

Neolithic occupation and stone working on the Yorkshire Wolds

John Pouncett

St John's College

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Abstract

This thesis explores the evidence for Neolithic occupation and stone working on the Yorkshire Wolds based on stray finds and lithic scatters from surface contexts. Traditional models for Neolithic occupation are based largely on evidence from excavated contexts, in particular the groups of Neolithic pits at Rudston, and Neolithic houses on the Holderness coast. Extensive scatters of worked flint, however, have been identified on the Yorkshire Wolds. These scatters have not been incorporated into accounts of Neolithic occupation for two reasons: 1) the lithic scatters are typically characterised by low-densities of artefacts, and; 2) the scatters typically contain few artefacts which are typologically diagnostic. A methodology that addresses both of these problems was developed, using: 1) an implementation of Tobler's resel-based GIS to apply focal functions/spatial filters to polygon features in order to identify spatial patterning in survey data characterised by low-densities of artefacts, and; 2) a method for assigning dates to stone tools and lithic debitage using artefact scores based on diagnostic traits identified through the analysis of lithic assemblages from excavated contexts. The methodology was developed using case studies drawn from a study area centred on the parish of Fimber that had previously been investigated in the nineteenth century by J.R. Mortimer. Analysis of lithic assemblages from sixteen of the Neolithic burial mounds excavated by Mortimer and a surface scatter at Wharram-le-Street close to the former source of the Gypsey Race was carried out. This analysis indicates that traditional models of Neolithic occupation based on a distinction between the High Wolds and Low Wolds cannot be sustained on the basis of evidence from surface contexts and that Neolithic stone working traditions on the Yorkshire Wolds were constrained by the nature of the raw materials available to local communities.

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Neolithic occupation and stone working on the Yorkshire Wolds

Whilst there has been a growing realisation that prehistoric monuments were built within an inhabited landscape (c.f. Barrett, Bradley, and Green 1991; Tilley 1994), little emphasis has been placed on the routine activities implicit within that landscape that can be identified through the analysis and interpretation of lithic scatters. These scatters are frequently part of a more extensive multi-period surface spread, the complexity of which, until recently, has presented an insurmountable barrier. Discussions of the prehistoric landscape have been dominated by the study of monumentality and associated ceremonial activity (Pollard 1999). Although evidence for contemporary occupation in the form of domestic structures is limited, extensive traces of occupation have been identified in many regions through surface survey (Schofield and Humble 1995). Despite the biases inherent within distributions of artefacts from surface contexts, lithic scatters represent an unparalleled data set for the study of the inhabited landscape. The interpretative potential of lithic scatters has long been recognised; however analysis has tended to be highly reductive (both spatially and temporally) and this potential remains largely unfulfilled (Schofield 1995).

The significance of the archaeological resource represented by lithic scatters was highlighted by the *Lithics Scatters Project* (Schofield 1994, 1997, 2000a, 2000b). This project was a joint initiative between the Monument Programme and the Central Archaeology Service. A total of 3,290 lithic scatters (defined as two or more stone artefacts from the same locality) was identified from the four counties included in the project, namely Buckinghamshire, Cornwall, Oxfordshire and West Yorkshire. Approximately two thirds of these lithic scatters could be dated through the presence of chronologically diagnostic artefacts (Schofield 2000b). Most notably, 340 lithic scatters containing only Neolithic artefacts were identified within the four counties, suggesting a figure of over 4,000 nationwide. This figure has been contrasted with the number of locations where Neolithic buildings have been recorded, only two of which lie within the counties included in the *Lithics Scatters Project*, and it has been observed that "... in understanding Neolithic settlement, these data must be significant and we should do all we can to read them effectively" (Schofield 2000b, 50).

The interpretative potential of surface lithic scatters has been highlighted by recent studies of the prehistoric landscape. Extensive scatters of worked flint, for instance, were recovered and assessed as part of the *Stonehenge Environs Project* (Richards 1985; Richards and Allen 1990). The results of surface survey were also included in accounts of the prehistoric settlement of Cranborne Chase (Barrett et al. 1981; Gardiner 1987; Barrett, Bradley, and Green 1991). In the second instance, emphasis was placed upon the analysis of material held in museum collections and collected as part of previous survey work. Where site-specific field walking surveys have been carried out to supplement existing data, intensive sampling strategies have usually been employed to address particular research questions. The collection strategies employed at North Dale and South Landing in East Yorkshire, for example, were designed to investigate the production of specialist artefacts during the Late Neolithic (Durden 1996). In contrast, collection strategies employed in the Cambridge Fens have been concerned with much broader questions about the complexity of lithic scatters and the nature/extent of the activities that they represent (Edmonds, Evans, and Gibson 1999).

Recent discussion of surface survey has highlighted the need to develