not in its attempt to simulate past soils (the almost complete absence of which is acknowledged), but by taking the novel step of using relict cultivated fields and certain inferences to locate relict eroded soil material in the modern landscape.

The relationship of the ancient fields to archaeo-colluvium was a premise which underpinned the whole predictive process. Using GIS, it was possible to identify and quantify the extent to which this relationship existed across the Berkshire Downs, initially using proxy information from modern soil maps and later using estimates of the extent of actual archaeo-colluvium based on field checking. The second stage of developing the model involved multiple selection of landscape, soils and field information based on some observed inter-relationships and a number of simple land use and topographic assumptions. The culmination of the process was the map of predicted colluvial sites (Fig 18).

The digital environment into which the study area was transformed within IDRISI allowed the rapid computation of proportions of field and soils and a range of manipulation, overlay and selection functions. This was particularly useful in defining the slope and aspect attributes at high resolution for use in the selection of some of the colluvial/terrain parameters. While the storage, manipulation and display functions of GIS provide a tool for organising vast arrays of landscape information, far exceeding the capacity of any manual options, GIS brings with it a number of potential problems.

1) The procedure for loading the map data, the process of digitising each layer of data and preparing the maps to be handled by the computer programs is time-consuming offering a marginal advantage over manual drafting, particularly for maps which are relatively simple. It is recognised that up to 80% of GIS projects are occupied by data collection and editing. For simple drafting tasks the disadvantages of data preparation would seem to outweigh the advantages which might be achieved in later map handling and manipulation. The advantage of GIS however is in the manipulation and display of map and terrain information and computation of multiple layers of data. It is for the client to decide on the specific tasks which are required before choosing to use GIS.

2) One of the most beguiling aspects of GIS is that it has the capacity to perform a huge array of functions but the temptation is to use them whether they are central to the aims of the project or not. GIS should therefore be used as a tool and prudently employed to assist the project rather than to drive or distract it. While it is often cited that GIS is *just* a tool, the distinction between usefulness and distraction becomes blurred when presented with such a vast array of ancillary functions.

3) The choice of algorithm used with the digital terrain model was discussed in Chapter 5.6. Different spatial algorithms create variable interpretation of topographic data, a subject dealt with by Kvamme (1990). The algorithm employed within IDRISI provided a representation of topography, which for the broad purposes of this project was deemed adequate. Caution however must be exercised and the degree of distortion and extrapolation between contours should be identified and adjusted, according to the aims and accuracy requirements of individual projects.

4) The processing of information preliminary to running the different GIS functions warrants comment. A number of functions exist which act to smooth or summarise the spatial data. It was a simple task to cut corners, straighten curves and delete irregularities in a process of homogenisation of the original landscape information for the purpose of neatness and scale. The initial digitising method in autocad represents the reduction of a curved line to a series of segments which can be smoothed to produce an extrapolated curve. The manipulation of data through interpolation, while representing only small shifts in the data, is an example of the way in which GIS subverts the original information. At certain mapping scales these changes are insignificant particularly given the inherent inaccuracies in the topographic maps and base maps from which the digitised information is derived. Nevertheless, by reprocessing spatial information, errors can be compounded. The GIS operator may unwittingly magnify error for the purpose of providing a neat or rapid map or image and explain away the inaccuracies as one of the unfortunate costs of the digital process.

It is also suggested that the homogenisation of the map data is the price paid for all the manipulation and computational functions. If the landscape were not reduced to manageable cells and segments it would be infinitely more difficult to compute the spatial data. This is no doubt the case and again the practitioner must be aware of the sacrifice to scale which is often part of the GIS process. The DEM used for this project (Fig 13) incorporated numerous flat areas on hilltops and ridges which might have been smoothed using a number of sophisticated statistical interpolation processes such as kriging and triangulation. The filtering program used within IDRISI however produced a DEM which had negligible distortions, particularly on hillslopes and valley floors and was suitable for the purposes of the project.

5) GIS also dictates the resolution of the map project by virtue of the storage limitations of different platform programs. For example while a 10x10m cell size may have produced better resolution, this project was confined to a 20x20m grid because of the lower storage capacity of the available hardware. Choice of the most suitable resolution of the DEM, smoothing functions and the scale of topographic information is GIS issue which is introduced in Section 5.7.1.. The topographic information chosen for this project was 1:10,000 scale with contour intervals at 5m. This still represents topographic information at quite high resolution and the Digital Elevation Model cell size of 20m x 20m represents a level of terrain detail more than suitable for the broad-scale approach adopted in this project.

The project benefited greatly from the organisational capacity of GIS. The combination of spatial information about soil and ancient fields, which was used to draw some important links between erosion and colluvial processes was achieved rapidly. The definition and selection of three or four classes of land use, soils and topographic information in addition to the capacity for rapid computation of vast data arrays made GIS invaluable, even given the time consuming phase of data preparation and processing. Any bias as a product of topographic interpolation or smoothing in a project of reconnaisance scale, such as this, appears to be acceptably below the resolution of the other spatial information on which the model relied – notably the soil and geology maps for example.

9.6 TRYING SOME DIFFERENT PARAMETERS

The predictive model which has been developed and tested on the Berkshire Downs is based on assumptions that archaeo-colluvium will be found at the base of gentle east-facing slopes on chalk soils. The field testing results produced a general picture of the distribution of these ancient deposits and found the model to be accurate in 71% of cases. It is possible to assess the validity of the original parameters and attempt to improve the original predictive model by changing some of the model parameters. This can be done using some random changes in what is termed a "what if" process or according to some of the observations from the field testing programme in a process of feedback.

The assumption that fields are linked with archaeo-colluvium was supported by field-checking with 75% correlation, as was the broad association of these ancient deposits with east-facing slopes - at least in the western and central catchments. An assumption which was questioned on the basis of field observations was the presence of thicker colluvium in valleys surrounded by Clay with flint and drift soils. The original model excluded fields on Clay with flints from the prediction based on the assumption that heavy soils would not be as erodible as chalk soils.

The following section describes the colluvial predictive model reproduced in seven separate trials. The first considers the effect on site prediction of using topographic information at different scales. The remaining six trials involve changing soil, aspect and a range of slope-angle criteria.

9.6.1 Change of map scale

Until the last few months when more detailed digital topographic information became available, the predictive model had been based on 1:50,000 scale information. The change to 1:10,000 scale information, while involving a time consuming overhaul of the model, meant that two versions were available for comparison. Two predictive models therefore exist with supporting digital elevation models and slope and aspect information. It is a useful exercise to compare the distribution of predicted sites using terrain information at each of the two scales and examine the benefit of choosing more detailed topographic data in the final product.

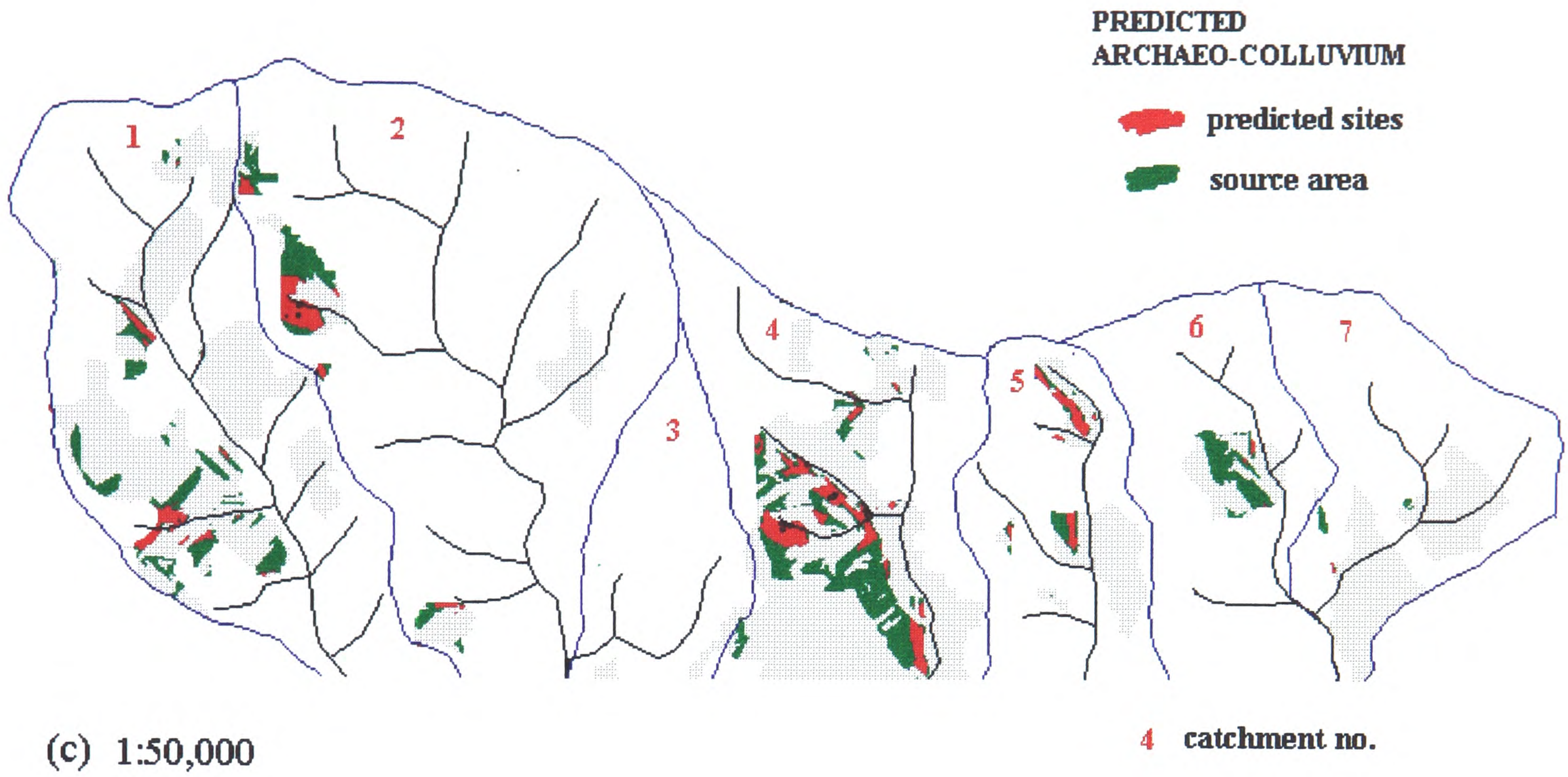
Figure 78(a)(b) show areas which are east-facing with slopes of 2 degrees or more at (a) 1:10,000 scale and (b) 1: 50,000 scale. A glance at both maps reveals much greater capture of these aspect/slope areas by map (a). Figure 78 (c) shows the sites of predicted archaeo-colluvium from the old model (1:50,000 scale) in red, surrounded by fields in green which lie within the 500m buffer. In this model there was no distinction between class 1 and class 2 sites. Figure 78(d) shows the current model (1:10,000 scale) with class 1 sites in red and class 2 sites in yellow. While there will clearly be differences in the terrain information at both scales, the smaller scale data presents much more extensive contour information than the 1: 50,000 scale information for which interpolation will be considerable especially in flatter areas where contour spacing is relatively wide. The north-west, south-east grain which is evident in parts of Fig 78 (b) bears this out. Slope and aspect information can be generated more accurately and across larger parts of the landscape from the greater density of contours produced at 1:10,000 scale. There are some small differences in the distribution of fields within the 500m buffer between the two maps but it is the higher resolution of the 1:10,000 scale map in the lower slope/valley areas which provides the most significant distinction between the two.

Fig 78 (e) shows the overlap between the old and new predicted areas. The 1:10,000 scale map produced new sites in catchments one 1, 4, 5 and 6 (shown by asterisks). Of the five new areas, archaeo-colluvium in the field was confirmed in the upper part of catchment 1, catchment 4, and catchment 6. The choice of higher resolution terrain information, as might be expected produced a model of greater accuracy with respect to colluvial distribution.

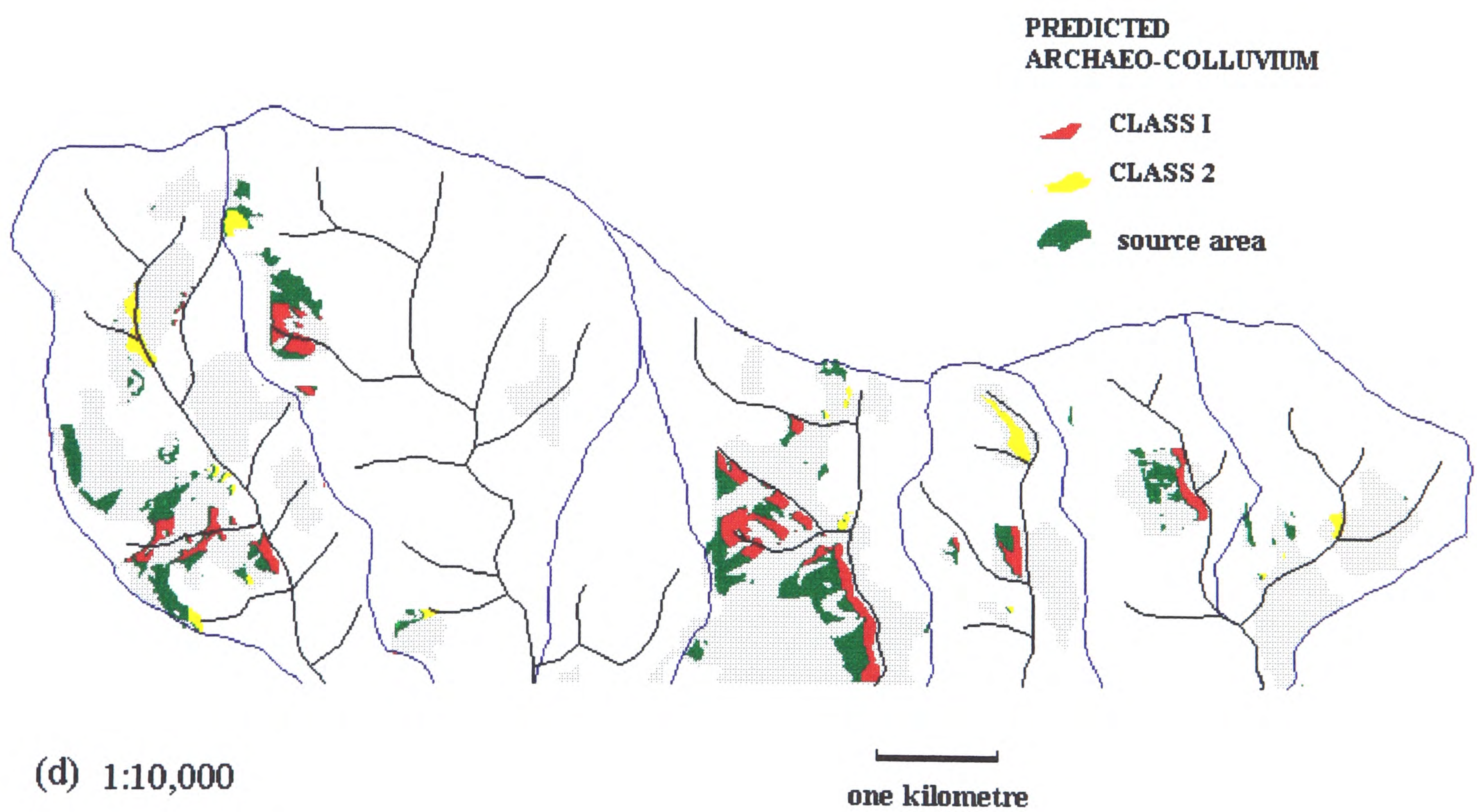
(a) 1 : 10,000 scale DEM

(b) 1 : 50,000 scale DEM

Figure 78(a) and (b) Comparison of east facing/>2 degree slope information using DEM at 1:10,000 and 1:50,000 scale.



(c) 1:50,000



(d) 1:10,000

Figure 78(c) and (d) Comparison between predictive models at 1:50,000 and 1:10,000 scale

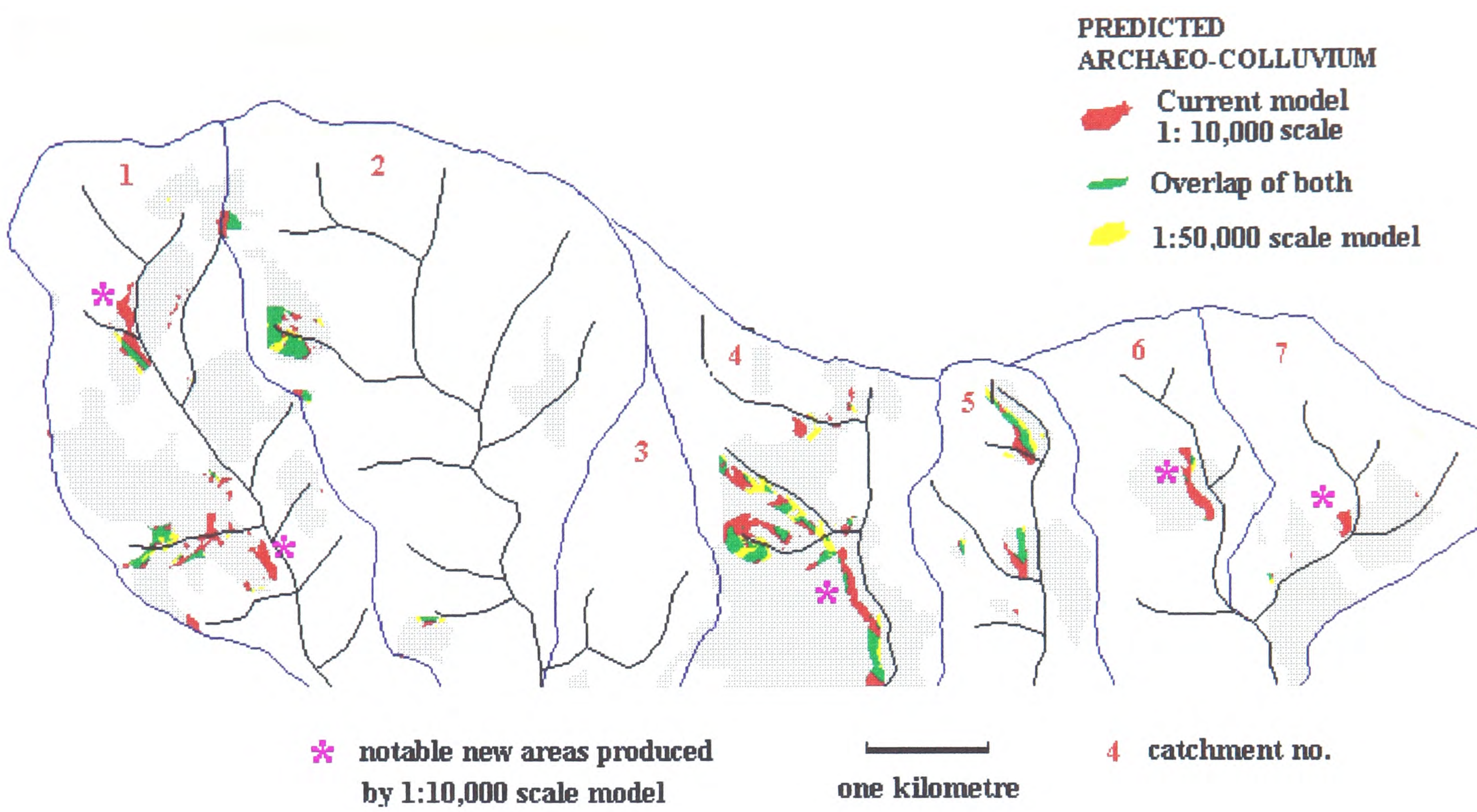


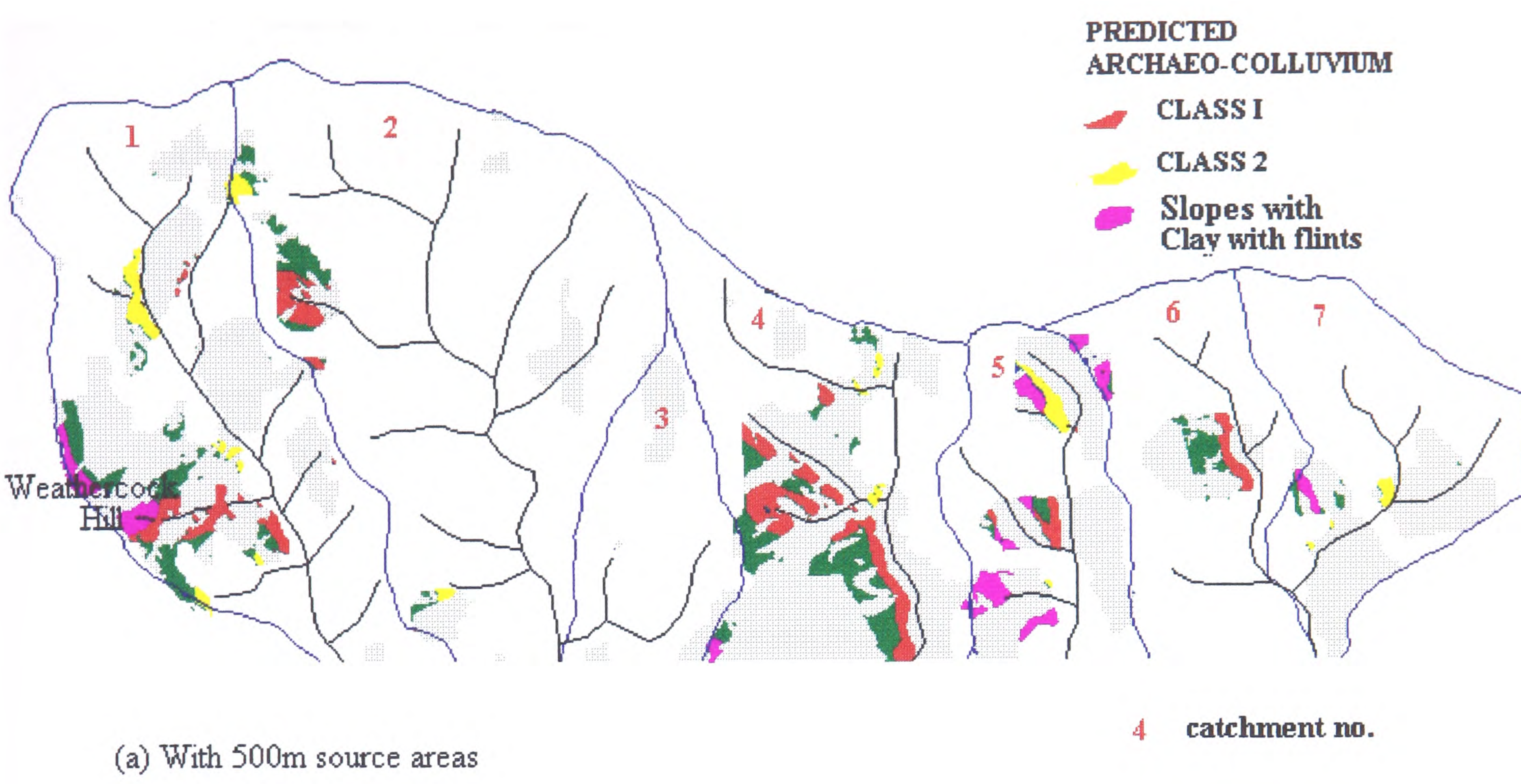
Figure 78(e) Overlay of predicted sites of both scales

9.6.2 Changing the soil parameters

The original model assumed that areas of ancient fields on chalk soils were the primary sites of soil erosion. Field checking however suggested that greater colluvial thickness occurs in valleys surrounded by Clay with flints and some of the Charity soils. It is a relatively simple task to include Clay with flints in the predictive criteria. If all the other parameters are retained (ancient fields, chalk soils and east-facing slopes exceeding 2 degrees), the predicted distribution of colluvium with inclusion of Clay with flints appears in Figure 79(a) which includes the 500m source area and Figure 79(b) which includes the 200m valley floor buffer.

Clay with flints appear below Weathercock Hill and most significantly in catchment 5 where field results confirmed the association of Clay with flints and deeper flinty colluvium. The inclusion of clay as well as chalky soils expands the distribution of verified colluvial sites and proves a useful model feedback parameter. The 500m buffer however fails to reach many of the upper slopes of catchments 6 and 7 which have heavier soils, though they exist in patches which are up to a kilometre from the valley floor. It was however noted during the course of field work that many of the Clay with flints and silty drift soils are more extensively distributed than is suggested by the 1:63,360 scale soil map. If the soils informatoin was improved and the model revised to include the distribution of these heavier soils in the eastern catchments then more predicted sites might be expected.

It is also notable that the presence of silty de-calcified ancient colluvium may reflect hillslope soils which have been completely removed. Such is probably the case in catchment 4 where flinty soils occupy a valley surrounded by chalk soils. It was a basic assumption and (acknowledged weakness, section 6.3.4) of the original model that the predictive process was limited to maps of current soils, and the presence of colluvium at some of the sites is certain to reflect soils which are no longer featured on modern soil maps.



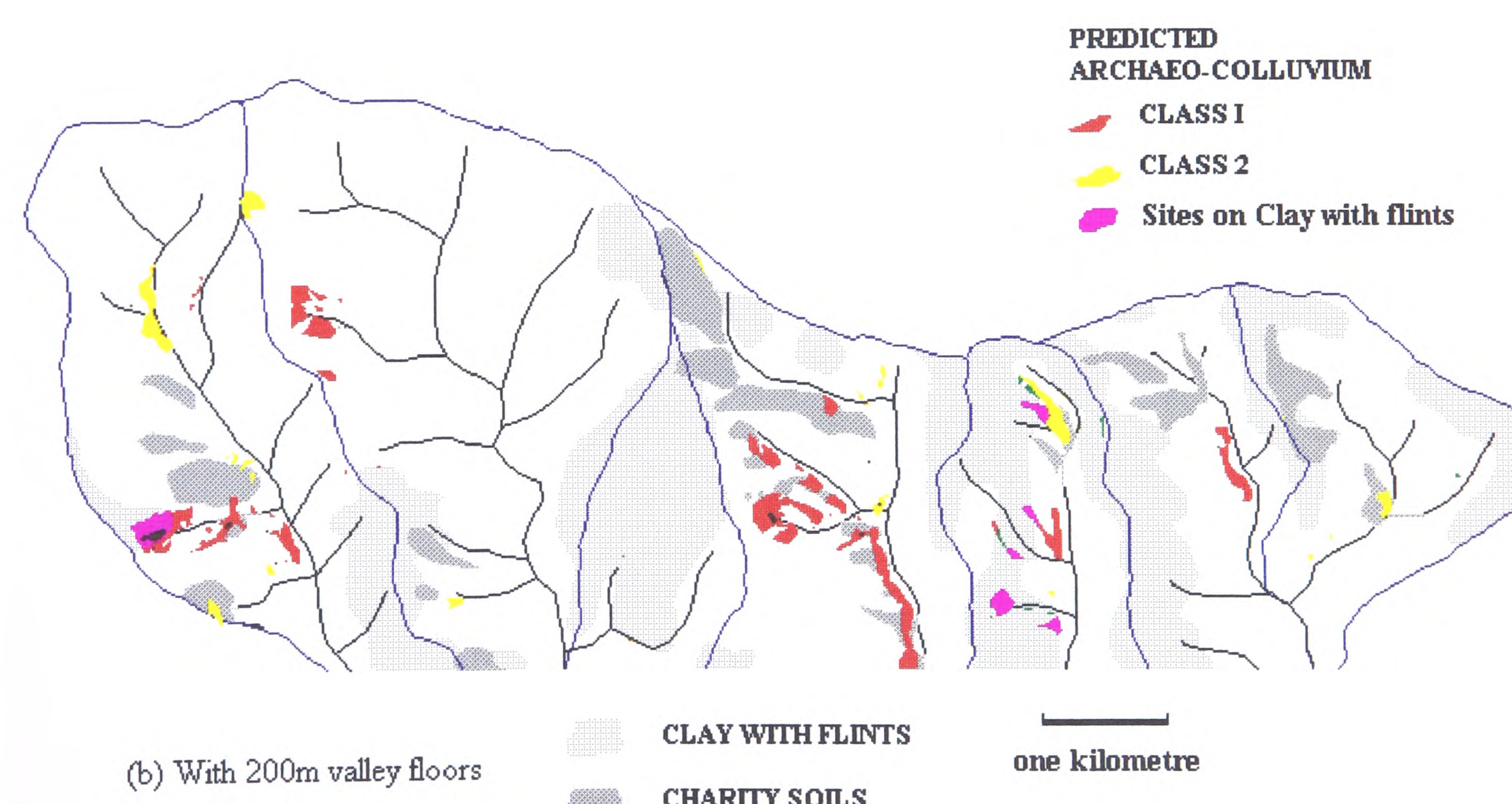
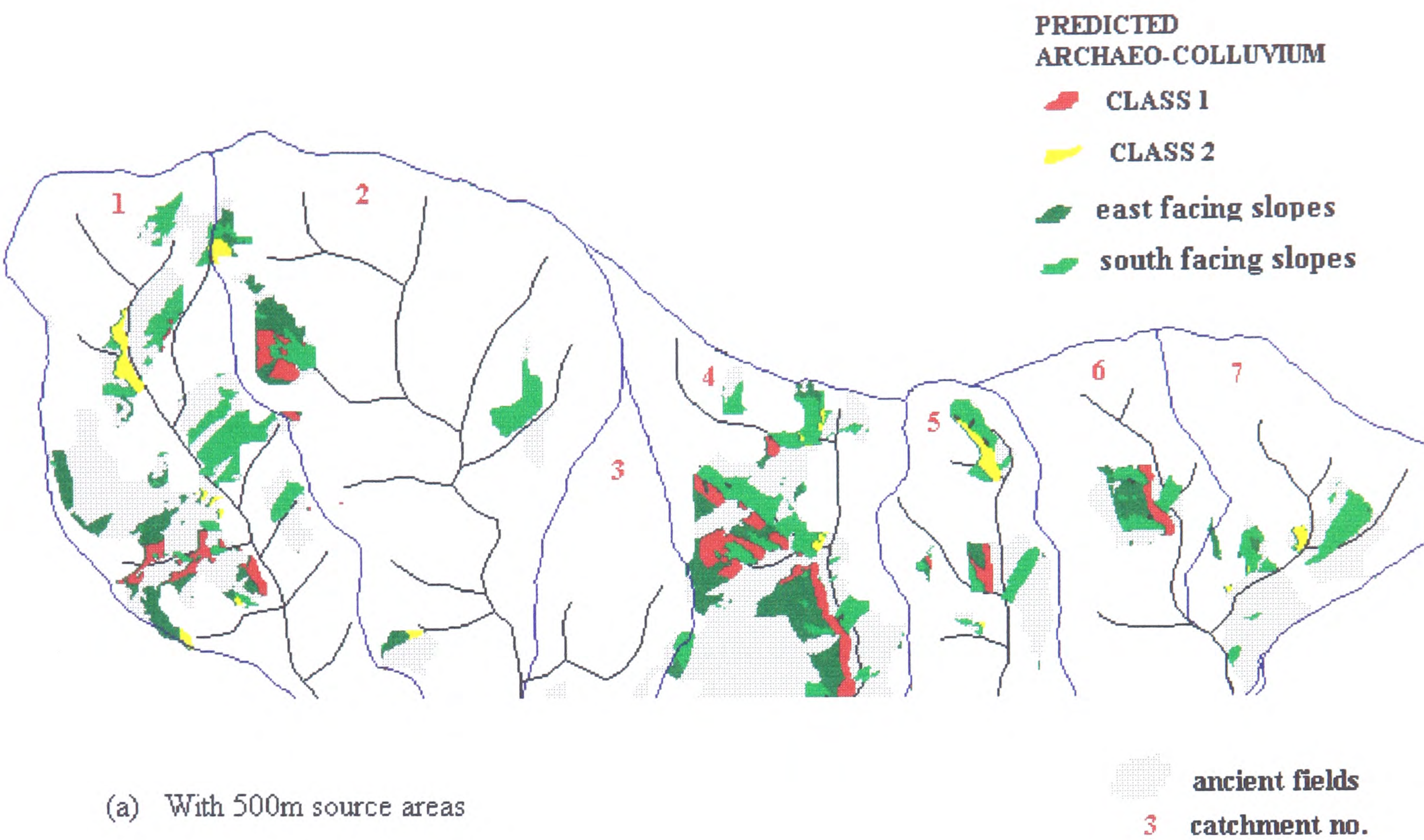


Figure 79(a) and (b) Predicted sites including Clay with flints

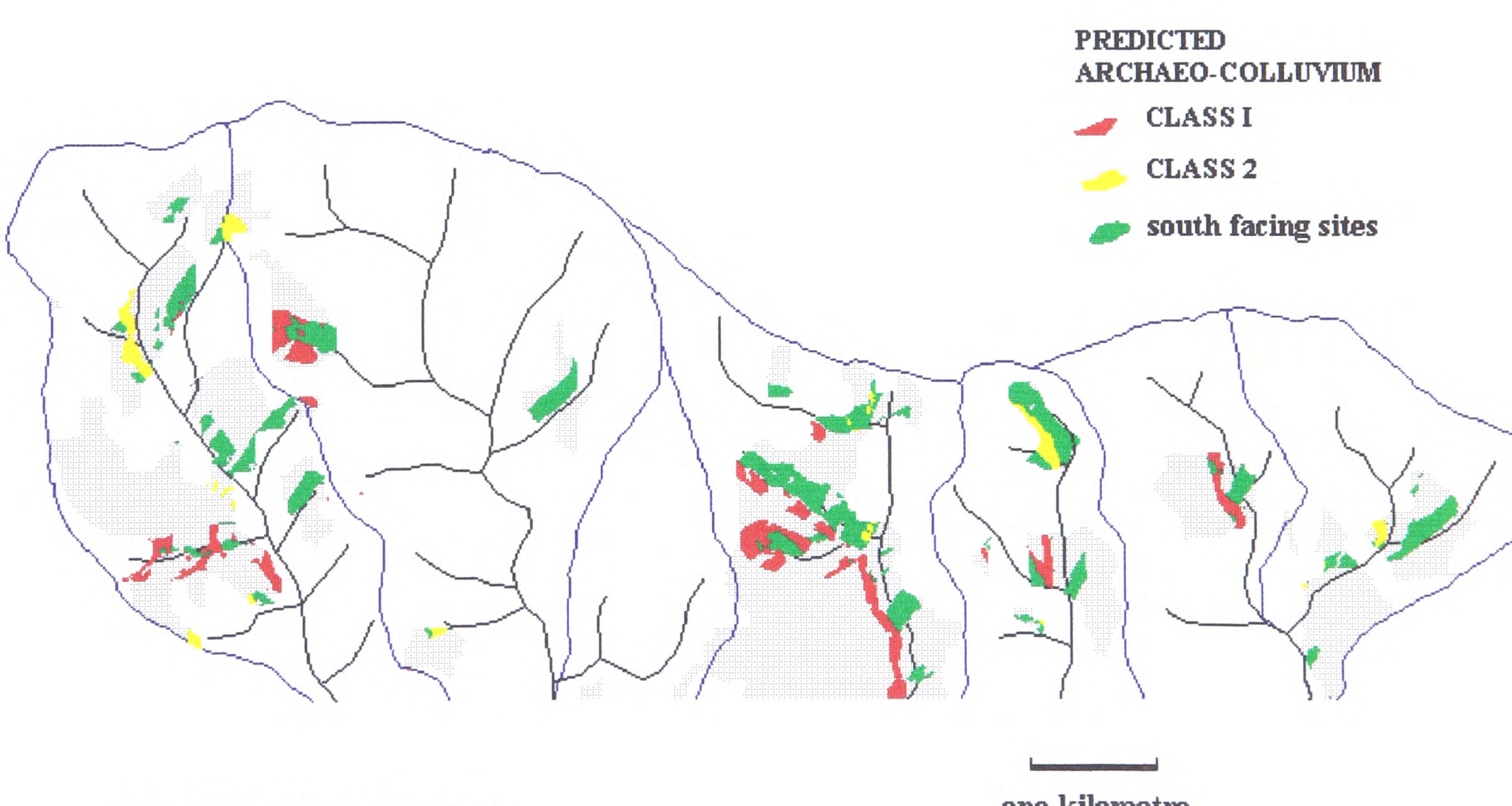
9.6.3 Changing the aspect parameters

Field checking showed that east-facing fields produced more colluvium than west-facing slopes. A significant proportion of fields however also exist on southerly (30.4%), west (16.2%), and northerly (16.7%) aspects. It was decided to incorporate ancient fields of southerly aspect to determine whether the addition of wider aspect parameters might support an improved model. Two maps have been produced, Figure 80(a) in which the new aspect information is captured by the 500m source area and Figure 80(b) where the effect can be seen within the 200m receptor area.

In Figure 80(a) large new swathes of south-facing fields (lighter green) appear in catchments 1, 2 and 4. When the 200m valley floor buffer is examined in these areas (Fig 80(b)) it would appear that the inclusion of fields of southerly aspect does not significantly change the original distribution of predicted sites (reliant solely on east-facing slopes). The large areas of south-facing slopes in these catchments all have characteristically thin valley soils. The choice of easterly slopes as viable criteria for colluvial distribution in asymmetric valleys appears to have been confirmed.



(a) With 500m source areas



(b) With 200m valley floors

Figure 80(a) and (b) Predicted sites including both east and south facing slopes

9.6.4 Changing some of the slope parameters.

The original model included areas where slopes exceed 2 degrees. A series of trials were conducted where slope categories were changed, to investigate whether different slope parameters significantly alter the distribution of predicted sites. Other criteria such as east-facing slopes and chalk soils were held constant.

Inclusion of flat areas (0-1 degree)

Areas with slopes between 0 and 1 degree were reclassified from the IDRISI DEM. Figure 81 shows all predicted sites on flat areas, in green, compared with those of the model - which is confined to slopes above 2 degrees (shown in red and yellow). Flat areas in valley floors are confined to narrow areas at the centre of each of the main and tributary valleys. The slope map (Fig. 85) provides a general view of of catchment morphology across the project area. The open valleys of catchments 1 and 2 are represented by slightly wider flat areas, notably around Seven Barrows while the asymmetric catchments 3, 4, 5 and 6 have almost neglible flat land along their valley floors. It is these narrow valleys in the center and east however which are captured by the model.

It is notable in Figure 81 that ancient fields do not encroach onto the gentle valley floors of catchment 1. In catchment 4 however, fields occupy the valleys although only a narrow corridor along the centre of the drainage line is included by the 0-1 degree classification. The very low incidence of flat areas in combination with the avoidance of open valley floors by fields explains why the incorporation of flat areas in the predictive model has a negligible effect on the distribution of predicted sites. The only sites added to the pre-existing pattern were very small - in mid-catchment 1 (at a site known to have de-calcified archaeo-colluvium) and in the lower part of catchment 7.

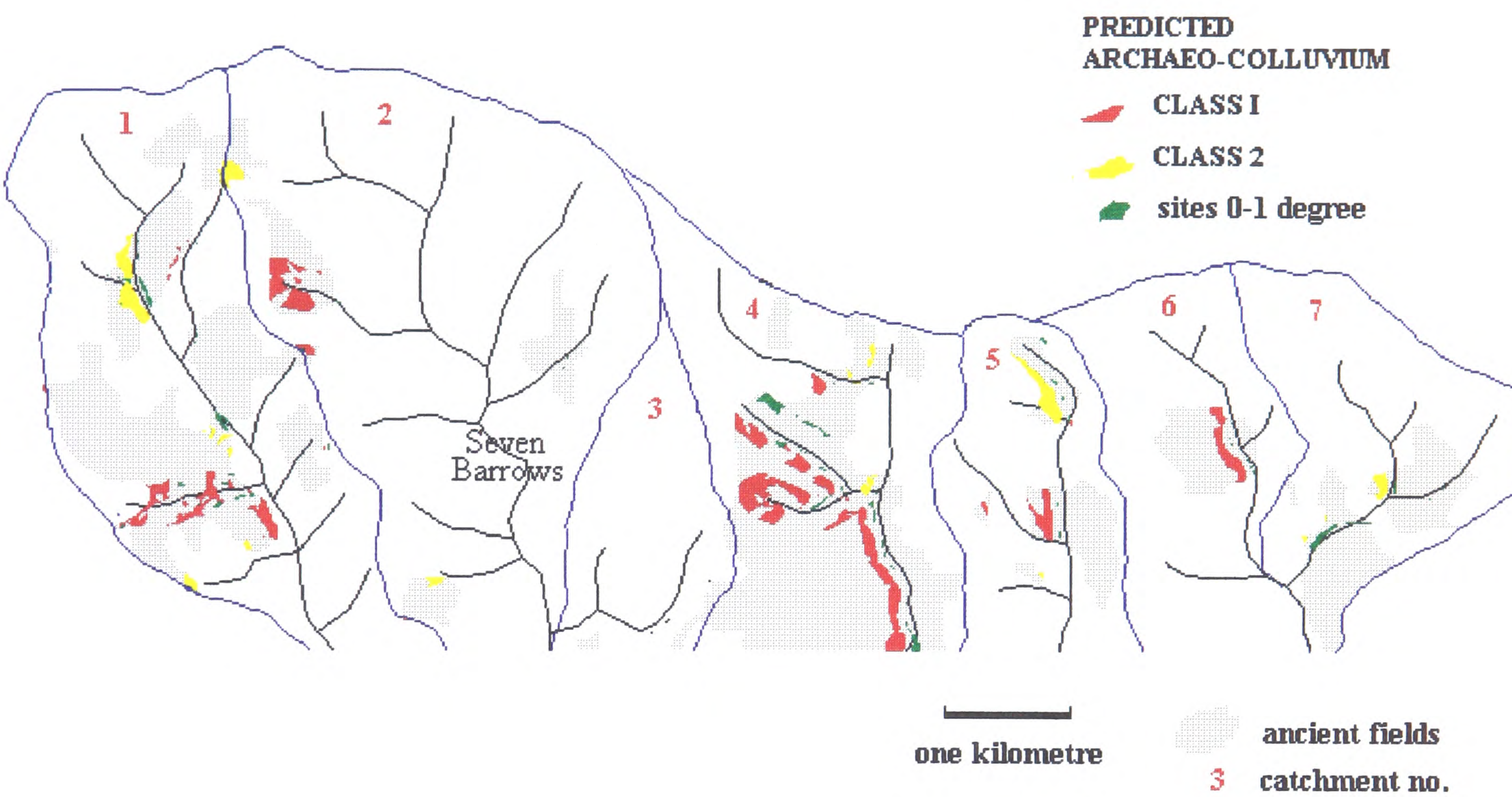
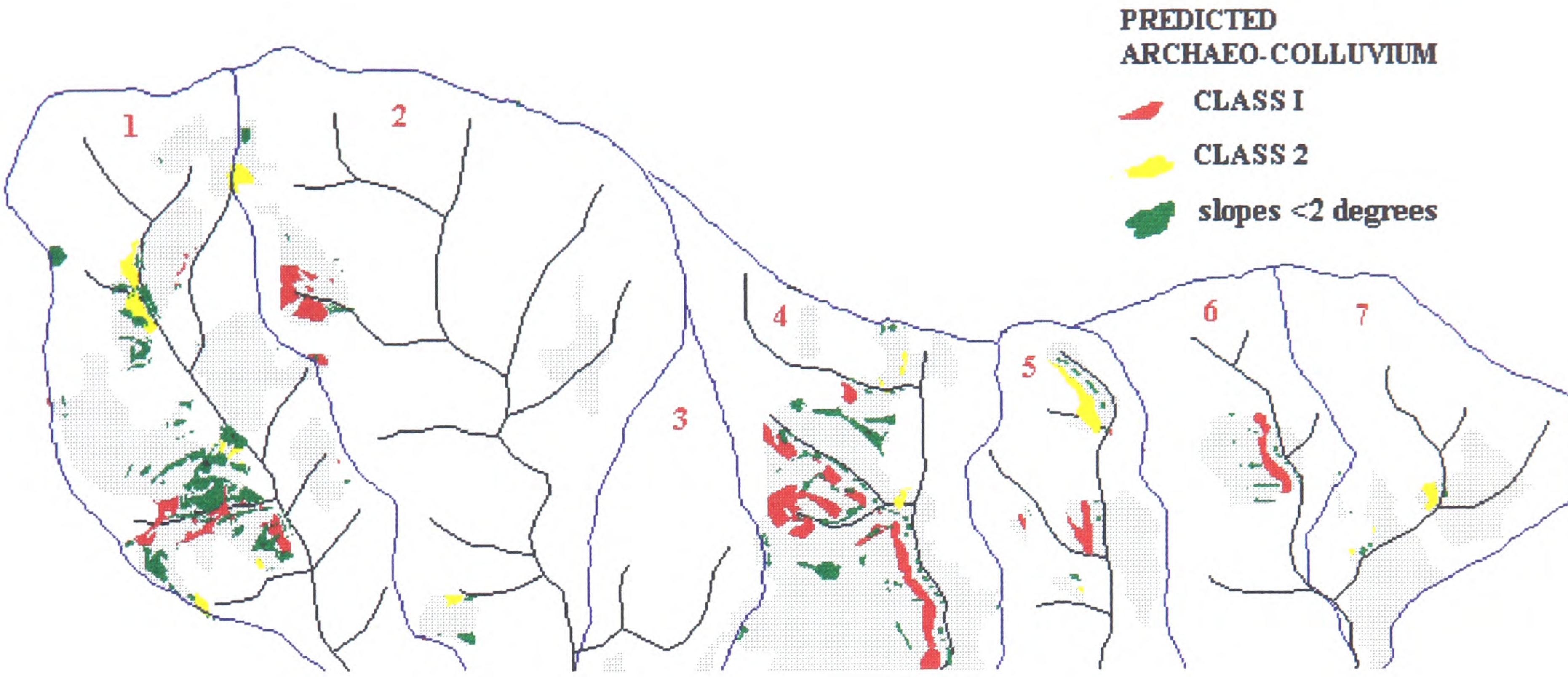


Figure 81 Predicted sites including flat areas

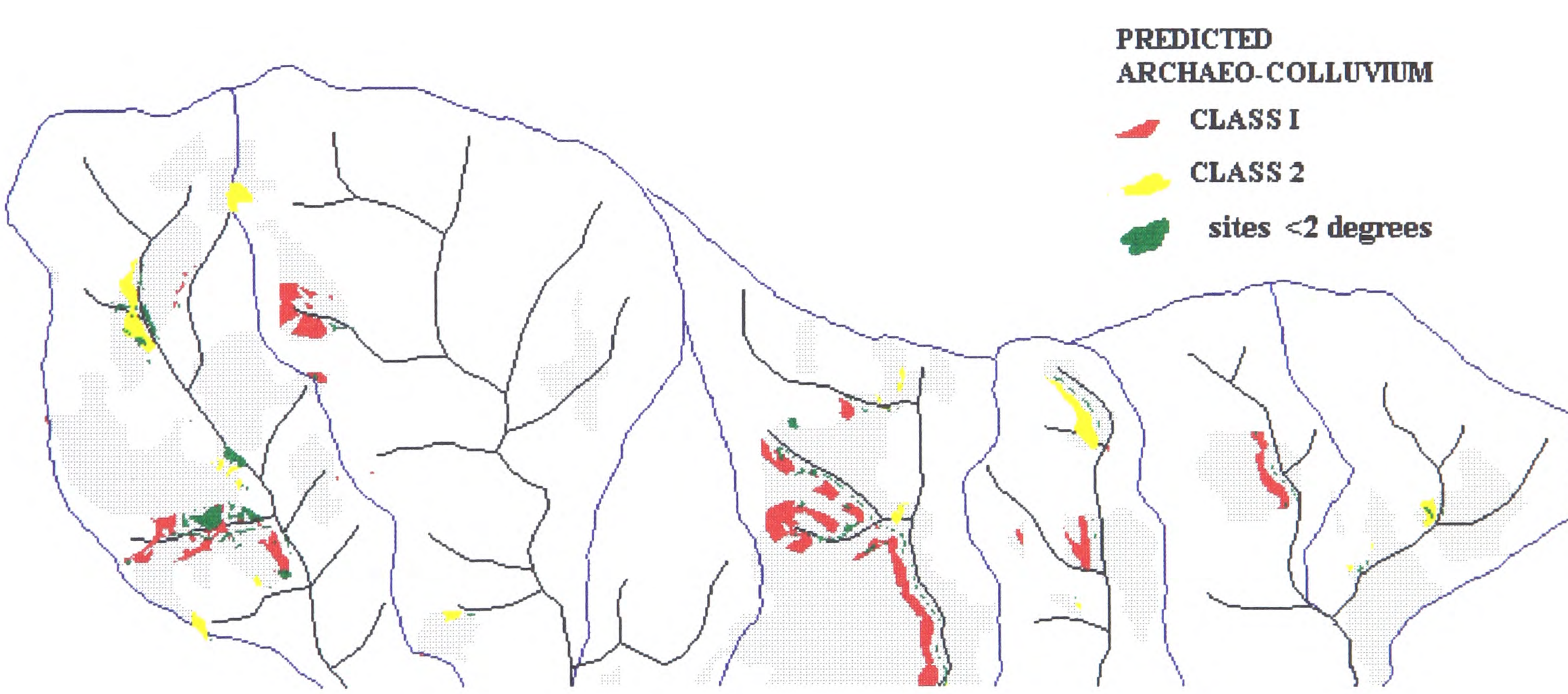
Slopes (0-2 degrees)

Figures 82(a) and 82(b) show the model with the inclusion of sites on slopes less than 2 degrees. As was the case with the selection of flat areas, slopes less than 2 degrees do not occupy large areas of the lower landscape, particularly in the eastern catchments. The only significant addition to the original prediction was below Weathercock Hill in catchment 1. The main reason why the inclusion of gentler slopes does not produce an increase in predicted sites in the central and eastern catchments (4, 5 and 6) is that these valleys appear to rise steeply from the valley floor - a feature illustrated in the next section.

Figure 82(a) shows the model prediction with inclusion of sites less than 2 degrees, captured by the 500m buffer. The main addition reflects the gentle slopes in catchment 1 below Weathercock Hill and smaller areas in the upper part of this catchment. These areas correspond with the lower slope bench-like landforms which carry Charity soils, though the archaeo-colluvium derived from these soils is thin. Figure 82(b) shows sites less than 2 degrees within the 200m valley floor.



(a) With 500m source areas

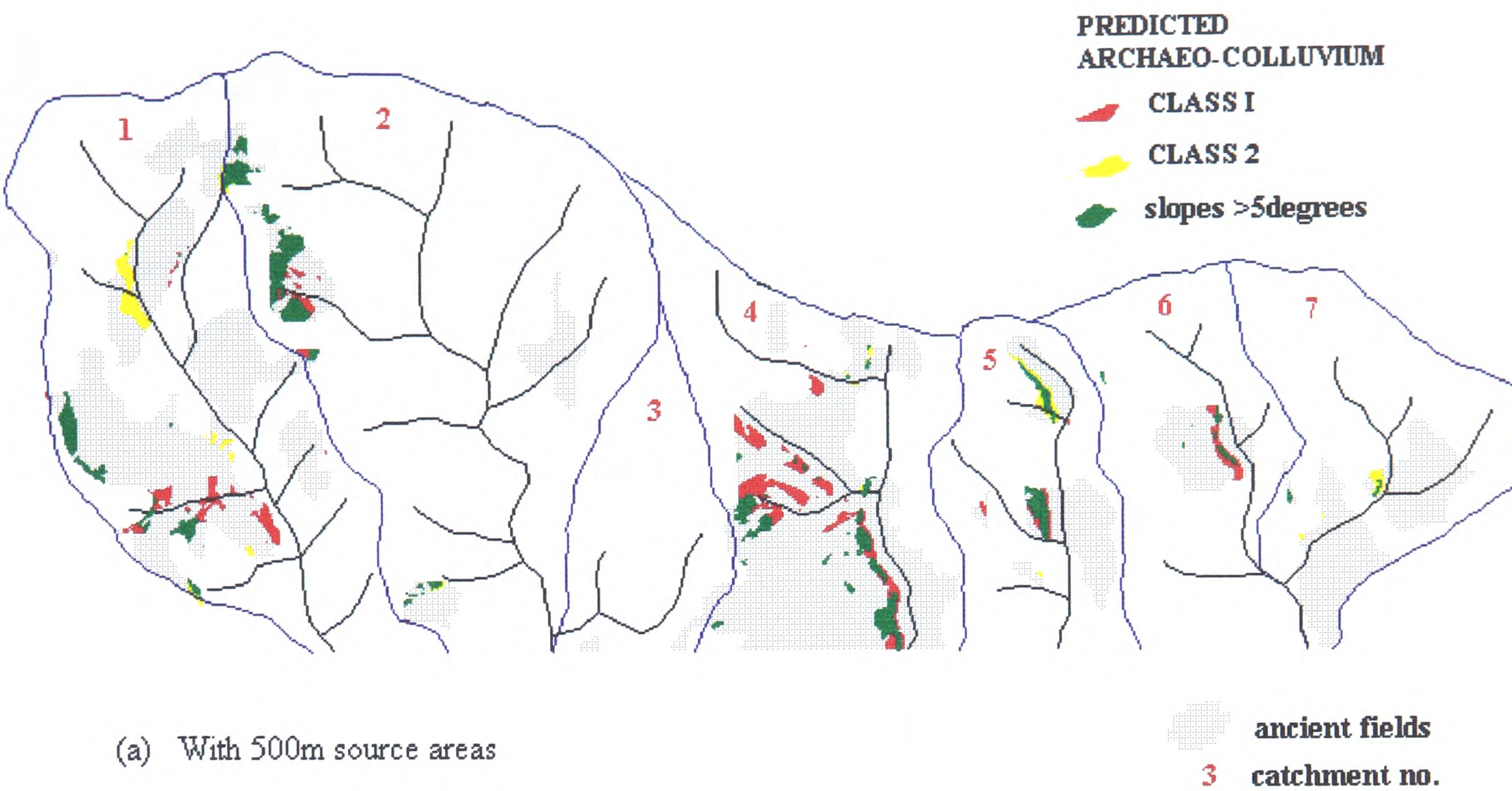


(b) With 200m valley floors

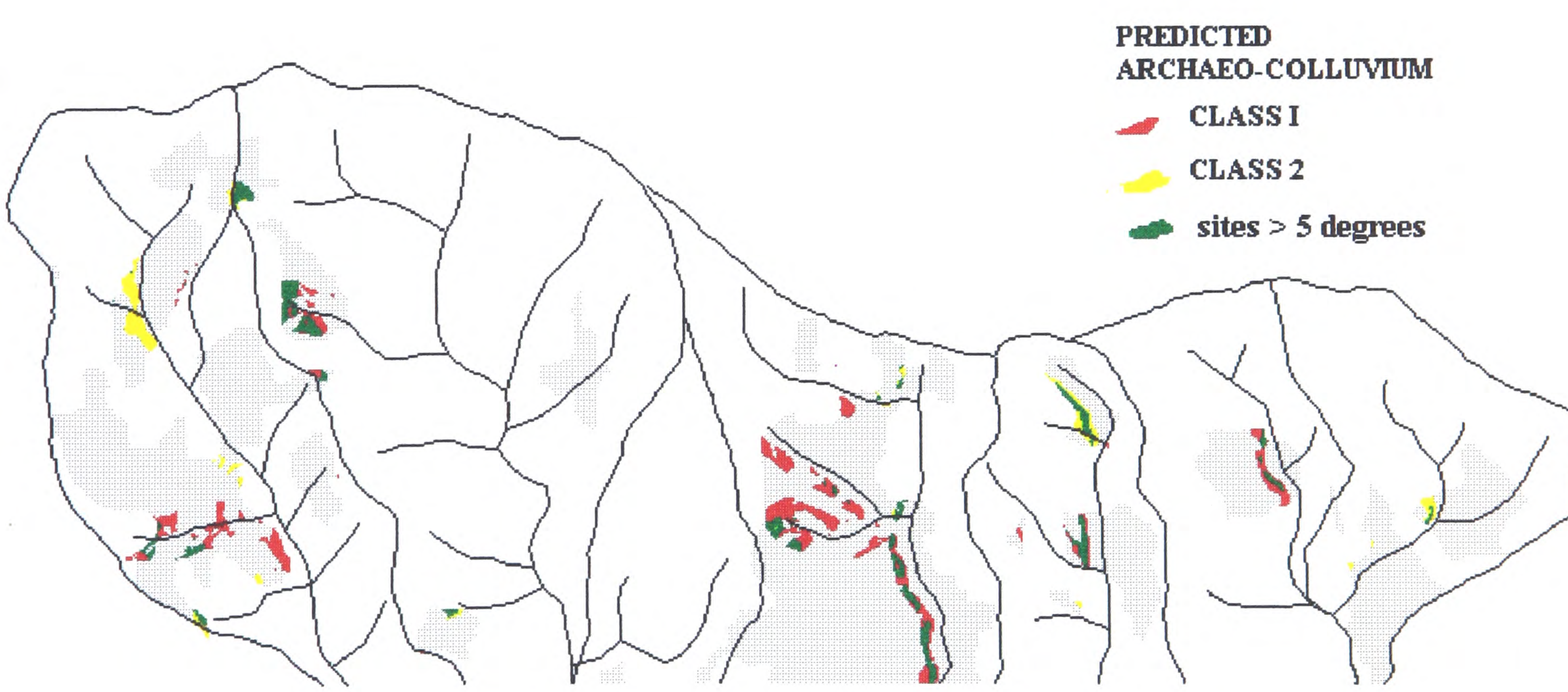
Figure 82(a) and (b) Predicted sites including slopes less than 2 degrees

Slopes >5degrees

The incorporation of slopes of 5 degrees and above demonstrated that in the valleys of catchments 4, 5 and 6, a large proportion of the predicted sites lie on or below slopes exceeding 5 degrees (Fig 83 (a) and (b)). As almost all of these fall within the 200m buffer this reflects valley shape and the relatively steep rise from valley floor to the surrounding slopes. Valley shape in the western catchments reflects a much gentler rise from the valley floor. The presence of steeper slopes in all catchments where colluvium was present and relatively thick further supports the notion that the steeper valleys of the eastern project area, in combination with soils of heavy texture, appear to influence archaeo-colluvial distribution on the Berkshire Downs.



(a) With 500m source areas



(b) With 200m valley floors

Figure 83(a) and (b) Predicted sites including slopes > 5 degrees

Slopes >8 degrees

The final slope category included slopes exceeding 8 degrees. From Figure 84 it can be seen that except for a small area in the upper part of catchment 2, all of the predicted areas on the Berkshire Downs occur on slopes less than 8 degrees and most, as demonstrated in the last section, on slopes less than 5 degrees. There were no sites within the 500m buffer so only the 200m valley floor sites have been shown.

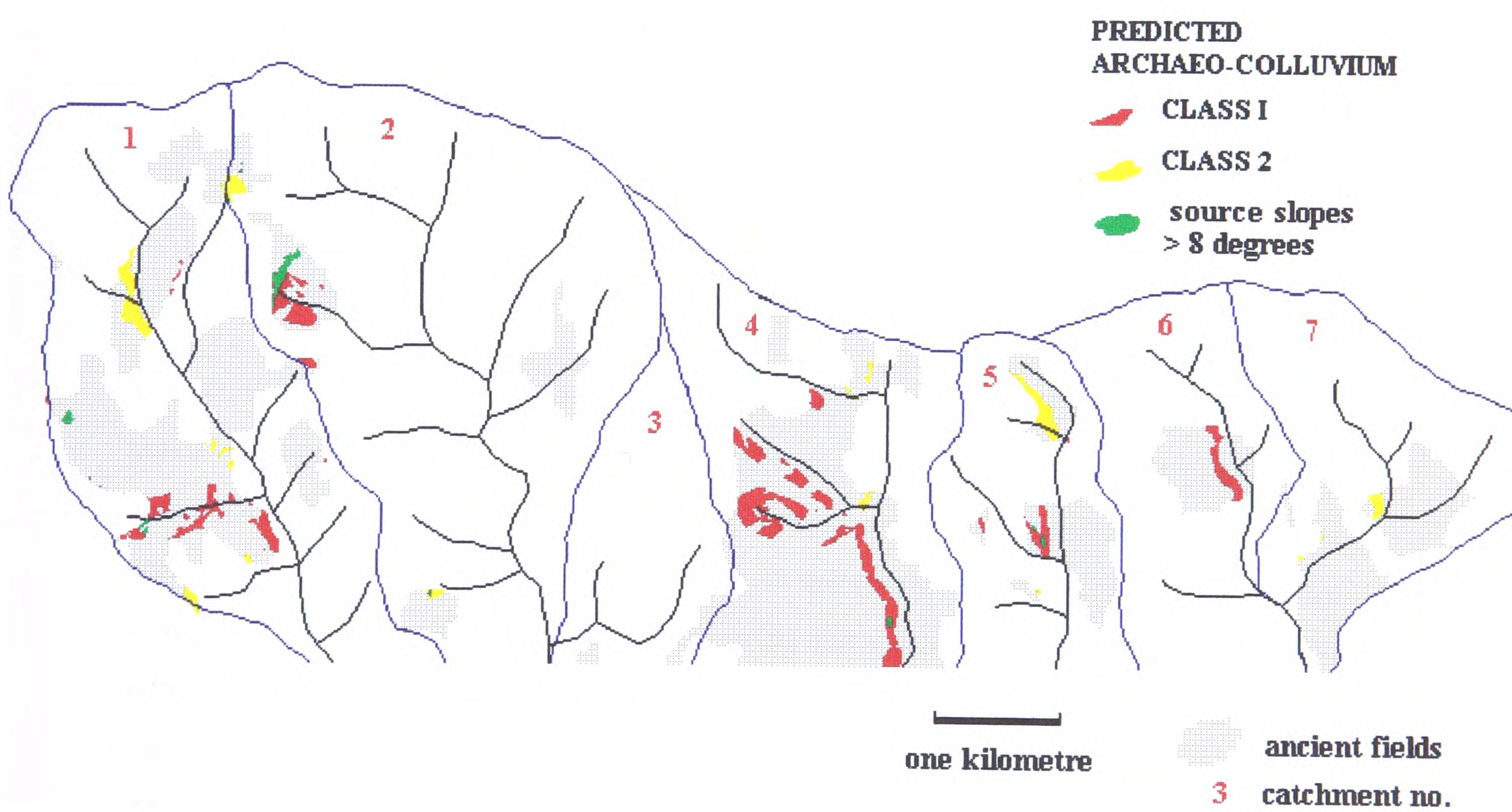


Figure 84 Predicted sites including slopes > 8 degrees

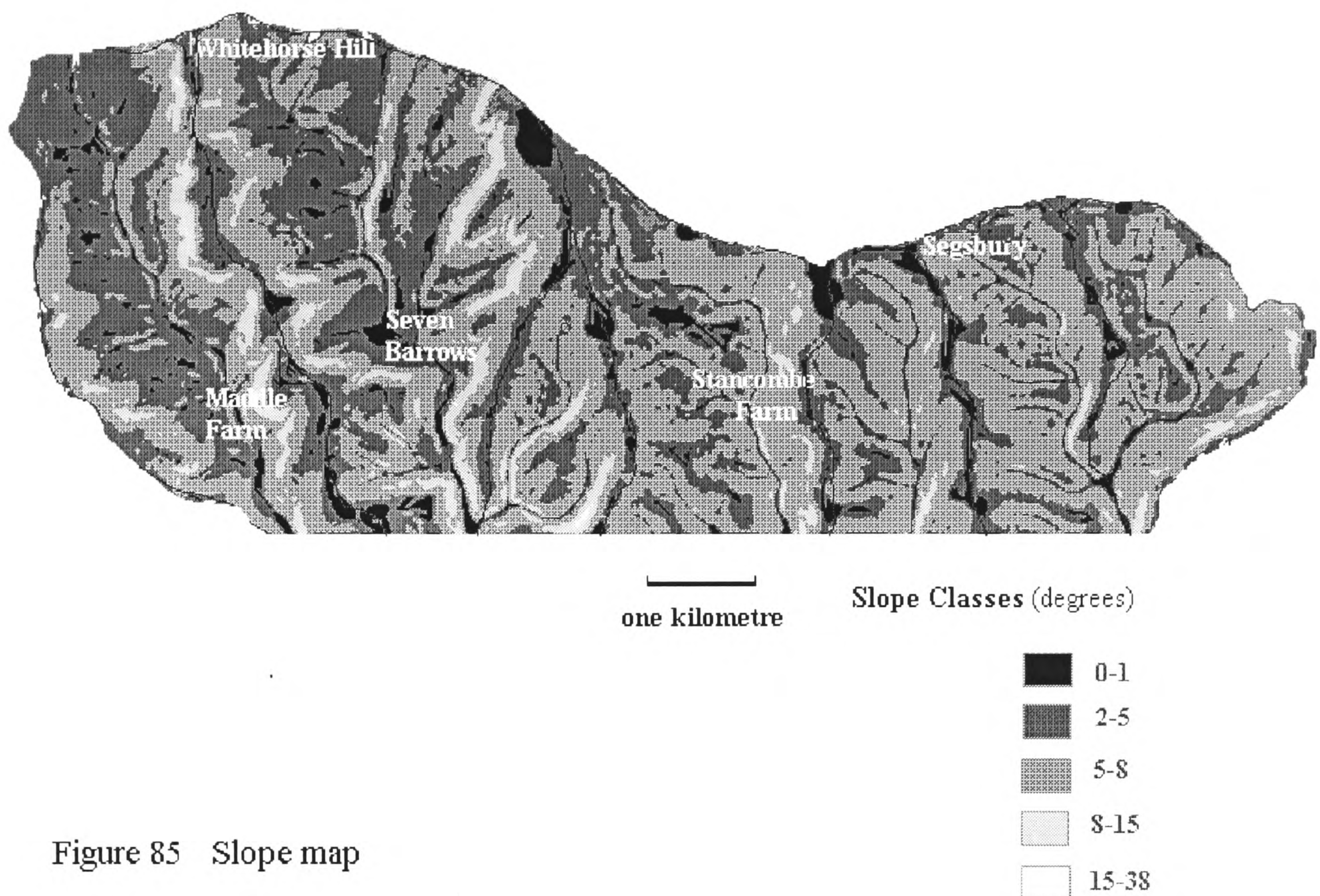


Figure 85 Slope map

9.6.5 Summary

The cell size (20m x 20m) and the detailed topographic data represented on the slope and aspect maps results in terrain information of high resolution. While GIS has the capacity to undertake complex analysis of the relationship between slope, aspect and colluvial prediction, such a task was beyond the aims of this project. A more complex terrain model might permit identification of valley shape and terrain convexity and concavity by which asymmetric and symmetric landscapes might be determined. For a model of sub-regional scale and as a first approximation however, a single slope category and choice of slope-length/source area was applied across the whole area.

After several trials in which the model was run with different slope classes it is the primary conclusion that the existing slope category (2 degrees and above) appears to be an appropriate choice. The incorporation of slopes of less than 2 degrees revealed that there was little overlap of fields and flat areas. This might explain why colluvium is characteristically absent in the open chalk valleys.

Flat and gentle areas occupy a relatively small proportion of valley floors. Within the 200m buffer zone used by the model, slopes in the large western catchments are commonly between 1 and 3 degrees. From the slope map (Fig 85) the asymmetric eastern valleys have slopes which exceed 5 degrees nearer the valley. This reflects a wider observation that valley shape and colluvial distribution correspond (discussed in section 10.3). In areas where slopes exceed 8 degrees there are negligible sites of predicted colluvium.

The addition of south-facing slopes did not appear to improve the model. Most south-facing fields were shown to be associated with valleys of shallow or absent colluvium. This supported the choice of east-facing slopes as a viable parameter. The addition of Clay with flints as model criteria revealed source areas in catchment 5 which probably contribute to deeper flinty valley colluvium in this region. In catchments 6 and 7 however, according to Soil Survey maps, Clay with flints lie up-slope of the 500m source area. Observations in the field however, revealed that the heavier soils fall well within this mid and lower slope zone. The use of different soil criteria re-inforced the fact that the small-scale survey maps used in the model were too inaccurate at a localised scale.

The brief trial of different slope parameters further highlighted the difference in valley shape and landform from west to east. This was particularly clear when the relationship of colluvium in the field was compared with topographic information at the high level of resolution used by the model. The trial and evaluation of different parameters also highlighted a fundamental feature of the GIS based map analysis namely the fact that the resolution of the GIS data at 20m x 20m cannot be matched in the field by soil or archaeological maps or even localised field checking. Detailed analysis of colluvial distribution from pixel to pixel is clearly unrealistic. For this reason it is necessary to treat the predictive map as indicative when reconciling the precise GIS-based information with soils and terrain information and observations made in the field.

CHAPTER 10

DISCUSSION

10.1 FACTORS IN THE DISTRIBUTION OF ARCHAEO-COLLUVIUM

The primary conclusion from a survey of colluvium across the Berkshire Downs is that, despite earlier reports to the contrary, significant deposits exist. This places the colluvial results from the Berkshire Downs within a wider corpus of sites where ancient colluvium has been recorded across the Southern Chalkland. In developing some notions about the spatial distribution of colluvium, the programme of field testing provides a means for evaluating the accuracy of the model, while the assembly of information about colluvial thickness and archaeological information allows some conclusions to be drawn about local land use and soil erosion history.

The previous section concluded that the assumptions about fields and topographic criteria provide an encouraging basis for locating these deposits. There are notable exceptions though, both in the eastern-most catchments where thick colluvium exists and in the western-most catchment where archaeo-colluvium is either absent or sporadic in distribution. Certain observations can be made about the variable thickness, composition and age of the colluvium across the Berkshire Downs when it is examined and integrated, first with the pattern of ancient land use and secondly with physical factors such as local differences in soils and topography. Some observations about the relative influence of both human and physical cause on the processes of formation and preservation of colluvium will enhance the general understanding of the spatial distribution of these valley soils. In doing so, feedback will be provided for an improved predictive model.

10.2 COLLUVIUM IN RELATION TO ANCIENT FIELDS

Ancient fields and archaeo-colluvium had a 75% correlation (discussed in section 9.2.1). At sites where fields and colluvium were found, 90% produced datable ancient sediments. The most obvious trend from an observation of the distribution of archaeo-colluvium is that ancient fields and relatively thick and datable deposits correspond well in catchments 1, 4 and 5, as does the absence of fields with absence of archaeo-colluvium in catchments 2 and 3 (Fig. 86). Colluvium is thick in the eastern-most catchments (no. 6 and 7) but the earliest pottery was Roman and there were thick deposits of more recent material. The busiest catchments with respect to ancient land use therefore seem to produce corresponding thick and datable colluvium.

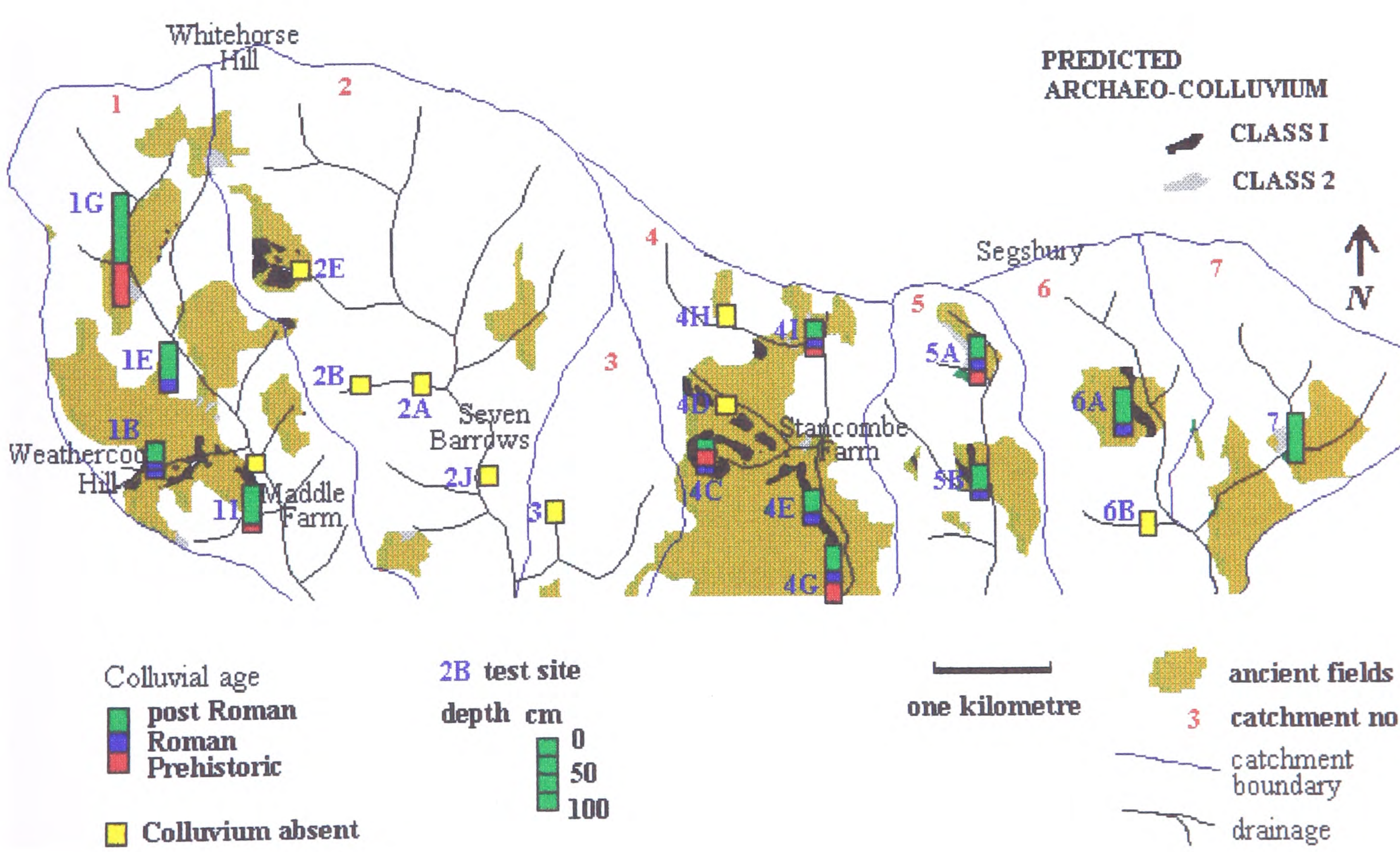


Figure 86 Distribution of archaeo-colluvium in relation to ancient fields

The earliest phases of colluvium defined by OSL dating and entrained prehistoric pottery appear linked with field systems in catchments 1, 4 and 5, which provides support that the establishment of fields date to these periods. In catchment 2, which includes the Seven Barrows Bronze Age cemetery, colluvium was absent which appears to imply that an absence of fields produces an absence of colluvium (Bradley and Ellison 1975).

Three sub-regions can be identified based on distribution of fields and archaeo-colluvium.

1) The earliest use of fields in catchments 1,4 and 5.

2) The landscape of catchment 2 which has no fields and no colluvium - implying pastoral use.

3). The landscape of the eastern catchments in which few fields and thick but younger deposits impling later Roman or post-Roman land use.

The model was successful in locating datable prehistoric or Roman archaeological material at all but one of the sites where archaeo-colluvium was predicted, with general support from seven of the test sites (where dating was achieved) of a prehistoric date for land use across the west and centre of the project area. The field checking programme almost certainly revealed a new prehistoric settlement site in the vicinity of trench 4C. When compared with the method of lynchet excavation conducted by Bowden *et al.* (1991b), intensive hillfort excavation and widespread field survey (Gaffney and Tingle, 1989; Shennan 1985), the sampling success of the colluvial programme demonstrated the potential of archaeo-colluvial prediction and follow-up survey for recovering archaeological material. The sampling of discrete sites in this way would be a useful tool to incorporate into landscape survey methodology.

10.2.1 A review of field dates

Bowden *et al.* (1991b) assert that the fields of the Berkshire Downs reflect predominantly a landscape of Roman intensification, based on an interpretation of fields, barrow and linear ditch relationships. In this study earlier notions of a simple progression from Bronze Age fields to linear ditches or refuted. While these authors acknowledge the existence of Bronze Age elements within the field systems on the Berkshire Downs, their conclusion from an examination of the entrained pottery within boundary features and lynchets is that the fields were predominantly of Roman date. It is notable though that Bowden *et al.* (ibid) found significant concentrations of pottery in the lowest levels of the lynchets which were classified as undiagnostic. If, as is quite plausible, these sherds are prehistoric, then this argument might be reversed and a strong case put for much earlier use.

The case for Roman intensification of arable landscapes on the Downland is also supported by Bradley *et al.* (1994). It is difficult to refute the impact of Roman agriculture and the demand for grain in this part of Britain for domestic and military consumption (Gaffney and Tingle 1989); however, both the material evidence for earlier use and the thin soils show that these landscapes had been subject to erosion and removal for the previous two millennia. Until more thorough investigation of lynchets and colluvium is undertaken (a critical source of land use evidence in these barren and degraded landscapes), it would be imprudent to underestimate the extent and impact of early use in any of these Chalk landscapes. It is possible to review the work of Bowden *et al.* (ibid) with a slightly different interpretation of his trench data. When this is viewed in association with the archaeo-colluvial information from this project an alternative to the predominantly Roman date given the fields on the Berkshire Downs is suggested.

Bowden *et al.* (ibid) excavated lynchets in the major field blocks around Knighton Bushes, near Maddle Farm to the west of the Berkshire Downs and Stancombe Down to the east, as well as sites at Eastbury Down, Cranes Wood and Ashbury-Weathercock just outside the project area. The morphology of the ancient fields around all but the first trench at Knighton Bushes were classified as elongated - a shape for which Roman use has been suggested elsewhere in Southern Britain (Richards 1978). The fact that the trench sites chosen by Bowden *et al.* (ibid) mostly fall within fields of "Roman" shape would suggest that Roman lynchet dates would not be too surprising. Significant blocks of irregular shaped fields were not examined with respect to lynchet sequences. There are large swathes of these more irregular shaped fields north of Knighton Bushes and most clearly north of Stancombe Hatts which might have produced evidence of prehistoric activity.

While Bowden *et al.* (ibid) suggested that pottery sequences, particularly *terminus post quem* dates in most of the trenches implied Roman dates, the presence of unstratified prehistoric pottery and more significantly unclassified pottery in the lowest levels suggests that prehistoric activity should not be wholly discounted in many of the areas. Prehistoric pottery is likely to be under-represented on the Downland both because of condition and the probability of lesser manuring activity than the Roman period. This was borne out by the failure of Bowdens attempts to recover pottery from prehistoric boundaries and a resort to collecting pottery from ditches and an enclosure.

The nine trenches at Knighton Bushes are poorly dated to the Roman period with only two of the trenches datable by Roman sherds. In trench KB1 there were two prehistoric sherds in middle levels among the 67 Roman sherds which while both sparse and residual at least suggest some form of local prehistoric activity. At Whit Combe about 1km to the east of Knighton Bushes, the majority of sherds (137) were Roman although there were three unclassified sherds in the lowest levels. While the evidence for prehistoric activity here is slight, an earlier date of lynchets at both these sites is not inconceivable.

At Stancombe Down, Stancombe Hatts and Nutwood, all within catchment 4 of the project area, the evidence for earlier field dates is more compelling. At Stancombe Down, the lynchet profile contains two prehistoric sherds and some 18 undiagnostic sherds in the lower levels along with 27 Roman sherds. Such a large proportion of unclassified sherds in the lowest levels would at best suggest that the dating of the lynchet to the Roman period is highly unreliable. If any of the undiagnostic material were prehistoric, which is highly plausible, then an earlier date is more likely.

At Stancombe Hatts there are three prehistoric sherds and five unclassified sherds together with 10 Roman sherds. While the Roman pottery provides a *terminus post quem* for a Roman date, the presence of an almost equal proportion of prehistoric and unclassified sherds, again in the lowest levels of the lynchet suggest that a prehistoric date here is not implausible. At Nutwood some 1km to the south, in the same catchment, there are higher numbers of Roman pottery (45 pieces) and no recorded prehistoric sherds. There are however 12 pieces of unclassified sherds in the lowest levels which should again cast some doubt on the definitive Roman date which was assigned.

A trench at Eastbury Down about 1.5 km south of Stancombe Down (just south of the project area) revealed 53 pieces of unclassified pottery and 25 pieces of prehistoric pottery, much in the lowest levels, among 77 pieces of Roman pottery. With such a high proportion of prehistoric and unclassified material, again a Roman date must be regarded as speculative. With field marks and a possible enclosure in the vicinity it is possible that such a high number of prehistoric sherds also suggest proximity to a settlement site. At Cranes Wood, some 1km outside the project boundary and south of catchment 5, there are eight unclassified and three prehistoric sherds. While there are only seven Roman sherds, Bowden *et al.* (ibid) prefer a probable Roman date for this lynchet. At Ashdown - Weathercock, just outside the project area to the west there is also sufficient prehistoric and unclassified pottery in the lowest levels (11 pieces), compared with 34 Roman sherds to at least hint at a possible earlier date for this lynchet. Table 12 summarises the lynchet pottery chronologies.

Date / Site	Unclassified	Prehistoric	Roman	Roman? (possible)	1-3rd century	3-5th century
KB Knighton Bushes	0	2	64	0	3	0
WC 1 Whit Combe	2	0	44	2	5	2
WC 2	1	0	53	5	10	1
AW1 Ashbury-Weathercock	3	1	2	3	1	1
AW2	6	1	16	7	3	1
CW Cranes Wood	8	3	6	0	1	0
ED1 Eastbury Down	37	15	25	19	2	3
ED2	16	10	16	8	4	0
NW1 Nutwood	7	0	10	0	7	0
NW2	5	0	19	4	4	1
SH1 Stancombe Hatts	5	3	3	2	5	0
SH2	0	0	12	0	1	1
SD Stancombe Down	18	1	16	7	4	0

Table 13 Pottery chronology from lynchet sequences on Berkshire Downs (Bowden *et al.* 1991b)

Bowden *et al.* (ibid) use *terminus post quem* and diagnostic pottery to assign dates to field lynchets although it would seem that there are significant gaps by way of undatable material in many of the trenches, suffice at least to render many of the trench dates as inconclusive. If the undiagnostic material were in fact prehistoric then most of the fields in and around catchment 4 could be reassigned with these earlier dates. Although the western part of the Berkshire Downs at Knighton Bushes, Whit Combe and Ashdown-Weathercock argue more strongly for Roman dates, prehistoric material is present suggesting some activity during earlier periods.

The archaeo-colluvial results broadly support this latter scenario with prehistoric material represented in both the western and eastern field blocks. Figure 87 presents the results of both the Bowden *et al.* (ibid) trench sites and the archaeo-colluvial results from this project. The small columns represent the broad date determined from archaeo-colluvial sequences, the open black dots denote lynchet sites and the red dots within the larger black dots represent sites where there was a significant amount of both unstratified prehistoric pottery and undated material in the lower levels of each lynchet.

The colluvial survey supports an earlier date for field use on the Berkshire Downs from a more extensive survey than that conducted by Bowden *et al.* (ibid) (15 sites compared with 8). The dating of fields in this study was drawn from only two sites in catchment one, whereas colluvium was investigated at five sites in both the upper and lower parts of this catchment. Colluvial dates here suggest that activity was earlier than the Roman date assigned by Bowden *et al.* (ibid). Colluvium was dated to the prehistoric period in catchments 4 and 5, again on the basis of eight colluvial sites spread across these catchments. It is argued therefore, both on the basis of the frequency of prehistoric pottery within colluvium from a wide range of sites investigated in this project and the possible under-estimation of unstratified and undatable pottery in the work of Bowden *et al.* (ibid) that the earliest and widespread use of the fields on the Berkshire Downs was prehistoric rather than Roman.

Even though most of the archaeo-colluvial trenches yielded a small amount of pottery, the model provides a method for recovering prehistoric artefacts which have been largely lost from the surface. The Maddle Farm extensive and intensive survey covered some 18km^2 (Gaffney and Tingle 1989, 18) and recovered some 8,000 sherds of Roman age and only 376 prehistoric artefacts (an approximate density of less than 2 per km^2). While only a handful of prehistoric sherds were found in most of the trenches and seven pieces were recovered from colluvium at trench 4C near Stancombe Farm, the archaeo-colluvial investigation proved the value of targeted subsurface sampling. Archaeo-colluvium clearly proves effective in preserving archaeological material otherwise lost or sparsely distributed across the landscape.

The low concentration of sherds within the archaeo-colluvium however, does appear to suggest either that survival of sherds within the thin soils of these chalk uplands is poor or that manuring was not particularly intensive. Concentrations of Late Bronze Age pottery exist at Weathercock Hill and Tower Hill, however outside these foci of activity there appears an overall marked paucity of both surface and subsurface prehistoric pottery. It should be remembered that the high concentration of pottery and artefacts recovered in the colluvium sampled by Bell (1983) and Allen (1992) was a function of deliberate siting of colluvial trenches near known settlements.

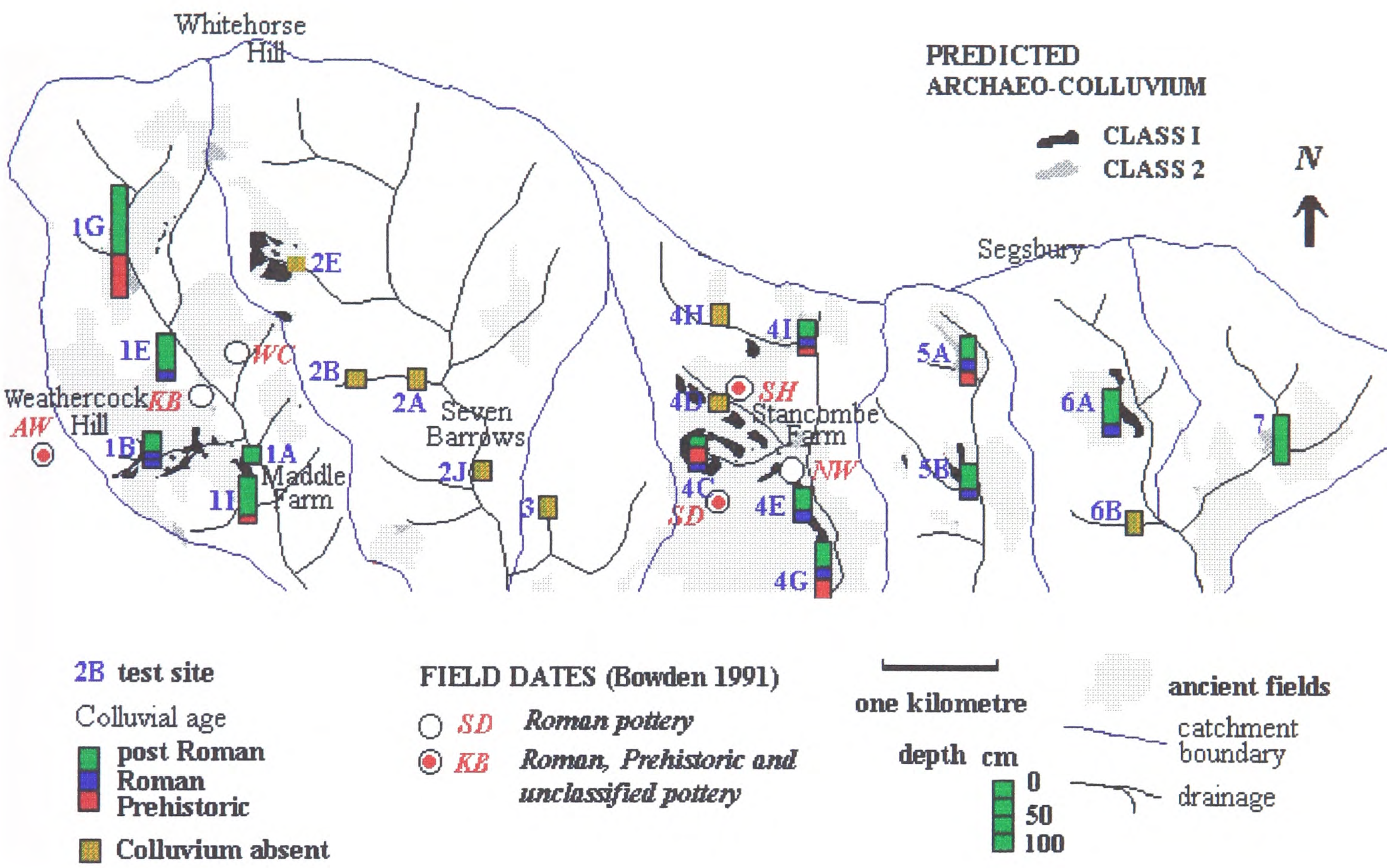


Figure 87 Archaeo-colluvium and field dating

10.3 COLLUVIUM DISTRIBUTION IN RELATION TO SOILS AND TOPOGRAPHY

The link between archaeo-colluvium, fields and land use history seems plausible when these two factors are considered on their own. Indeed it is has been a habit of archaeologists to look no further when seeking answers to soil losses and landscape change. This, however, underestimates the obvious role of geomorphic factors such as soils and topographic differences in the formation and preservation of colluvium.

A distinction in the physical character of the Berkshire Downs was described in Chapter 3 and discussed briefly with respect to colluvial distribution and slope parameters in Chapter 9. Here it was noted that the distribution of colluvium appears to bear some relationship to the change in landscape across the project area (Fig 88). The influence of physical differences from west to east on colluvial distribution is discussed in the following sections.

10.3.1 The western chalk catchments : variable distribution of colluvium

In catchment 1 the widespread distribution of fields and presence of archaeo-colluvium again proved the reliability of the model, though the deep colluvial sequences are more sporadic in distribution. There are small patches of Clay with flints and large units of lower slope drift deposits which appear to produce de-calcified valley-edge colluvium. The main valley however is chalky and devoid of colluvium. When the pattern of archaeo-colluvium is more closely examined in relation to fields and physical factors, a more complex picture of land use history, colluvial formation and preservation begins to emerge.

Catchment 2 has few fields and a corresponding absence of colluvium, an observation which Bradley used to assume the continued pastoral use of this valley in antiquity (Bradley and Ellison 1975, 181). He assumed that the absence of colluvium implied an absence of arable use. At first glance, this supports a link between absence of fields and absence of archaeo-colluvium. The only site in this catchment in which colluvium was predicted was within a small area of ancient fields near Idlebush Hill, which revealed valley soils less than 25cm thick. When the distribution of archaeo-colluvium and fields are linked with some observations about the surrounding soils in this catchment a different interpretation of the landscape history emerges.

The assertion of long term pastoral use in this valley is contradicted by the obvious and widespread distribution of thin skeletal soils, which imply an intensive arable history. If, as the thin soils of the slopes suggest, there has been widespread erosion within this catchment then the evidence in the form of valley soils must have been swept away. Earlier assertions based simply on colluvial thickness independant of other catchment factors underestimate catchment-wide geomorphic processes and the possibility that these sediments have been evacuated.

The likelihood that there has been severe truncation of the valley soils seems a more plausible explanation for the absence of colluvium in the light of the wider evidence. This has implications for a re-interpretation of the Berkshire Downs landscape, which is fully expanded in the next section.

It was an assumption of the model that the amount and distribution of predicted colluvium represented relatively uniform regimes of preservation across the project area. It is clear however, particularly in the chalk catchments of the western part of the project area that colluvium has been removed from the valleys. The fact that the soils of the hillslopes of both western catchments are thin and chalky implies substantial soil loss though evidence by way of valley deposits appear to have been completely removed – more significantly from the chalk catchment at Seven Barrows.

The most obvious difference in the topography of the Berkshire Downs from west to east is the change from a landscape of large open chalk valleys to smaller, narrower and more assymetric catchments of mixed clay and chalk soils. An explanation for the variable distribution of colluvium across the project area can be argued according to the erosional regimes produced by these physiographic differences.

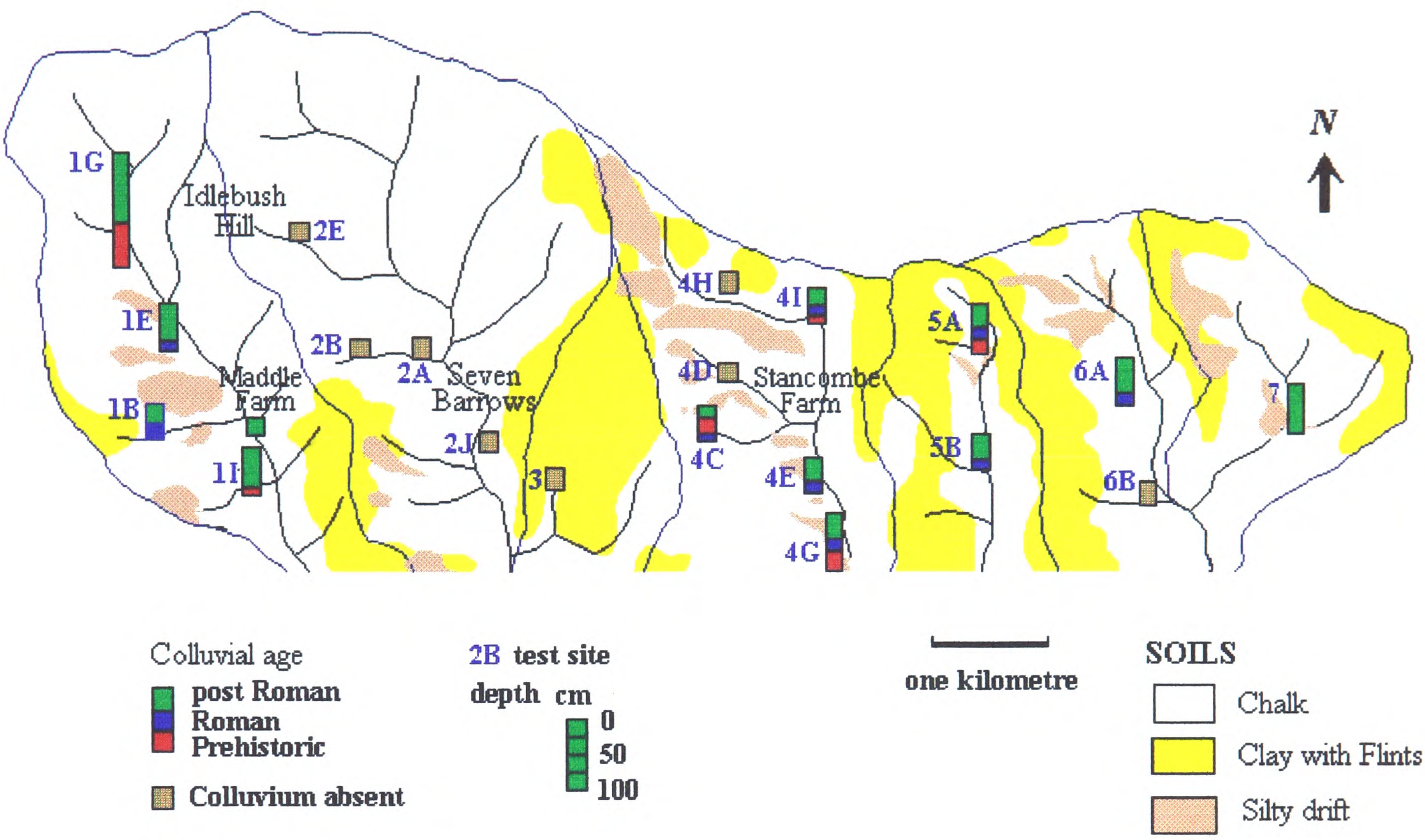


Figure 88 Distribution of archaeo-colluvium in relation to soils

In the west, both catchments 1 and 2 are characterised by broad open valleys with steep upper slopes which sweep in general concave shape to broad gentle valley floors. On the chalk soils of prehistory these long slopes would have been more predisposed to run-off and erosion than the landscape of heavy soils, smaller valleys and shorter convex slopes to the east.

The fact that catchment 1 produces a more uneven thickness of colluvium than catchment 2 which is wholly chalk can be explained by the local presence of some small Clay with flint cappings and larger drift deposits on the lower east-facing slopes. These units appear to be the source of de-calcified archaeo-colluvium which exists along the valley edge, although very thin and chalky colluvium is typical in the main valley.

While soil type and valley shape may account for the variable distribution of colluvium across the project area, it was also noted that the two western catchments are some 30m lower in elevation than the narrower valleys further east. The valley floors in the western catchments would be therefore be more susceptible to stream removal during periods of higher water-tables – a more compelling reason why colluvium is absent in the central valleys of these chalk catchments. Catchments 1 and 2 therefore present a landscape which, though widely cultivated in prehistory has suffered removal of colluvial soils - completely in catchment 2 and from the chalky central valley in catchment 1. The heavy soils, convex slopes and smaller valleys of the centre and east of the project area however, present a topographic setting pre-disposed to greater accumulation and storage of valley sediments. The more cohesive nature of the eroded clay soils, situated as they are well above any springlines, would be spared the process of removal suggested above. The observations about physiographic factors and the pattern of colluvium on the Berkshire Downs suggest that while ancient fields generate valley deposits, local valley form, elevation, soil properties and hydrology modify the thickness and extent to which these deposits are preserved.

The presence of deep de-calcified Charity units across the Berkshire Downs remains problematic. The auger survey conducted across these deposits (p 141-142) proved that the large bench-like drift units near Maddle Farm did not yield artefacts nor did they comply with the descriptions of dry valley colluvium found elsewhere on the Chalkland (Avery 1980; Bell 1992). It would seem reasonable therefore to assume that in this part of the project area these units are not archaeo-colluvium even though their relationship to fields suggests such a link. The Charity series around Stancombe Farm in catchment 4 however are more heterogenous in composition, darker, flinty and contain artefacts - clearly the product of ancient land use. The Charity series has been mapped according to a broad classification which appear to include a variety of lower slope soils. It is only on closer examination and at the finer scale of resolution used for this study, that a distinction becomes evident.

10.3.2 The central and eastern catchments : thicker colluvium

Archaeo-colluvium is thicker and more widespread in association with fields on Clay with flints and drift deposits in catchments 4 – 7, though some valley edge sequences occur with drift deposits in catchment 1. Trenches 1I, 4G, 5A, 6B and 7 surrounded by Clay with flints all showed deep colluvium within this setting. The only exceptions within the Clay capped eastern catchments were chalky sub-catchments such as trench sites 4D and 4H which confirmed the link betweeen chalk soils and shallow or absent colluvium. It is notable that while parts of catchment 1 and catchments in the centre and east have a similar distribution of ancient fields, the eastern catchments retain thicker colluvial material within the valleys. With land use constant therefore, this further supports the notion that the variable thickness of valley sediments might be attributed to physiographic differences across the project area. A cross-section from west to east across the Berkshire Downs provides a summary (Fig 89).

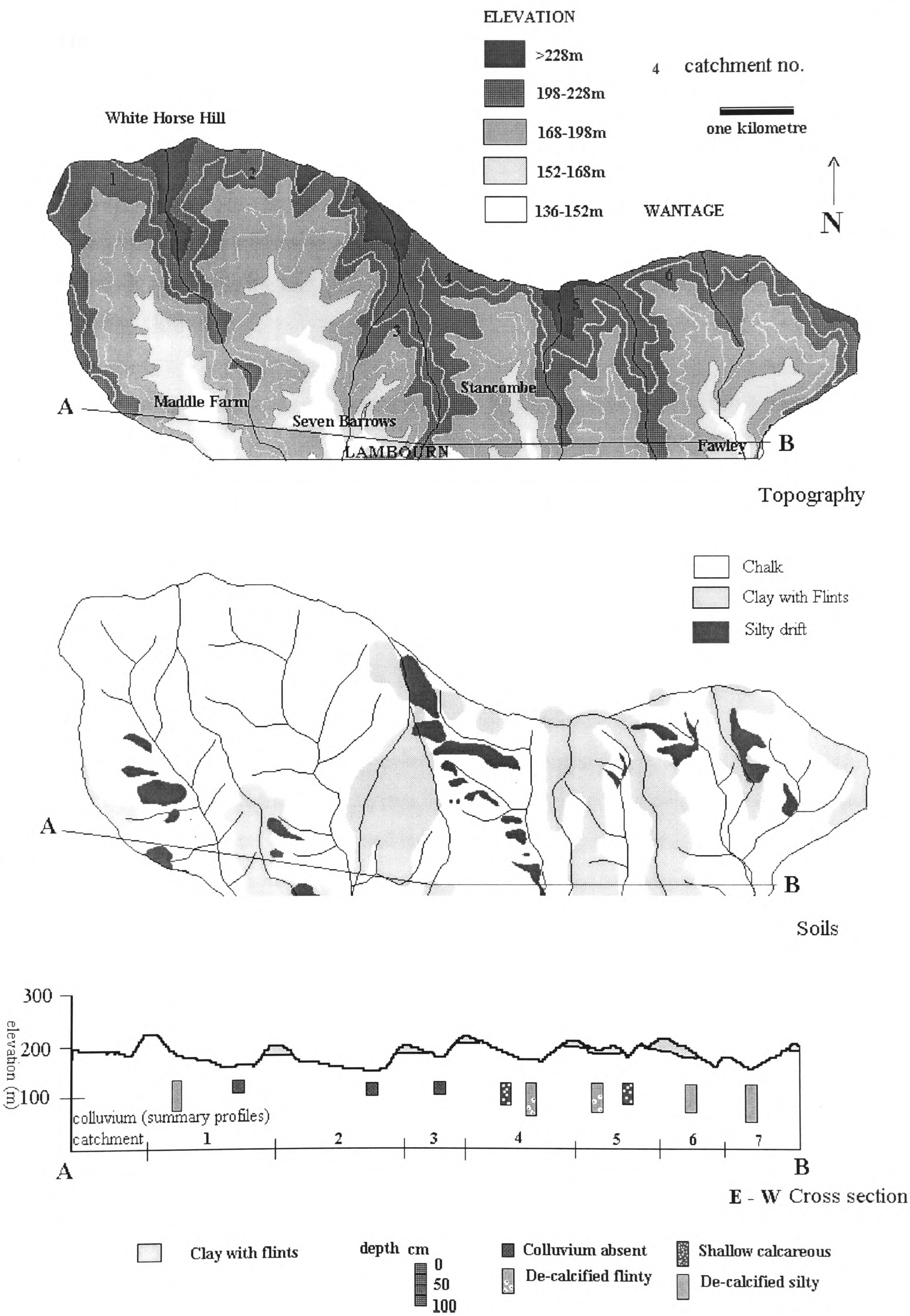


Figure 89 Cross-section of Project area

While the programme of field checking supported an association between ancient colluvium and ancient fields on the Berkshire Downs, the relative amounts from catchment to catchment appear to be function of local physical factors such as topography and soil type. Colluvial thickness as a direct function of land use history has been assumed in many other landscape studies often with little account given to the effects of local catchment factors. Evans (1992) for example used approximate volumes of valley sediments to estimate soil losses, a potentially unreliable method given the evidence of colluvial truncation evident on the Berkshire Downs.

The predictive model made the assumption that chalk soils were more erodible than Clay with flints soils. This is a reasonable assumption based on the contrast in erodibility properties between clay and chalk soils and the general avoidance of the heavier soils by ancient agriculture. Over long time periods however it is evident that more complex regimes of erosion deposition have developed.

The less erodible Clay with flint soils, though not extensively cultivated appear to promote better preservation of valley deposits and archaeology because they occupy smaller valleys less disposed to removal than the chalky colluvium of the long and open valleys to the west. In other words, in catchments characterised by heavy soils, narrower valleys and less intensive cultivation the products of ancient soil erosion appear better preserved, while the intensively cultivated open chalk catchments are both more erodible and more susceptible to spring fed evacuation of valley sediments.

The implication of this observation is that on the limited tracts of land (10-20%) where cropping has drifted onto the heavier Clay with flint soils, colluvial preservation is more likely. The conclusion that valleys within Clay with flints offer potential sites of remnant archaeology and windows of preservation on these otherwise degraded and stony Chalk landscapes was a significant finding of this study. As the chalk catchments are devoid of colluvium, the valley sediments within the landscapes of heavier soils offer potential repositories of sediment and archaeology from earliest land use, an observation which might be replicated in other archaeological landscapes across the Chalkland.

The fact that the thickest sequences of colluvium in the project area correspond to catchments where ancient fields significantly overlap the heavier soils appears to find support from the Maiden Castle landscape where thicker colluvial soil units (Millington group soils) appear to occur in regions which are more incised with cappings of Tertiary deposits. Staines (1991, 13-14) provides detailed soil, soil acidity and colluvium distribution maps for the Maiden Castle survey area (35km^2). While he suggests that colluvial thickness is linked to the proximity of calcareous chalky soils, the valleys to which he refers - a major dry valley some 3km north of Maiden Castle, running north-east to the Frome River, in fact lies in a landscape capped by a large area of Clay with flints (Roman Road ridge). Catchments about a kilometre due north of Maiden Castle which are rich in ancient fields and almost wholly occupied by chalk soils however have colluvium which is much shallower. The thickness of colluvium in catchments predominantly of Clay with flints was also noted at Bullock Down (Drewett 1982).

Several factors appear to correlate with the distribution of ancient colluvium on the Berkshire Downs. Fields undoubtedly produce colluvium, however, these deposits are variably preserved at the valley edge or in the valley bottom below the fields. Differential preservation has modified the deposits such that conclusions about land use based on different local colluvial thicknesses must be carefully qualified. After a short program of field-work some of the physiographic factors which appear to modify the thickness of valley sediments have been identified and summarised (above).

10.3.3 The lost loess

The acknowledged weakness of the colluvial model and of many models which deal with past landscapes is a reliance on maps which represent the modern soil cover. The absence of widepread traces of (what is presumed to have been) the original loessic soils within the project area prevented any reconstruction of erosion regimes for the earliest phases of agriculture. The assumptions about prehistoric erosion regimes were developed from the current distribution of soils and the pattern of broad use and avoidance which persists in the modern landscape, reflected in the layout of the ancient fields (Section 6.3.4). In the absence of any previous geo-archaeological work on the Berkshire Downs this was a convenient working assumption.

The fate of the early pattern of agriculture, sustained by an earlier and more erodible soil cover raises several issues. If the distribution of ancient fields, on which the model is based, persist within the shallow modern soils (Moffatt 1988), why not traces of the fields from the earlier loessic soils. In answer, it has been argued that the loessic cover may not have been thick or extensive after phases of peri-glacial removal (Section 3.2.2) and certainly not uniformly distributed. Neolithic farmers, for example, may have enjoyed these fertile soils for a relatively short period, before encountering the calcareous and flinty soils which characterise the present major soil groups across the Downland. With an absence of land allotment during this period, suggested in Section 3.3.1, there may not have been much early evidence by way of field boundaries to lose. The concept of vast early arable cultures dissappearing Atlantis-like into the alluvial valleys on a tide of eroded silt is therefore an unlikely scenario.

The risk inherent in a predictive method for locating ancient deposits which uses modern soils, is that investigation of these sediments may reveal valley sequences which contradict the original assumptions. Indeed the nature of this project dictated that this would almost certainly be the case. The presence of old land surfaces and palaeosols in previous excavation work within the project area were sparse (Richards 1986). There were no loessic soils or Neolithic pottery within the basal sequences of any of the colluvial trenches from which earliest farming might be directly implied. Attention however might be directed at the Clay with flint landscapes in which some deeper archaeo-colluvium was preserved. It was noted in Chapter 8 that shallow calcareous colluvium of Iron Age-Romano-British date occupies tributary valleys in Catchment 4 around Stancombe Farm, while the main valley contains sequences of deeper flinty de-calcified soils which can be ascribed an earlier date (from entrained Mid Iron-Age pottery), but more convincingly according to the fact that these deposits imply an earlier cover of silty soils (Section 8. 5). In this catchment some tell-tale remnants of Clay with flint soils, which must have been much more extensive in the past, can be seen on the Soil Survey map (Jarvis 1973). This suggests that an earlier non-calcareous soil was farmed during this period and is the most obvious example witihn the project area of where the valley deposits imply almost total removal of a non-calcareous soil cover. In the other catchments (sites 1I, 5A, 6A and 7), archaeo-colluvium is at earliest Iron Age in date, but the composition of the colluvium does not reflect significant change in the character of the surrounding soils (Figure 74, 89). The association of prehistoric pottery with deep flinty colluvium in trenches 4G, 5A or deep chalky fill (1G) suggests that farming during these periods was on flintier soils and also that the episodes of soil loss were of larger scale.

While the paucity of information about past soils was an acknowledged weakness of this study, the results from colluvial investigation on the Berkshire Downs however did not reveal widespread evidence that the soil erosion assumptions used for the model were inappropriate. Detailed mineralogical analysis of the colluvial material will reveal more about the age and origin of the valley sediments within the project area. The prospect that the Charity soils, particularly near Maddle Farm are the eroded remnants of original loessic soils for example may repay further investigation. It is also possible that answers about the fate of the loessic soils, particularly those sediments which have been completely removed from the Seven Barrows valley might be found in alluvial sequences further down the Lambourn or Kennet valleys. The absence of colluvium of any description from the open valleys in catchment 1 and around Seven Barrows leave little evidence behind of the earliest soils and little scope for comment, except to re-iterate that both the earliest and most of the modern soil cover on the slopes, together with the accumulated valley sediments have been removed according to regimes of erosion which seem common to these chalk valleys.

10.3.4 The time factor

The variable thickness of colluvium across the Berkshire Downs may simply be a function of a longer history of agriculture, longer cycles of erosion and susceptibility to frequent erosion events. While the archaeological implications of colluvium contribute to a more comprehensive re-interpretation of the ancient landscape of the Berkshire Downs in the next chapter, the following scenario suggests a chronology of arable activity and colluvial formation. Neolithic features are more prominent in the western catchments, hence it might tentatively be assumed that an early landscape of cultivation (without boundaries and lynchets) in these open chalk catchments would have produced a more erosive regime than the landscape of organised fields, which occupied the neighbouring catchments at a later date. This suggestion is developed further in the next section. There are few examples of Neolithic colluvium of this age across the Chalkland almost certainly due to the low activity of farming at this early period. If however, evidence for Neolithic soil loss, albeit circumstantial, exists in a landscape such as Seven Barrows then the deposits might conceivably have been by removed by infrequent storm or climatic events during the 2000 years of Neolithic activity. An extra 2,000 years of activity is a significant argument for more removal of valley deposits in one part of the project area compared with another. It is therefore important to recognise the time-scale over which these arable cycles took place and the possibility that incremental erosion during early prehistory may have been responsible for soil thinning as the evidence from truncated old land surfaces and original soils across this region seems to suggest.

In the Stancombe catchment, where there is evidence of later agriculture, extensive field systems and a landscape of mixed chalk and heavier soils, colluvial thickness may be a function of both catchment morphology and soil factors (mentioned in the previous section) but also simply because of a shorter history of arable activity.

10.3.5 Summary : the distribution of archaeo-colluvium

It can be seen by a closer examination of soil and geomorphic factors that while the distribution of colluvium and fields are closely linked, the thickness and preservation of colluvium appears influenced by local physical factors. The general regime of preservation seems to be one in which archaeo-colluvium formed within the open valleys of the chalk catchments but has been removed or severely truncated. In the catchments of mixed clay and chalk soils further east archaeo-colluvium appears to have been better preserved. The thickness of archaeo-colluvium therefore is not an accurate index of land use history. Nevertheless, the sequences of ancient colluvium which survive, and from which datable sequences remain, provide useful clues about the land use history across the project area and the processes by which they are variably preserved.

While the predictive criteria assumed that the pattern of colluvium might reflect relative rather than absolute proportions of deposition this proved not to be the case. The results from the field testing programme and observations about catchment factors suggest that relief, soils and hydrology have an important influence on colluvial thickness, distribution and preservation. It is certainly clear that colluvial thickness corresponds with a change from steep upper slopes, long gentle concave valleys and thin soils in the west to a more dissected landscape of heavier soils and narrower valleys in the east. The fact that deeper colluvium is linked with the heavier soils of the east seems consistent for all of the catchments east of Seven Barrows.

There remains a link between fields and dateable ancient colluvium in these mixed chalk and clay landscapes from which useful information about land use history might be derived. The use of ancient fields as a control on the distribution of ancient colluvium appears to be valid, athough the relative thickness might be attributed to local catchment factors such as relief, soils and hydrology. Colluvial thickness has therefore has less relevance to reconstructing ancient landscapes as the dateable material which it contains. Where colluvium has been lost completely from valley floors some factors can be implied about formation and preservation based on local soil type and valley form. These type of observations allow wider catchment processes to be incorporated into reconstructions of land use history.

The archaeologically "busiest" blocks of fields correspond to the most detailed sequences of archaeo-colluvium providing some evidence for the date of earliest field use. It was also clear that simple parameters which formed the basis of the colluvial prediction held true in a majority of sites. The predictive model satisfied three simple objectives. (i) It located colluvium, (ii) it located ancient colluvium from which (iii) a number of conclusions might be drawn based on its variable age and distribution across the project area.

What the archaeo-colluvial sequences revealed in terms of new evidence does not significantly alter concepts that the Berkshire Downs is poor in settlement sites, though one more was added to a rather short list. When combined with some wider soils observations, the results from the project however allow the land use history of the Berkshire Downs to be re-interpreted. As a first attempt at simplifying what are clearly complex processes it was recognised that :

a) Colluvium near Clay with flints is both thick and datable within a landscape where chalk soils and valley sediments have been almost wholly removed.

b) The distribution of ancient fields is a useful common factor, certainly in terms of sites from which datable material is generated. While fields and datable sequences were closely linked, the relationship between ancient fields and colluvial thickness is less obvious. Thickness therefore can be discarded as a serious measure of land use history.

10.4 THE ARCHAEOLOGICAL IMPLICATIONS OF COLLUVIAL DISTRIBUTION

The distribution and age of the colluvium across the Berkshire Downs was used in the previous section to draw some conclusions about the age of fields and arable activity of this region. Some of these ideas and a wider interpretation of colluvial distribution and the archaeological landscape of the Berkshire Downs are expanded in the following section.

The recovery of artefacts from the test trenches confirms that soil loss related to ancient cultivation has occurred across the Berkshire Downs, allowing a prehistoric date to be given to colluvium in catchments 1, 4, and 5. Colluvium in catchment 6 produced some Roman pottery while catchment 2 was devoid of colluvium. There was insufficient pottery for statistical analysis, though it seems reasonable to conclude, on the basis of the presence of Mid-Late Iron Age pottery at the base of seven out of 12 trenches, that the earliest arable was of prehistoric date in the largest field blocks of the Maddle Farm and Stancombe areas, while it was not until the Roman or later period that arable came to catchments 6 and 7 further east.

This does not significantly alter the earlier view that the Berkshire Downs were farmed widely in the Bronze and Iron Age (Bradley and Ellison 1975) before Roman expansion, though it strengthens the argument for earlier rather than later arable intensification put forward by Bowden *et al.* (1991b) and Bradley (1994)(Section 10.2.1).

10.4.1 Seven Barrows revisited : absence of colluvium is not equal to absence of arable.

The consequences of shallow colluvium in the Seven Barrows catchment has already been discussed with respect to the field-colluvium assumption adopted by the model. Absence of colluvium was argued not to imply absence of agriculture but in combination with other local factors implied early soil exhaustion and removal of valley deposits from this landscape. When a regional perspective is taken and combined with local soil, land use and archaeological information, an alternative to some of the earlier ideas about the landscape history of the Seven Barrows catchment can be proposed.

The conclusions that this catchment had been avoided by prehistoric cultivation was based on both absence of colluvium and absence of fields (Bradley 1978, Bradley and Ellison 1975). While it might be argued that any evidence of ancient fields in the form of lynchets or soil marks may have been lost from this catchment, Moffat argues that field boundaries persist even on the thinnest soils in his study of ancient fields in Hampshire (Moffat 1988). Indeed the presence of large swathes of fields in catchment 1, many on thin chalk soils, would seem to imply that if similar fields were delineated in the Seven Barrows catchment then they should be visible. It has been asserted by Richards (1978, 40), supported by similar observations of Moffat (1988) in Hampshire, that prehistoric fields were never a part of the landscape of the Seven Barrows catchment.

A question therefore remains in the land use history of this catchment. The soils of this catchment are chalky, thin and skeletal and have clearly undergone widespread erosion. In the absence of traces of field boundaries it is possible that soil loss occurred in the period before significant land division was imposed on the landscape. Indeed if it were since, then surely field boundaries would be visible. Indeed the sparse evidence from beneath round barrows indicates few old land surfaces and evidence of truncated soil profiles which imply that soil thinning had occurred before the barrows were sealed in the Early Bronze Age (Richards 1986).

The large expanse of gently sloping chalk soils in this part of the Berkshire Downs would have been attractive to the earliest farmers and was presumably first to be exploited, compared with a landscape of heavier soils by which it is surrounded. Despite the absence of fields there are hints of agriculture (Section 4.4) and an ordered landscape here in the early Neolithic (around 4000BC) (Richards 1986, 35) seen in the concentration of long barrows Waylands Smithy, Park Farm and Lambourn.

It is plausible that the soils of this catchment were degraded and abandoned as early as the Neolithic (suggested by Richards 1986) with the loss of the few field boundaries which may have divided the early arable landscape. To refute absence of arable on the basis of absence of colluvium cannot be sustained in the light of wider soils information. It is therefore not so much that the colluvium never formed, as it surely must have, given the soil loss evident on the hillslopes, but that the missing colluvium has been lost from the valleys at some period since as a result of a number of possible mechanisms. Among these, differences in valley form and the action of local seasonal streams (Wymer 1966) or a function of both, are plausible causes (see section 2.7).

A similar early arable history is suggested in both the Dorchester and the Stonehenge regions. There is evidence for cultivation during the Neolithic in these landscapes (Entwistle 1990; 105-9, Christie 1964), but no apparent traces of formalised fields from this period - possibly the result of lower population and a "lack of necessity to define land" compared with expansion during the Bronze Age (Allen 1995; 1997a; 136). There is also an absence of colluvium in many of the dry valleys around Stonehenge (Richards 1990, 210-211; Allen 1991, 51-54; Allen 1995, 484; Allen 1997b, 133-134; Bell 1986). Allen suggests this may be due to a mixed yet more dominant pastoral economy but alternatively suggests it may reflect intensive arable use and evacuation of valley deposits. The Stonehenge region presents a series of open shallow-bottomed valleys, not topographically dissimilar to the western parts of the Berkshire Downs. That both areas lack colluvium is a comparison which is made with other archaeological regions in the next section.

The fact that the Seven Barrows catchment was not partitioned at a later stage when the rest of this north-western part of the Berkshire Downs was under fields, but appears to have been a focus of a barrow cemetery might be the result of ritual use of an otherwise degraded landscape. The environmental evidence from Rams Hill reveals both a conspicuous absence of quernstones, carbonised grain and mollusc data, information which supports a pastoral setting. This implies that the Seven Barrows catchment had reverted to pasture as early as the mid Bronze Age (Bradley and Ellison 1975).

Bronze Age cemeteries are commonly located both in valley floors (Gingell 1992) and in abandoned areas (Bradley 1994). With increasing land use in the late 3rd to early 2nd Millenia BC, hilltop sites particularly would have been susceptible to erosion. The location of barrow and linear cemetaries in early 2nd millenia BC in these less productive and degraded areas was also noted near Dorchester (Smith, R.J.C. *et al.* 1997) and at Stonehenge (Cleal *et al.* 1995). Once degraded and given over to pastoral use, this part of the Berkshire Downs might have been used for grazing near permanent water, complying with some of the lower watered areas which have been suggested in models of prehistoric land use on the high Downland (Cunliffe 1984; Gingell 1992). Though both a spring and cemetery suggest ritual importance, the thin soils of the catchment is an equally compelling reason why this area was not substantially partitioned even in Roman times. The use of this catchment for arable in earlier prehistory and maintenance as a grazing area during Roman settlement is supported by evidence from the Maddle Farm field survey. There was virtually no Roman or prehistoric pottery recovered in this valley which might suggest episodes of manuring.

It is postulated that Neolithic agriculture was practiced without prominent field boundaries in the Seven Barrows region until soil decline forced a shift to the surrounding catchments in the Bronze Age when field division became necessary. Gaffney and Tingle (1989) allude to a chronology of human activity in the Maddle Farm study which suggests that the Berkshire Downs in general reflects a landscape of comparatively low priority, particularly in the the Late Bronze Age. Such an hiatus may have been followed by expansion onto catchments west and east of Seven Barrows. The scenario proposed : one of early abandonment with this catchment given over to grazing and use for Bronze Age burial, provides some support for this assertion. If we ascribe the establishment of small fields in part to soil conservation practice, it is also possible to argue that Bronze Age fields and soil preservation in neighbouring catchments was a progression in land management methods learned from the soil losses sustained by earlier Neolithic farmers at Seven Barrows.

10.4.2 A three phase settlement scenario for the Berkshire Downs

The results of the survey of colluvial age and thickness from this project, together with a synthesis of the surrounding soils and archaeological evidence, suggest a sequence of land use from early use of the Seven Barrows catchment followed by a shift to the less favourable mixed Chalk, Drift and Clay with flint catchments to the west and east. The Seven Barrows catchment with its absence of fields, concentration of Neolithic long barrows at Waylands Smithy, Whitehorse Hill and Lambourn reflects a focus of early activity on the Berkshire Downs which was arguably arable. The later concentration of Early Bronze Age round barrows and significantly the (later) ceremonial Rams Hill, White Horse and Uffington hillfort in the later Bronze and Iron Age at its head, linked by water sources at Lambourn, reflect a landscape of later pastoral and ceremonial/funerary use. The significance of this landscape as one of ceremonial and genealogical importance is suggested in Gosdens interpretation of the Uffington hillfort and local complex of prehistoric monuments (Gosden and Lock 1998). It is possible to connect concepts of continuity from these monuments at the head of a catchment with evidence of earliest use and subsequent ritual sanctity around a cemetery and spring in the valley below. While this landscape implies some form of pastoral *set-aside*, the evidence for very early (and possibly revered ancestral) arable activity in this region is strongly implied.

It might be argued that Catchment 1 to the west of Seven Barrows, with a large expanse of open chalk soils was favoured once the Seven Barrows catchment was in decline. The barrow and settlement evidence provide tentative support for this idea. Prehistoric pottery was recovered in colluvial trenches, and a Neolithic ring ditch and Late Bronze Age settlement sites have been excavated at Weathercock Hill and Tower Hill (Richards 1986 ; Bowden *et al.* 1991a). While soils are thin in much of this catchment, there are large drift deposits and some small Clay with flint cappings which appear to have sustained arable from the Bronze Age to much later Roman agriculture, centred around the Maddle Farm villa (Gaffney and Tingle 1989). The dating evidence from the large blocks of field systems in this catchment is not extensive, nor conclusive and has been discussed in section 10.2.2. Roman agriculture is unquestionably imprinted in catchment 1 around the villa at Maddle Farm, with several Romano-British settlement sites interpreted from pottery scatters in the upper catchment. There are however, large blocks of both cohesive and aggregate fields in the mid and upper reaches of this catchment which in the absence of any dating from lynchet excavation might be considered prehistoric. Indeed the characteristic elongated fields only appear common within about a 2km radius of Maddle Farm. The proximity of aggregate fields in the upper catchment to Late Bronze Age settlements at Weathercock and Tower Hill suggest that the earliest of these fields may be contemporary with these settlements. The earliest pottery from deep chalky colluvium in the upper catchment was Iron Age, although the nature of the deep chalky fill in this part of the landscape implies the significant erosion of a landscape which, at this time, must already have been characterised by shallow chalky soils.

To the east of Seven Barrows at catchment 4, the landscape bears little evidence of Neolithic use but more evidence of later prehistoric activity. The concentration of round barrows implies Early Bronze Age activity, although there are two Iron Age settlements and limited prehistoric pottery from field survey (Gaffney and Tingle 1989, 88) indicating that this area might have been exploited as a third alternative a focus of arable in the chalk catchments to the west. Around the rim of the Stancombe region are large deposits of Clay with flints, Drift units and small remnants of what would have been larger clay cappings. These would have been less favourable for cropping though the appearance of iron coulters during the Iron Age would have opened these catchments to cultivation. This suggests that these catchments may only have been developed as land use pressure spread from the west, perhaps coincident with the degradation of chalk soils in catchments 1 and 2, widespread land use pressures and climatic change during the Later Bronze Age as suggested by Cunliffe and Miles (1984). The presence of Iron Age pottery and de-calcified flinty colluvium in the main valley of a catchment which is surrounded by calcareous soils implies erosion of an earlier soil cover (Section 10.3.3). In the tributary valleys, colluvium is more calcareous reflecting the contemporary soils. Within these sequences chalky lenses with Roman sherds support the notion of later Romano-British cultivation of thin and chalky soils.

Further support for the later phase of development of the Stancombe catchment might be found in the thickness of colluvium. While colluvial thickness has at least in part been attributed to regimes of preservation influenced by differences in topography and soils, thicker deposits might be expected in an arable landscape spared hundreds of years of erosion compared with the catchments to the west. This part of the Downs certainly seems the busiest catchment in terms of prehistoric fields and features and a parcel of agricultural land whose value might well be reflected in it's delineation by the East and East Garston Ditch linear ditches (Section 4.6).

The evidence from the fields themselves for a shift in acitvity to this catchment in the later prehistoric is again speculative in the absence of widespread field excavation work. Bowden *et al.* (1991b) suggests Roman fields in and around Stancombe though the possibility that they are prehistoric fields is argued in Section 10.2.1. Roman activity around the small villa at Stancombe (Money 1887) is not reflected in any surface pottery (Gaffney and Tingle 1989) though there are elongated fields in the vicinity. In the mid and upper part of this catchment however there are large swathes of both cohesive and aggregate fields, in fact at Green Down there is a particularly dense arrangement of well preserved fields, enclosures and double trackways. It would seem at least on the basis of field morphology to assign prehistoric dates to the fields in this part of the catchment. There are also no Late Bronze Age settlements of the type found in catchment 1. The use of these fields in the Iron Age is suggested by their proximity to the Segsbury hillfort which dates to this period - supporting a later phase of agriculture in catchment 4 than in both catchments 1 and 2.

The age of the hillforts along this stretch of the Ridgeway also supports this general eastward shift. Rams Hill is the earliest of the enclosure/hillforts dated most recently to Mid-Late Bronze Age. Uffington which might be considered at the head of catchment 1 has evidence of both Late Bronze Age and later early Iron Age material, while Segsbury which might be considered linked with catchment 4 and 5 has early Iron Age material. Romano-British re-use appears at Uffington perhaps coincident with the Maddle Farm intensification. This general chronology of settlement and land use is shown in Fig. 90.

This scenario is almost certainly stretching a sparse record of evidence. Contiguous land use was probably carried out on either side of the pastoral landscape at the Seven Barrows catchment. The proposed three-stage development is therefore advanced after a synthesis of the archaeology, ancient fields, colluvium and the wider landscape. Until the fields become more accurately dated it presents a plausible scenario.

Richards (1986) has suggested at a regional scale that the western and eastern parts of the Greater Berkshire Downs which stretch some 20km further east than this project area, represent zones of differential land use delineated by the linear ditches. Richards recognised the level of funerary activity and field systems to the west supporting an arable economy which contrasted with an apparent pastoral landscape on the heavier soils to the east. Richards drew this distinction in land use history for a much larger part of the Berkshire Downs based broadly on soil types (discussed in Section 4.7.1). It is notable that when closer attention is focused on both land use and geomorphic conditions further refinement and reinterpretation is possible. What is perhaps most profound is that there is strong circumstantial evidence in the form of thin soils for early Neolithic exploitation of the Seven Barrows catchment, and support for later prehistoric use in the form of colluvial sequences both west (truncated) and east of Seven Barrows, which strengthens the argument for substantial earlier (prehistoric) use rather than simply implying Roman intensification which an examination of field boundaries might imply.

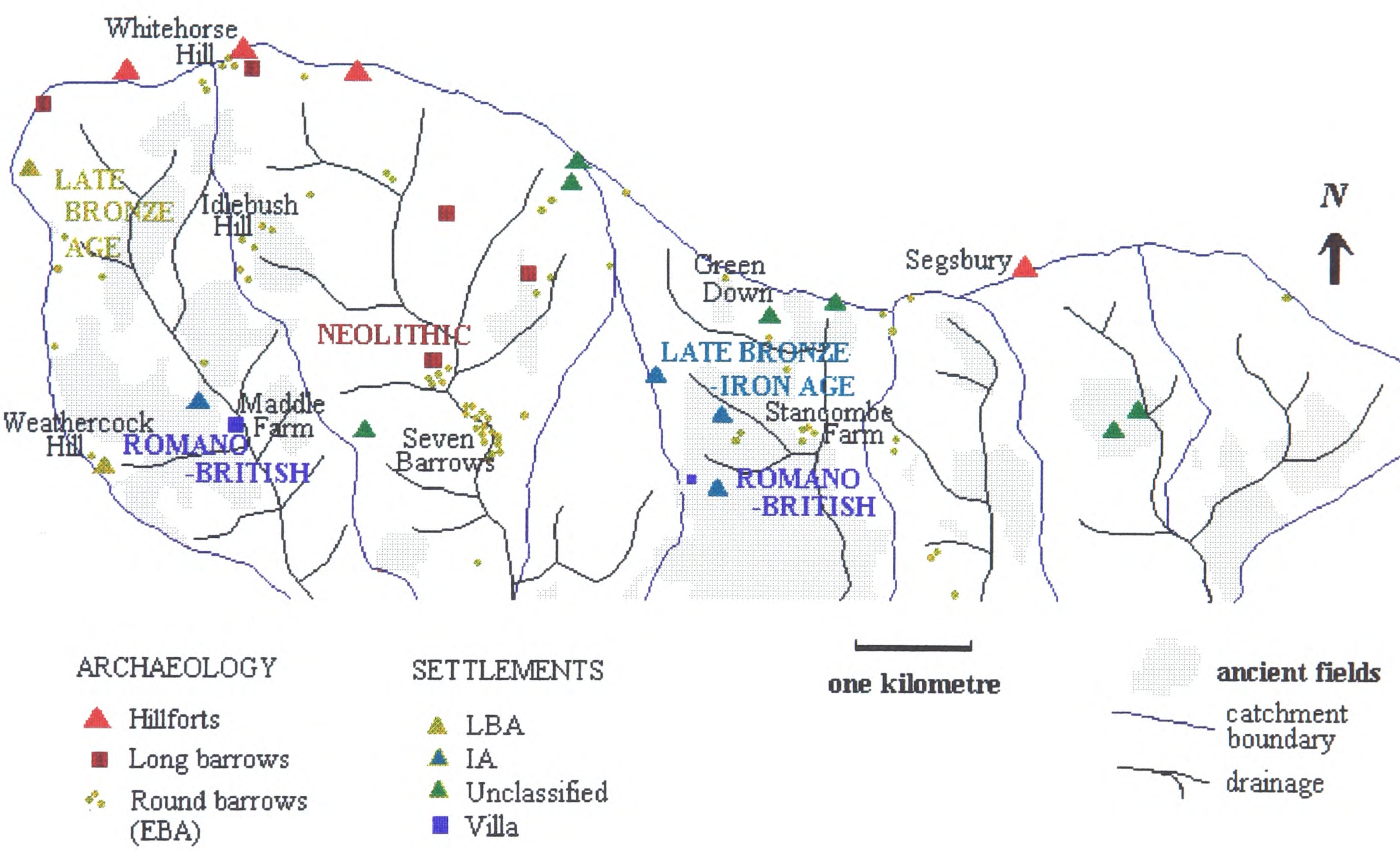


Figure 90 Suggested chronology of ancient land use on the Berkshire Downs

10.5 THE PROJECT AREA IN A WIDER SETTING

Richards' observation that the Berkshire Downs might be divided into a western (Lambourn) and an eastern (Beedon) zone was made according to the distribution of fields, soils and funerary monuments (see Fig 10). This project falls wholly the "Lambourn" zone in the north western corner of the wider Berkshire Downs region. It is useful to consider the project area within a wider physical and archaeological setting and Richards' survey (1978) provides a convenient summary of the landscape and archaeology of the whole Berkshire Downs between the Ridgeway and the Kennet River, an area of about 450 km^2 of which the project area occupies some 60km^2.

An immediate observation when the project area is examined in relation to it's wider surrounds is that field systems, hillforts and archaeology are concentrated within a relatively small part of the north-western corner of this region. It is also clear that the project area offers an *enclave* of chalk soils surrounded by a sea of Clay with flints and Plateau Drift which provides some explanation for such a focus, certainly of fields and arable activity. There are few large field blocks outside the project area which lead to the conclusion that the north-western Berkshire Downs, as an area of concentrated arable surrounded by a vast pastoral landscape is likely to have provided grain for an area far beyond its boundary and as a result suffered high land use pressure. It is also conceivable that the those engaged in cropping within the project area, situated as it is in the high Downland, may have come from settlements or locations well outside it's boundaries.

The size of the Seven Barrows cemetery and general concentration of the immediate surrounds certainly implies at least a ritual importance well beyond the local area. The fact that the project area is subdivided by a number of linear ditches also suggests land division aimed at accommodating land use pressures. Indeed it has already been noted that the East Ditch and East Garston Ditch bound a prominent block of fields around Stancombe Farm in catchment 4 (Section 4.6). As a regional focus of agriculture it is not surprising therefore that the soils of the project area have been severely eroded and the wholly chalk catchments most serious of all - with the loss of soils from both the slopes and most of the western valleys.

A little further to the south-west are the Marlborough Downs, an area of extensive fields and settlement activity, also located at the northern extremity of the Southern Downland. It is a region of comparable size to the project area, occupying about $50km^2$ with approximately 12-$15km^2$ of ancient fields. It is also a landscape of high Downland, open chalk valleys and prominent Clay with flint hill-cappings - which again have been largely avoided by ancient fields. There are several features common to both areas, namely the existence of dry valley barrow cemeteries, large blocks of fields and linear ditches. Most significant by way of contrast is the evidence that the Marlborough Downs is a Late Bronze Age landscape with settlements and features rich in Neolithic and Late Bronze Age pottery. The Berkshire Downs however provides evidence of being a re-used Late Bronze Age landscape with both later prehistoric and Romano-British activity.

In addition to a greater richness of archaeological material from excavations, the Marlborough region is closer to the water sources of the Og and the Kennet Rivers. The Berkshire Downs by contrast relies on the smaller and more distant Lambourn River. Gingell (1992) suggests that any model for the land use of the upper Downland must account for a mix of land use types and that the Berkshire Downs could not have functioned without linkages to better watered districts (for dairying etc). On the Marlborough Downs such areas are identified in the lower valleys which have been spared fields, according to Gingell, for this reason. On the Berkshire Downs, the obvious parallel for this would be the Seven Barrows catchment for two reasons. The first according to the possible ritual significance of the valley focused on the barrow cemetery, and secondly the fact that (as has been suggested in Chapter 9 and 10), the catchment is degraded and offers some grazing land not too far from the Lambourn spring and in close proximity to the swathes of arable.

There has been no investigation of colluvium on the Marlborough Downs although the implications from the Berkshire Downs study are that, while valley deposits are expected to be poorly preserved in similar open valleys, the presence of relatively small areas of Clay with flints, where they have been encroached by fields, might provide a source of deeper colluvium and preserved artefacts in this landscape. The comparison of the project area with its surrounds serves to emphasise the pattern of available resources and focus of regional pressures under which the landscape of the more elevated districts within the Berkshire Downs developed in prehistory.

While ancient cultivation appears to have been widespread and intensive, the presence of relatively thin colluvial sequences on the Berkshire Downs (compared with elsewhere on the Chalkland) might be attributed to the particular erodibility of these High Downland landscapes (150 - 250m). The higher relative erodibility on the Berkshire Downs for example would be exacerbated by relatively steep and exposed slopes, thin soils, and higher rainfall (Fowler 1983, 23). A fragile physical setting under sustained land use, this part of the Chalkland would present a landscape of higher sensitivity to erosion than regions of lesser topographic prominence. In some respects these High Downland areas share some of the characteristics of the Highland zone in which agriculture and settlement were vulnerable to small shifts in climatic regimes (Evans 1975).

For this reason, the Berkshire Downs during several phases of prehistory might have been regarded as marginal arable land passing into this state after long episodes of land degradation and particularly climatic change (suffering longer frosts and shorter growing seasons) during the Late Bronze Age. Such a transition while not as profound, may have some parallels with the agricultural landscape at Dartmoor which was abandoned in the Late Bronze Age (Fleming 1986). There are also some more subtle parallels with Dartmoor with respect to archaeological preservation. With decline in Roman cultivation, a landscape of thin and degraded soils does not seem to have attracted widespread Saxon or Medieval cropping. While other regions of the Chalkland have been masked by subsequent cultivation the earliest traces of arable persist in the upper parts of the Berkshire Downs giving an impression that prehistoric and Roman activity was more widespread than elsewhere.

10.6 SOME REGIONAL COMPARISONS

It is a useful exercise to examine several other archaeological landscapes on the Chalkland with respect to land use history, physical setting and colluvial distribution and compare whether the results and observations from the dry valleys of the Berkshire Downs are replicated in other Chalkland regions.

10.6.1 Maiden Castle Landscape

The Maiden Castle landscape is located at lower elevation (100-150masl) than the Berkshire Downs in a gentler landscape of chalk, Clay with flints and drift deposits which occupy broadly equal proportions. The Maiden Castle project is some 60km^2 in area with about 4km^2 of field systems. The depth of colluvium has been interpolated from Soil Survey maps and supplemented by site-specific colluvial sequences described for the Dorchester By-pass report (Smith, R.J.C. *et al.* 1997). As discussed in Section 2.3.1, the soil units which Staines interprets as ancient colluvium have not been dated (Staines 1991, 11-21). The presence of archaeo-colluvium in these valleys was however proven by excavation of valley sediments at Middle Farm and Fordington Bottom (Smith R.J.C. *et al.* 1997, 81-82, 205-207. For the purposes of comparison the Soil Survey maps will be assumed to represent the spatial distribution of ancient colluvium.

Land use around Maiden Castle contains fields and colluvial evidence for large-scale erosion during the Early Bronze Age (Staines 1991, 35, 251; Smith, R.J.C. *et al.* 1997, 177, 267) though notably evidence for continued use in Saxon and Medieval times as well (Smith, R.J.C *et al.* 1997, 283). This provides an immediate contrast with the Berkshire Downs in which little post Roman or later colluvium is found. Such broad multi-period phases of agriculture would influence the survival of earlier landscapes and valley deposits, a phenomenon less common to high Downland areas (see previous section). Although there are not so many blocks of ancient fields in close proximity to valley floors as on the Berkshire Downs, the following pattern of colluvial distribution can be observed at Maiden Castle.

There are four main blocks of fields, which have been used to define arable units of Iron Age date (Staines 1991, 21). The landscape around Maiden Castle can be divided into 5 catchments which drain these regions. Within each of these, the thickness and nature of valley soils can be compared with the soils of the slopes and presence of ancient fields (Fig. 91).

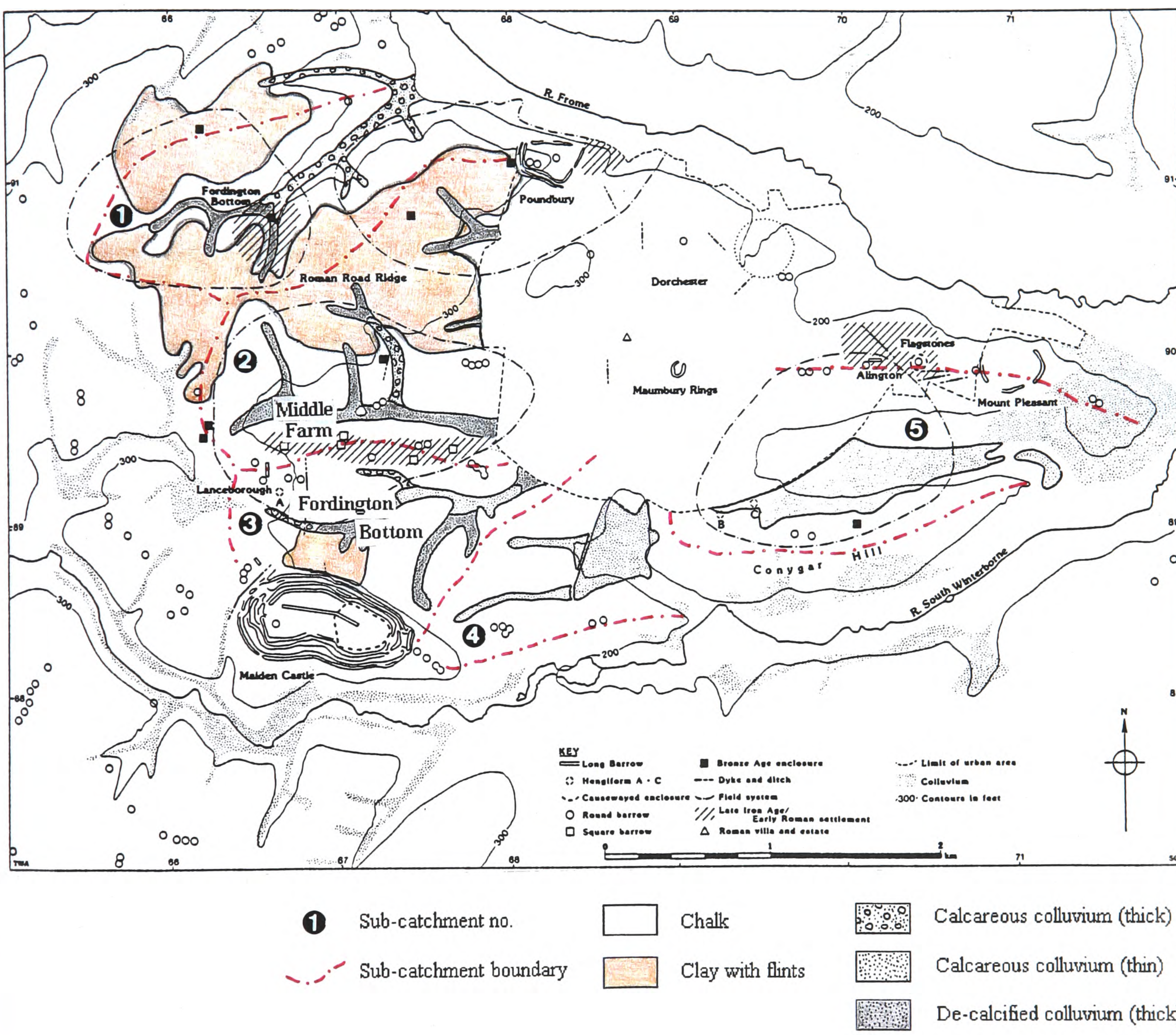


Fig. 91 The Maiden Castle landscape and colluvium

In the north of the Maiden castle region, a catchment with a capping of Clay with flints and lower chalk slopes has de-calcified colluvium in the upper tributaries and deep chalky colluvium in the main valley. Fields occupy much of the upper catchment. Catchment 2 possesses clay soils to the north and chalk soils on the southern slopes. Again thick colluvium appears to be retained in the tributary valleys with de-calcified colluvium in the main valley. Fields occupy most of the catchment. The Middle Farm colluvial sequence was located in this valley, revealing non-calcareous sediment of Early Bronze Age date in the lower 50cm, with Iron Age colluvium in the upper metre. While this provides some contrast with the colluvial mapping it confirms the existence of deep and ancient colluvium in proximity to Clay with flints. Catchment 3 is surrounded by chalk soils, few fields with de-calcified colluvium in the tributaries and thin chalky soils in the main valleys. The Fordington Bottom colluvial sequence was located in this valley revealing some 50cm of truncated Late Bronze Age to Roman colluvium with relatively thick deposits (over 50cm) of medieval and modern sediment. The presence of non-calcareous colluvium throughout this profile implies local erosion of Clay with flint or drift units which currently exist as a small patch on the slopes directly below the Maiden Castle hillfort.

Catchment 4 is also surrounded by chalk soils, few fields and thin chalky colluvium in the main valley, while catchment 5 has widespread fields in an open chalk landscape with thin calcareous colluvium. The soils and field characteristics of the five catchments at Maiden Castle are summarised below (Table 14).

The only catchment with thick valley soils is catchment 1 just north of Roman Road Ridge. This catchment has ancient fields, and a mix of both clay and chalky and deeper colluvium - a characteristic which seems to match well with the results from the eastern catchments on the Berkshire Downs. Elsewhere in this landscape, colluvial deposits appear to be preserved in the tributary valleys (in catchments 2 and 3) while main valley soils are all thin and presumably truncated. It might be a reasonable suggestion that in the relatively subdued chalk landscapes around Maiden Castle that most valleys would have experienced evacuation of older valley soils, if not during prehistory, then certainly after periods of medieval or later arable intensification. Such a regime might be comparable with the open chalk valleys on the Berkshire Downs in which colluvium was absent. The presence of some of the thickest colluvium in the smaller tributary valleys and in the upper parts of each catchment implies remnant deposits of colluvium otherwise stripped from the lower reaches of each of the open chalky catchments.

If the original Berkshire Downs model were to be applied to the Maiden Castle landscape we might expect to find archaeo-colluvium in catchments 1, 2, 3 and 5, coincident with the presence of ancient fields and erodible chalk soils. If, however, a revised prediction was made based on the actual distribution of colluvium on the Berkshire Downs, then colluvium might be expected only in catcments 1, 2 and part of catchment 3 at Maiden Castle. This appears to be the case with the only substantial valley deposits existing in catchment 1, below Clay with flints on the northern slopes of catchment 2, and at Fordington Bottom. This gives further support to the notion that the preservation of archaeo-colluvium is more common in association with catchments of heavier soils. In the remaining chalky catchments removal of colluvium has been widespread. This adds to a growing number of observations about open chalk catchments and the almost complete evacuation of valley material.

	Catchment 1	*Catchment 2*	*Catchment 3*	*Catchment 4*	*Catchment 5*
Soils	Clay and chalk	Clay and chalk	Chalk	Chalk	Sandy and chalk
Topography	convex	convex	Open	Open	Open
Fields	40%	75%	25%	Nil	50%
Colluvium (cm)	> 80cm	>80cm in tributary valleys	>50cm in tributary valleys	Thin	Thin
Composition of colluvium	Chalky	Non-chalky	Non-chalky	Chalky	Chalky

Table 14 Soils and fields at Maiden Castle

10.6.2 The Stonehenge Landscape

The Stonehenge region (33km^2) is characterised by subdued topography with relief varying between 70 and 150masl. In a landscape of broad open valleys and gently undulating concave slopes, ancient fields occupy mid and upper slopes. Based on colluvial survey within this region it was noted that a busy ancient arable landscape is curiously devoid of valley soils (Richards 1990, 210-211).

The Stonehenge environs report cites the clear evidence, by way of fields, ditch fill and molluscan sequences for ancient tillage but curiously also records an absence of colluvium in the valleys (Cleal *et al.* 1995, 484). Allen in this report suggests it may be due to the greater pastoral emphasis and the prospect that tillage may not have been continual preventing accumulation of eroded soils. He also suggests another prospect, that lack of colluvium may be a product of intensive arable use resulting in flushing out of deposits (Allen 1997b). The evidence from the Seven Barrows region on the Berkshire Downs where soils are also thin both on the slopes and valley floors suggests the latter (Section 10.4.1).

What is notable however is that the colluvial survey in the Stonehenge region was not oriented below any of the field blocks, most of which appear well upslope from the main valleys. Four of the dry valley transects were in the main valley, Stonehenge Bottom, while a further four were in tributary or valley edge sites. Of these, only one or two are (coincidentally) below fields. None of these transects produced colluvium any deeper than 0.4m (Richards 1990, 210-211). The only mention of thicker colluvium is in association with the upper slopes near Kings Barrow Ridge and at Coneybury Hill in an upper tributary valley (Allen 1997b, 134-135) - locations which suggest stranded residual deposits similar to those observed at Maiden Castle. It is difficult to draw any links between Clay with flints which exist at Fargo Wood, Durrington Down and Rox Hill, as colluvium was not investigated within any of the adjacent valleys. Certainly in the open chalk valleys of Stonehenge Bottom colluvium appears to be conspicuously absent.

The presence at Stonehenge of long slopes and open chalk valleys from which colluvial deposits have been uniformly removed compares with the open western valleys of the Berkshire Downs which have a similar absence of valley soils. The Stonehenge landscape however has few Clay with flint cappings which in both the Maiden Castle region and the Berkshire Downs appear to preserve deeper sequences of archaeo-colluvium.

If some of the modified principles of the Berkshire Downs model were applied to the Stonehenge landscape then it is expected that few archaeo-colluvial sites would be predicted within the broad and almost wholly chalk valleys which characterise this landscape. Nevertheless, some small areas which might yield archaeo-colluvium are shown in Figure 92. It was noted that the colluvial survey at Stonehenge investigated some upper valley sites near Durrington Down and Winterborne Stoke which failed to locate substantial colluvial deposits. Some localities near some of the larger field blocks and in close proximity to the small Clay with flint hill-cappings may however repay investigation. These are shown near Rox Hill in the south, below a large block of fields west of the Stonehenge monument and in some of the small tributary valleys on King Barrow Ridge. The discovery of deeper archaeo-colluvium near Coneybury Hill provides some evidence that some of the neighbouring small tributary valleys might also retain colluvium.

An unusual inversion of the colluvial stratigraphy on Coneybury Hill (Allen 1997b), where de-calcified silty material overlies chalky colluvium (containing Iron Age pottery), might be explained by later phases of cultivation of silty soils. The present distribution of Clay with flints lies some 300m to the south of Coneybury Hill.

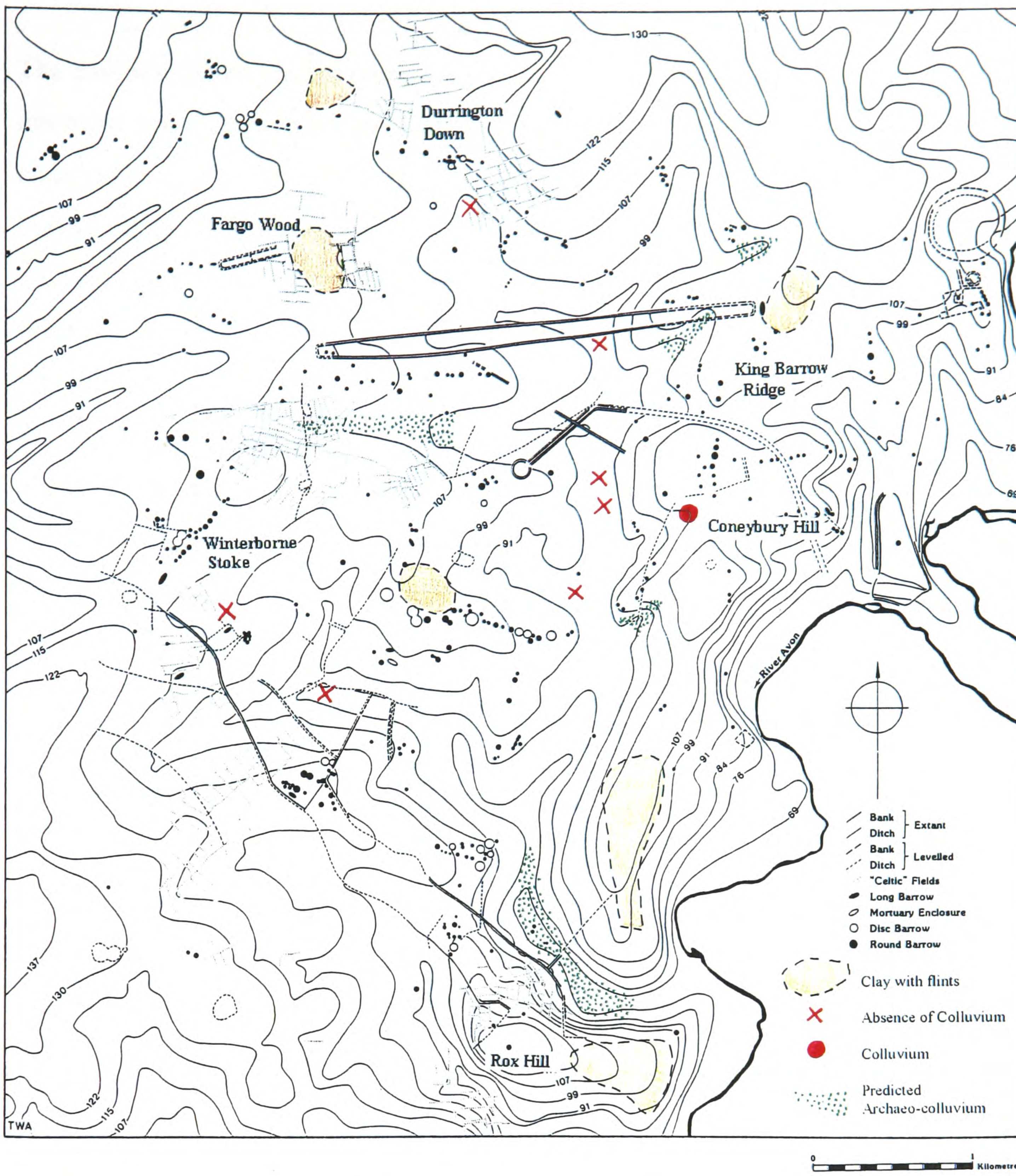


Figure 92 The Stonehenge landscape and colluvial potential

10.6.3 South Downs

There have been no major archaeological landscape projects of the scale and nature of the Maiden Castle study or the Stonehenge Environs project on the South Downs. This region of the Chalkland was however the focus of much of the early colluvial research by Martin Bell, although it is emphasised that research was by and large site specific.

The Bullock Down project represents a small part of the South Downs in which both intensive and extensive archaeological research has been undertaken and from which some observations about landscape, land use and colluvium might be made. Bullock Down is only about 12 km^2 in area but represents a multi-period landscape of ancient fields, archaeology and physical information. Kiln Combe, a site of deep colluvium (Bell 1983) lies in the centre of this region. There is less information about valley soils from Soil Survey maps or colluvial surveys here than for the landscape surveys at Maiden Castle or the Stonenhenge environs, hence estimates about valley soils and colluvial depth have been extrapolated from only a few sites.

The soils and topography of Bullock Down represent a mix of Chalk and Clay with flints - with a greater proportion of clay cappings than at either Maiden Castle or Stonehenge. Fields occupy about 50% of a landscape which is gently undulating and varies in relief from 100-150masl. The South Downs in general have been characterised by Drewett as a marginal landscape based on both intensive and extensive survey (Drewett 1982, 209). The general chronology of settlement and land use has been summarised by Drewett and reflects forest clearance which was perhaps as late as the Bronze Age (Bell 1992; Waton 1982) followed by small episodes of farming during this period. A gap between 1500 and 600BC represents a period of abandonment after which more widespread evidence suggests episodes of Late Iron Age and Roman arable.

The establishment of medieval agriculture in this district in the 13th century is clearly represented in the colluvium at Kiln Combe, and is manifest in relatively thick sequences dated to this period (up to 1m) at both Kiln Combe and Itfield Bottom some 10km to the west. Pits dug in a neighbouring combe at Itfield Bottom also revealed colluvium up to 2m deep. It is notable that there is negligible medieval colluvium on the Berkshire Downs, nor on the broad and open chalk valleys of the Stonehenge landscape.

If some of the observations about colluvial distribution on the Berkshire Downs were translated to the Bullock Down landscape, then colluvium would be expected to be widespread within a setting where Clay with flints occupy such a large proportion of the landscape (Fig 93). This provides a clear contrast with the open chalk landscapes of parts of the Berkshire Downs, Maiden Castle and most prominently the Stonehenge region. The preservation of deep colluvial sequences at Bullock Down might then be attributed to both a less intensive arable prehistory and to larger areas of heavier soils than the other 3 regions. Bullock Down therefore satisfies two of the ingredients which appear to promote colluvial preservation on the Chalkland : a land use regime which begins later in prehistory (sustained by a mix of soil types) and a landscape which is characterised by less erosive Clay and drift soils in which the eroded products seem preferentially preserved.

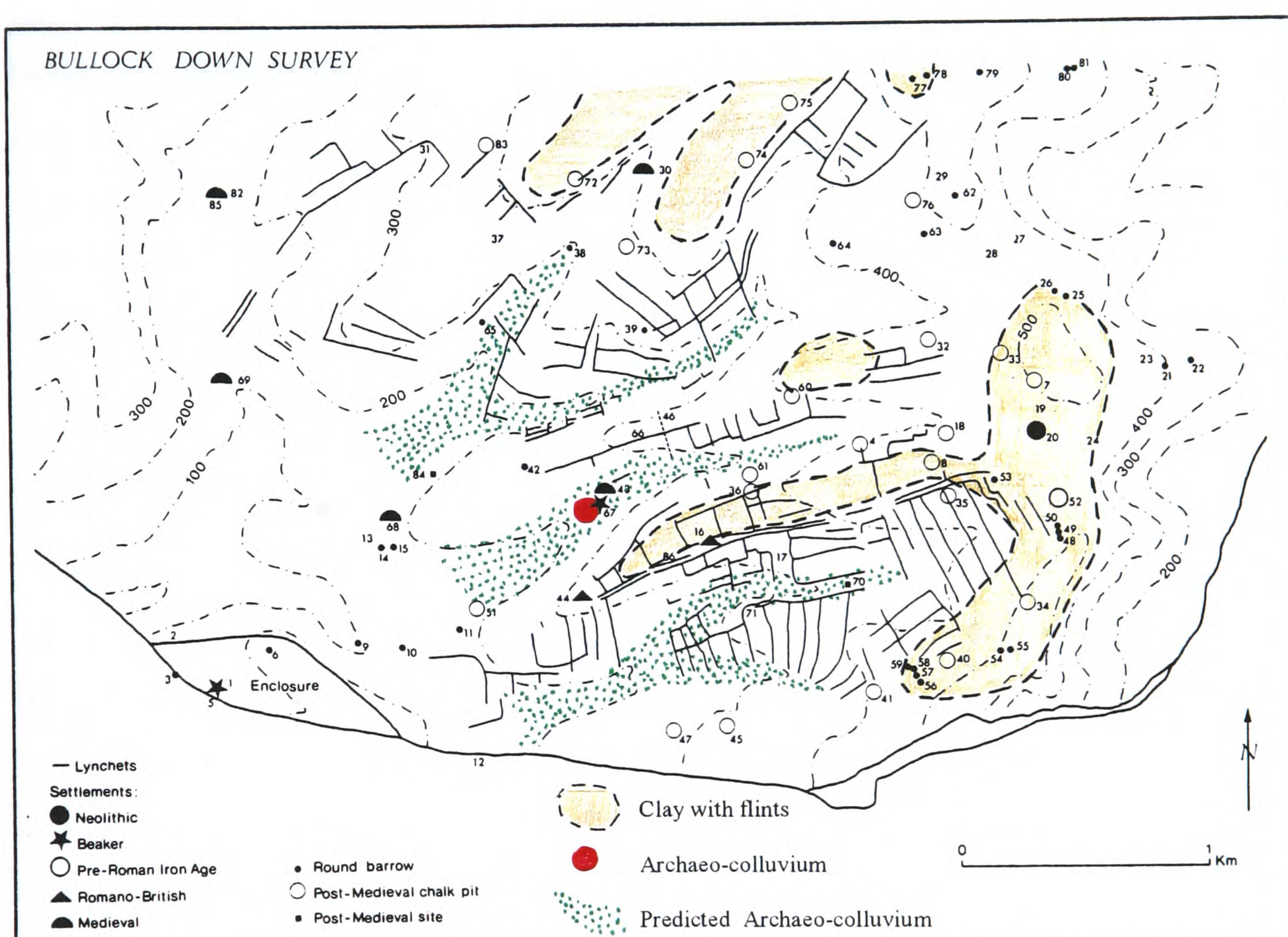


Figure 93 Bullock Down colluvial potential

These are some preliminary observations based on a brief synthesis of landscape, soils and archaeological relationships, limited secondary or site-specific colluvial information in three landscapes in areas for which there has been no colluvial mapping. What is clear is that each of the districts have distinct characters based on a blend of physical setting, development history and most importantly regimes of archaeological and colluvial survival. It is possible however, even at a general scale, to recognise some factors in the spatial distribution of colluvium which appear to be shared by the three landscapes.

The three Chalkland regions against which the Berkshire Downs model was compared offered landscapes of different relief and soil type. The Stonehenge region represented an open landscape of predominantly chalky soils while Maiden Castle and to a greater degree Bullock Down represented landscapes where Clay with flints were common. The presence of archaeo-colluvium in close relationship to the heavier soils in the latter two regions both complies with observations on the Berkshire Downs and is a working hypothesis for locating these valley sediments which (together with some of the other verified parameters) could be extended across other regions on the Chalkland.

10.7 FUTURE WORK

A) The observations which were made at Maiden Castle, the Stonehenge region and at Bullock Down demonstrated that colluvial distribution within Chalkland regions can be linked with some common factors. These were cursory observations and there is considerable scope for developing a revised model which incorporates some of the succesful assumptions such as the significance of Clay with flint and Drift landscapes with some improved terrain information for example. In addition to a programme of ground-truthing some of the prospective sites which were identified in the regions (above), the Danebury landscape, which has some prominent Clay with flint hillcappings would be a suitable pilot area for an extensive trial of an improved version of the predictive model.

B) The loss of colluvium from valleys and truncation of sequences is well documented on the Chalkland (Bell 1986; 1993; Staines 1991, 16). At Maiden Castle loessic material was found within the alluvium of the Frome River and Bell notes evidence of reworked loessic material in ailuvium below Hambledon Hill (Bell 1992, 31). The missing valley soils of the Seven Barrows catchment on the Berkshire Downs and the fate of the colluvium which has been evacuated particularly from the chalk catchments might be investigated by a survey of alluvium of the Lambourn River, below the Lambourn township or as far south as the Kennet River. It is also a prospect that evidence of the earliest loessic forest soils might be found within these alluvial sequences.

C) The use of geophysics to locate prospective thicknesses of lower slope and valley soils holds considerable potential (Greenhouse *et al.* 1994). The resistivity method is being used on a current study to measure depth of valley deposits in Slapton, Wales, by Chappell, N (p. comm) at Leicester University. It would be useful to correlate resistivity profiles for valleys where colluvial depth was known. On the Berkshire Downs, transect 1A and transect 6A would offer suitable valley profiles for such an exercise. The flinty nature of most of the colluvial sediments and the absence of distinct textural-conductivity boundaries between the base of the colluvium and the underyling chalk regolith or drift material might however prevent a clear conductivity boundary.

D) The rubbly valley soils also seem to present too many problems for Optically Stimulated Luminscence to be recommended as a useful dating technique on calcareous dry valley soils. The use of OSL in this project was experimental and the overall conclusion is that it is not suitable in this type of setting. Some techniques however are emerging for improving the success-rate of dating dry valley sediments, which involve more effective methods for feldspar recovery and washing than were used by this project. It is also notable that where preparation problems exist, the effectiveness of OSL work on the chalk might be improved by taking larger samples (E. Rhodes p.comm.). There are other techniques for isolating felspars which do not rely on sediment fractionation. One of these employs hydrogenated water to which felspars adhere, allowing it ti be separated from quartz. It has also been suggested recently that much of the masking of felspars is the product of iron-oxide coatings, a problem which has been successfully solved using dithionite acid. This has been effective in a number of studies where HCL and C_2CO_2 treatment failed to produce an IRSL signal. These are some methods for better sample preparation of fine-grained sediments which are currently being investigated.

E) An exercise in which groundwater change is modelled to estimate possible water-table rises would be useful in reconstructing, not only regimes of colluvial preservation within Chalkland valleys, but also more general issues of settlement, ritual activity and survival of archaeological material within zones of springline advance and retreat. It was suggested in this project that sites which are upstream of the present stream discharge zone at Lambourn may have been active discharge areas in prehistory. It has already been shown that a number of the physical and land use parameters for water-table modelling on the Chalkland have already been assembled in the work of Finch *et al.* (1999) in the Pang catchment, just south of the project area. The integration of archaeological information would allow the development of a hydrogeological model which estimates water-table heights at different periods of pre-history, during different climatic stages and under different regimes of vegetation and land use.

CHAPTER ELEVEN

SUMMARY

The Berkshire Downs offered an ideal study area with both open chalk and more dissected drift and clay capped valleys within a landscape of widespread prehistoric and Romano-British arable activity. Colluvium of any age or origin was previously unknown in the valleys of this region. The model provided evidence that it existed, was ancient and was distributed variably across the region. The results from a survey of soils and sediments within these dry valleys proved that a strategic approach can assist in locating this class of deposit.

The components of the colluviual prediction took evidence of past agricultural activity, the nature and extent of which was defined by traces of ancient field systems, incorporated assumptions about ancient erosion and drew relationships between these as sources of ancient erosion and the soils and landforms of the modern landscape. In a multi-disciplinary approach, a computer-based assembly of physical information, past and present land-use regimes, settlement patterns and erosion processes at catchment-scale were integrated at a level of resolution from which the general pattern of archaeo-colluvium might be predicted and investigated. This was achieved with some success supporting the notion that these deposits might be linked to the sites of ancient cultivation. At a general resolution, the results from soil investigation, test trenching and sediment dating proved the existence of archaeo-colluvium at 71% of the predicted sites.

It was clear in some parts of the project area that the model failed. The field-checking programme revealed several factors in the distribution of archaeo-colluvium which were not considered by the model. This was especially true in the east of the study area where the mix of soils and topography conformed poorly with inherent assumptions about sediment distribution and dry valley asymmetry. The most notable of these factors was the association of colluvium and the heavier soils. As part of the modelling process these observations provided feedback and some modified principles which were briefly tested elsewhere on the Chalkland.

The programme of field checking on the Berkshire Downs revealed that colluvium was thicker from the west to the east across the region, distributed according to the pattern of ancient fields though modified by local soil, valley shape and aspect conditions. These variably truncated deposits can be used to imply both the processes of formation and preservation as well as the archaeological implications such as broad land use chronologies. The catchments where colluvium has been almost completely removed appear to be the wide chalk valleys to the west of the project area. Conditions under which colluvium has been preserved appear to be the more dissected catchments occupied by Clay with flints in the eastern part of the project area. Removal during periods of high water-tables was suggested to play a significant role in regimes of preservation. The role of groundwater fluctuation and water-table change with different land use and climatic regimes on the Berkshire Downs presents considerable potential for further investigation, not only of colluvial preservation but wider issues of archaeological settlement and survival of remains across the Chalkland.

While the accuracy of colluvial prediction proved encouraging, the wider implication of the distribution of archaeo-colluvium on the Berkshire Downs is that these deposits are certainly extensive enough across the valleys of the project area to assume that soil loss and erosion generated from arable fields was a phenomenon of both prehistoric and Roman times. The remnant deposits however have clearly been truncated and in some sites almost completely removed making it difficult to quantify soil losses or speculate about some of the earliest soil cover or periods of land use. The presence of silty de-calcified sediments in several valleys did however provide sufficient evidence of soils which preceded the present thin and calcareous cover.

A synthesis of archaeological features, the present physical setting and the distribution of archaeo-colluvium suggests a chronology of development for this part of the Berkshire Downs as follows : The Seven Barrows cemetery and surrounding catchment with a general absence of ancient fields, thin stony soils and absence of valley sediments implied earliest arable use. The catchment to the west, centred around Maddle Farm has widespread fields which on patchy chalk and drift deposits have left a sporadic distribution of thicker valley edge and thin valley-floor sediments. The presence of field blocks and Late Bronze Age settlements implies later prehistoric arable use, though the villa site at Maddle Farm and large adjoining blocks of elongated fields show that the lower part of this catchment was extensively cultivated during the Roman period.

The extensive use of small, cultivated fields in valleys on either side of the Seven Barrows catchment reflect widespread land division. On the Berkshire Downs it is worth considering that the use of fields may also imply the adoption of better soil conservation methods learnt as a consequence of earlier soil losses and abandonment of Seven Barrows.

In catchment 4, centred around Stancombe Farm there are much thicker sequences of preserved colluvium in a catchment occupied by large blocks of ancient fields. The absence of Neolithic features provides some *prima-facie* indication, together with, at earliest, Iron Age archaeology from colluvium and lynchets for the later use of this catchment. While Bowden *et al.* (1991b) suggests a Roman date for the fields across the Berkshire Downs, there is sufficient doubt, by way of large numbers of prehistoric and undiagnostic sherds in the lowest levels of many of the trench sequences in this study for such a conclusion to be reviewed. Further east on the more symmetric valleys of mixed chalk and heavier soils, colluvium is relatively thick although there was no evidence (aside from some small blocks of fields) of any prehistoric activity in this part of the project area.

The use of GIS and to a greater extent the use of OSL were experimental methods employed by this project which proved of mixed success. The choice of OSL to date colluvial sediments is a method which is relatively new to prehistoric settings in Britain. Prior to this project OSL had few successes in Chalkland settings. The results from the Berkshire Downs do not significantly improve this status. The fact that only four dates on the project area were achieved was due to difficulty in sample preparation and insufficient sediment bleaching. There is a strong element of trial in OSL work with the ever-present prospect that any sample may not be fully bleached. The processes under which colluvial deposits accumulate would seem to pre-dispose these deposits to non or partial bleaching, though clay and carbonate content was a major hindrance to sample preparation. A successful distinction was made however between de-calcified sediments for which dating was possible and chalky sediments which all failed. This substantial finding would certainly assist with a more targeted sampling strategy in dry valley landscapes in the future.

The significance of the drift, Clay with flint and superficial units on the Chalkland as repositories of archaeological material, otherwise swept away or chemically dissolved from the adjoining highly erodible chalk surfaces has implications for archaeological prospecting and the interpretation of archaeological survival. The work of Julie Scott Jackson (1998) also found that these superficial hill-cappings preserve Palaeolithic tools in discrete sediment traps. Rather than considering them to be areas which were avoided, it was one of the conclusions of this project that they offer potential windows of preservation in a landscape which is uniformly poor in archaeological survival.

The use of GIS in this project was indispensible as a tool for handling the multiple tasks demanded by model preparation and development. For the most part, the issues of resolution, contour interpolation and idealogical shortcomings were less significant in a project which took a sub-regional focus. A future colluvial model on the Berkshire Downs might however choose a simple hydrologic terrain model which incorporates catchment morphology, size, convexity, concavity and slope length for example. This would improve on reliance on the rather inflexible 500m and 200m buffer zones as sediment source and receptor areas. An example of a model which integrates contour information and produces a map of valley slope-length is "Updrain" (Van Oost *et al.* 1998). A brief trial of this model, which incorporated the colluvial results from the Berkshire Downs showed rather indistinct correlation between some of the longest slopes and colluvial distribution.

The methodology and conclusions which were reached about colluvial distribution on the Berkshire Downs were taken to three other well-studied archaeological regions on the Chalkland. Although some colluvial information was available in these regions, a cursory reconnaisance-scale integration of landscape, soils and dry valley information was made and prospective colluvial sites were defined. This exercise was largely theoretical aimed at testing the Berkshire Downs model and identifying potential targets for colluvial investigation in similar Chalkland settings. This exercise revealed a number of factors of colluvial formation and preservation common to all regions, again notably the relationship of heavier soils with thicker colluvial deposits. Once again this re-inforces the observation that the valleys within superficial clay and drift settings offer considerable potential as prospective colluvial sites.

What might be said in summary, is that the patchy and truncated colluvium provides useful information about the earliest age of land use in the various catchments of the project area. The thickness of the deposits however when viewed in conjunction with local soil and topography says more about preservation conditions. This however is very useful in modifying a predictive model which might account for variable preservation, a feature of colluvial prediction which was considered difficult to account for in previous studies. Such observations also emphasise the importance of integrating both valley and catchment-wide soil and geomorphic processes in the reconstruction of past landscapes.

The combination of ancient processes, linked to the present landscape by some simple observations and assumptions, has been a step toward better understanding of the distribution of these relict deposits. The balance between local precision and landscape variation during the course of the project was often difficult, as was the mix of a range of disciplines from which information was available at various scales and levels of accuracy. Nevertheless, as was discussed above, some of the local patterns appear to find support from a cursory examination of wider ancient arable landscapes in Southern Britain.

A closer focus on the archaeology has revealed that the Chalkland of Southern Britain is more characterised by localised settlement and development trajectories. The emphasis on environmental data and particularly the role of soils and landforms in the survival of remains at this scale has critical relevance for understanding landscape change and the impact of human activity. It would appear that the potential of colluvium as repositories of otherwise obscured or buried archaeological and environmental information is beyond doubt. Some encouragement that these deposits might be located within some of the archaeological landscapes of Southern Britain has been offered by this project.

In many of the districts of the Chalkland, paucity of material evidence is a pervading feature. The study of the distribution of archaeo-colluvium has demonstrated the potential to remedy this deficiency by predicting and locating otherwise obscured valley sequences which can be linked to ancient activity. The benefit is that the patchy and apparent unpredictability these sediments can be partly explained in terms of some simple land use and soil parameters. This project represents a first attempt, the extension of which will lead to the improved targeting of these potentially rich archives and further elucidation of some of the enduring archaeological gaps on the Chalkland.

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APPENDIX 1(A)

Summary of Trench pottery finds

TRENCH NO.	COLLUVIAL COMPOSITION	Pottery Horizontal co-ord (cm)	Vertical (depth) cm	Pottery date	OSL co-ords.	Comments
1B	Shallow calcareous	50	36	Roman		Roman grey ware piece
		154	33	Roman		Dark rim in basal flints
		272	23	Roman		Roman grey ware
	OSL sample				35/26	
1E	De-calcified silty clay	100	24	Roman		Roman tile
1G	Deep chalky fill	75	35	Roman		Tile piece
		32	92	Iron Age		Med. Fabric, black flint and sand tempered ware
		16	110	Iron Age		Rim, fine sooty fabric tempered with organic matter and flint
1I	De-calcified silty clay OSL sample	40	50	Iron Age	30/46	Coarse ware, flint and sand tempered.
4C	Shallow calcareous	20	25	LIA-Roman		Pot fragment
		28	29	Roman		Beige fine ware
		52	28	Roman		Black rim, long
		55	38	Roman		Samian ware
		78	33	LIA-Roman		Black coarse ware
		100	37	Roman		
		136	24	Roman		Red slip ware?
		130	35	Roman		Roman New Forest ware
	OSL sample				150/31	
		159	28	Roman		Red pot
		169	33	Roman		Roman grey ware
		180	41	Roman		Roman pot fragment
		196	37	Iron Age		Small black gritted
	OSL sample				197/20	
		225	40	Roman		Nail
		227	42	Mid Iron Age		Coarse gritted fabric, flint tempered.
		207	28	Roman		Roman black pot fragment
		254	42	Roman		Red pot
		257	39	Roman		Red/pink fine ware
		272	37	LIA-Roman		Pot fragment, flint tempered.
		280	34	Late Roman		Black pot fragment
		304	36	Roman		Beige fine-ware rim
		313	25	Roman		Roman pot fragment Rim
		317	35	Roman		Roman boot hobs
		317	36	LIA-Roman		
		346	35	Roman		Black pot fragment
		346	42	Roman		Roman grey ware
		352	40	LIA-Roman		Black pot fragment
		355	38	Roman		Roman grey ware rim
		355	22	Roman		Red/pink fine ware
		355	24	Roman		Roman New Forest ware
		390	25	Roman		Roman grey ware base

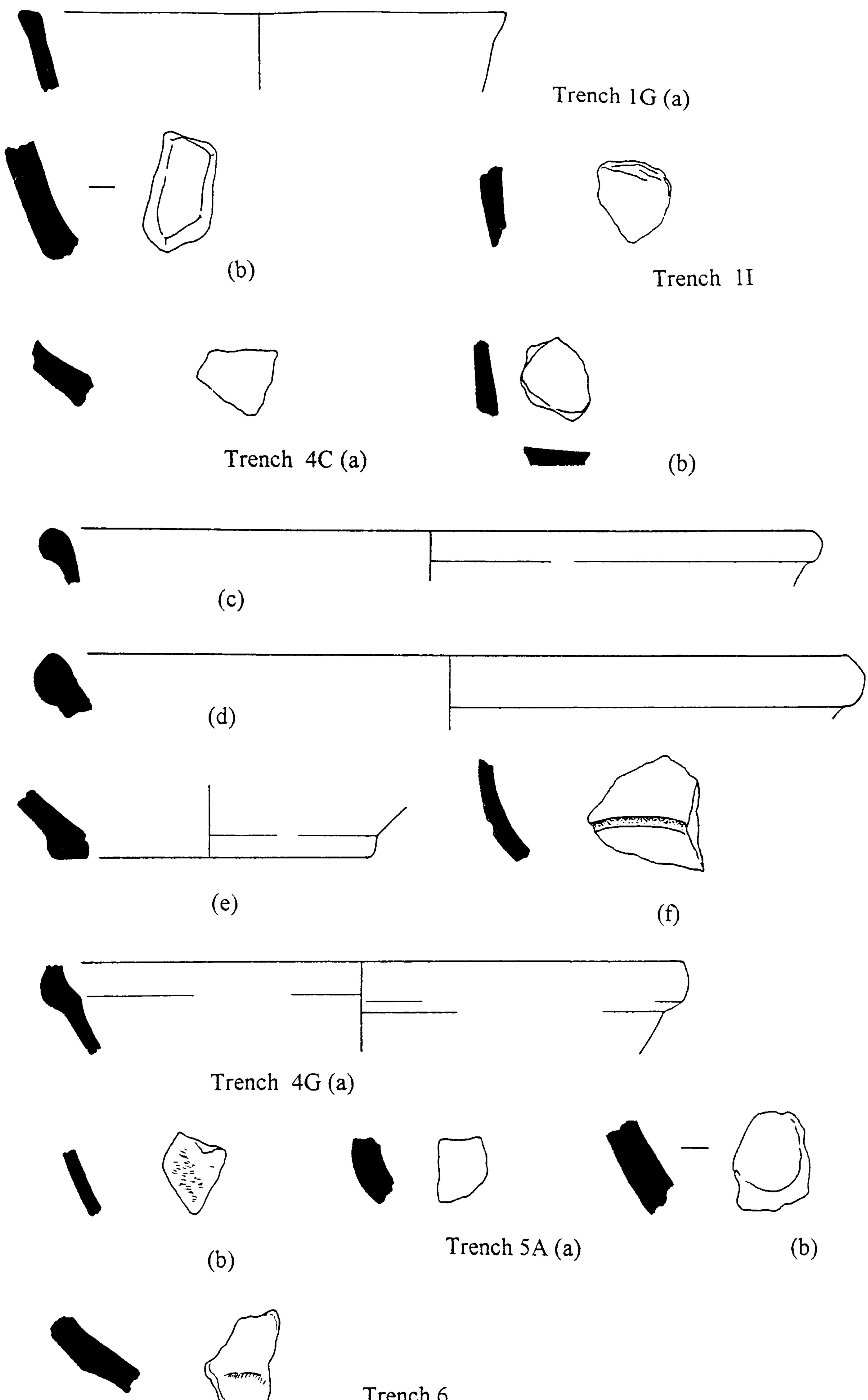
TRENCH NO.	COLLUVIAL COMPOSITION	Pottery Horizontal coord (cm)	Vertical (depth) cm	Pottery date	OSL co-ords.	Comments
4E	Shallow calcareous	47	35	Roman		Roman tile
		180	20	Roman		Thick rim fine ware.
		195	46	Roman		
		210	38	Roman		Roman tile
4G	De-calcified flinty	175	40	LIA-Roman		Cordon, shoulder piece with small groove. Sand and flint tempered.
		178	47	Mid-IA		Reddish thin flint tempered pot fragment
		130	22	Roman		Roman tile fragment
	OSL sample				178/47	
	OSL sample				150/60	
4I	Calcareous flinty	95	25	Roman		Roman grey ware
		87	35	Iron Age		Black sooty fabric, white inclusions
	OSL sample				87/35	
5A	De-calcified silty-flinty	95	55	Mid Iron Age		Black sooty glauconitic sand fabric.
		98	39	Roman		Roman grey ware
		50	38	Mid-LIA		Coarse brown fabric, sand and grog tempered.
	OSL sample				95/55	
5B	Shallow calcareous	110	32	Roman		Roman tile
6	De-calcified silty clay	114	47	Roman		Pot fragment
		288	31	Roman		Pot fragment
		276	50	Roman		Nail
		220	31	Roman		Roman grey ware
	OSL sample				10/80	

TOTAL 54 finds 40 Roman 14 Prehistoric 10 OSL sites

APPENDIX 1 (B)

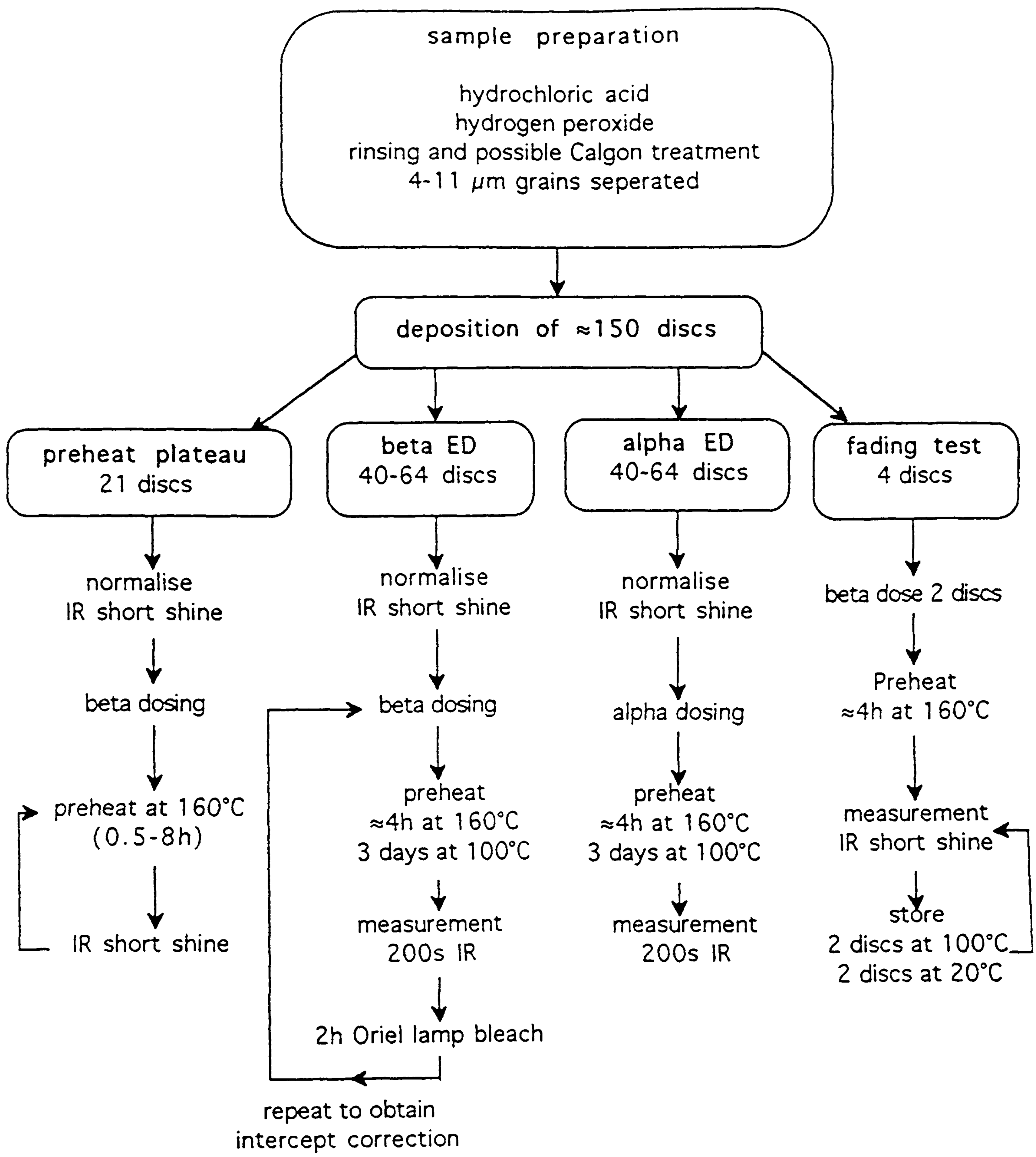
Key to drawings

1	Trench 1G	(a)	32 - 92cm deep	Late Iron Age
		(b)	16 - 110cm deep	Iron Age
2.	Trench 1I		40 - 50cm deep	Iron Age
3.	Trench 4C	(a)	227 - 42cm deep	Mid Iron Age
		(b)	352 - 40cm deep	Late Iron Age
		©	304 – 36cm deep	Roman
		(d)	313 - 25cm deep	Roman
		(e)	390 - 25cm deep	Roman
		(f)	355 – 24cmdeep	Roman
5	Trench 4G	(a)	175 - 40cm deep	Late Iron Age
		(b)	178 - 47cm deep	Mid Iron Age
6	Trench 5A	(a)	50 - 38cm deep	Late Iron Age
		(b)	95 - 55cm deep	Mid Iron Age
7	Trench 6		114 - 47cm deep	Iron Age-Romano-British



Pottery sherds (selection) from colluvial trenches

APPENDIX 2 (a) OSL METHOD



. Sample preparation and measurement procedure used for fine grain IRSL dating.
(From Rees-Jones 1996)

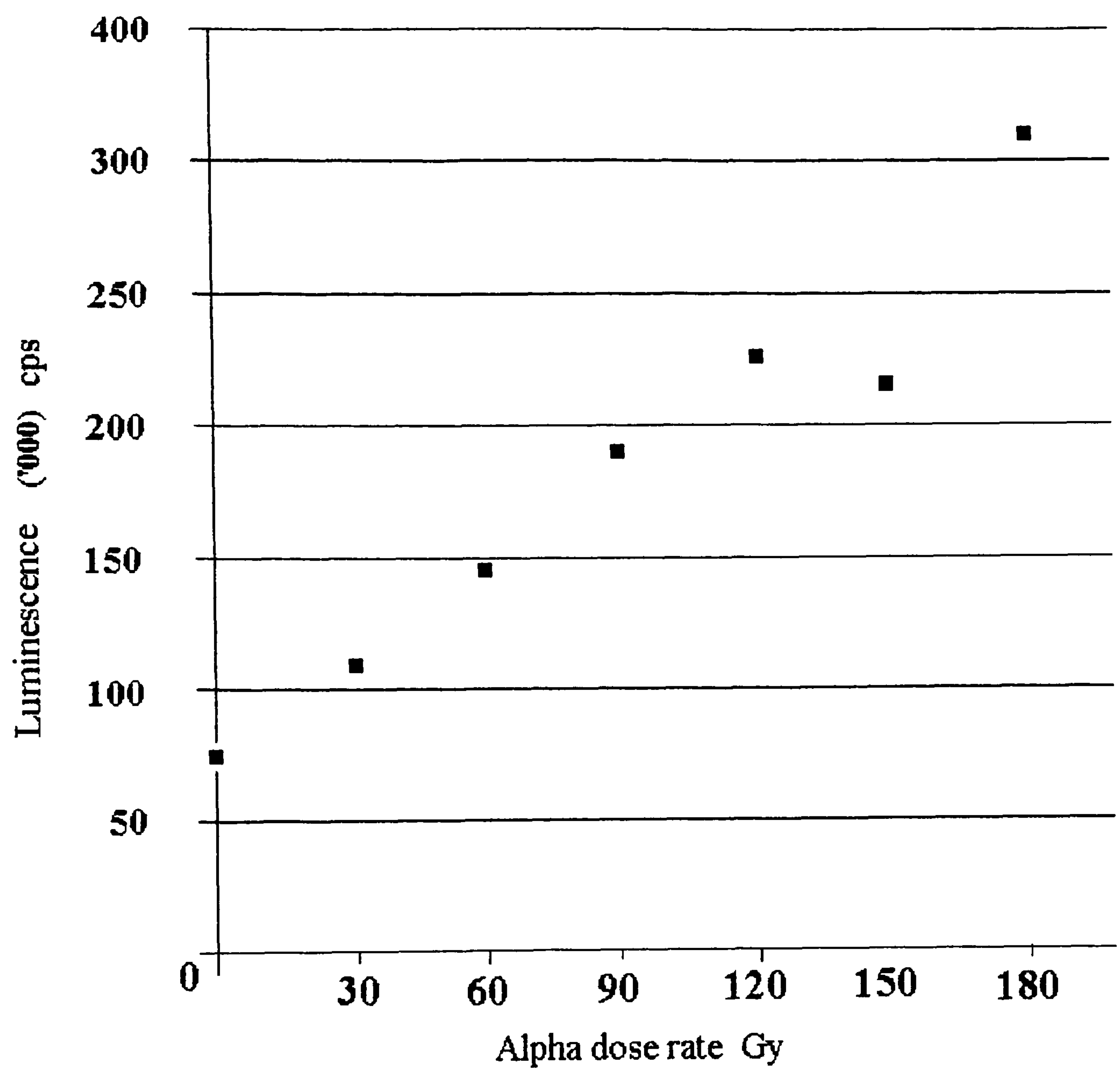
APPENDIX 2 (b) TRENCH 5A FINAL DATE CALCULATION (INPUTS)

DOSE RATE MEASUREMENTS FOR FINE GRAINED IRSL SAMPLES

Sample number	**Trench 5A**	
Beta Ed	6.82	
Beta Ed error	0.123	
Alpha ED	52.7	
Alpha Ed error	1.04	
Intercept correction	2.42	
Intercept error	0.0856	
W measured	1.022	
F measured	0.11	
F to use in calculation	0.8	
Gamma spec. Beta(Th, U)	0.356	
Error on Beta Th, U	0.019	
Gamma spec. Beta(K)	0.484	
Gamma spec Gamma(except cosmic)	0.588	
Error on gamma	0.026	
Cosmic	0.174	
Th ppm	6.6	
Error on Th ppm	0.33	
Uppm	1.6	
Error on U ppm	0.176	
a value	0.13	
Error on a value	0.003475	
K20% (FPH)		
BETA DOSE RATE (Th, U) (gs)	0.201	0.201
BETA DOSE RATE (K) (gs)	0.273	0.273
BETA DOSE RATE (Th) (ICPMS)	0.098	
BETA DOSE RATE (U) (ICPMS)	0.119	
BETA DOSE RATE (K) (FPH)	0.000	0.273
ALPHA DOSE RATE (Th) (ICPMS)	0.285	0.285
ALPHA DOSE RATE (U) (ICPMS)	0.260	0.260
GAMMA DOSE RATE (Th) (ICPMS)	0.171	
GAMMA DOSE RATE (U) (ICPMS)	0.091	
GAMMA DOSE RATE (K) (FPH)	0.000	
TOTAL BETA DOSE RATE (gs)	0.474	
GAMMA DOSE RATE (gs)	0.343	0.343
COSMIC DOSE RATE (gs)	0.174	0.174
TOTAL BETA DOSE RATE (ICPMS)/(FPH)	0.217	
TOTAL ALPHA DOSE RATE (ICPMS)	0.545	
TOTAL GAMMA DOSE RATE (ICPMS)	0.262	
Fractional component of alpha from Th		0.185657
Fractional component of alpha from U		0.169083
Total fractional component of alpha		0.35474
Fractional component of beta from Th,U gs		0.130728
Fractional component of beta from K (gs)		0.177731
Total fractional component of beta		0.30846
Fracctional component of gamma		0.223523

Fractional component of cosmic	0.113278
TOTAL DOSE RATE Gy/kyear	**1.536**
ERRORS	
ED errors	6.038479
Th/U dr errors	4.320994
K dose rate errors	0.789712
Gamma spec gamma errors	2.865084
Gamma spec beta errors	1.530023
Total dose rate error	9.505813
Calibration errors	10.22114
Water uptake errors	23.96591
Total error	24.49755
AGE	**2864.495**
Error on age	701.7311

APPENDIX 2 © TRENCH 5A DOSE RATE CURVE



OSL site T5A Additive Dose Curve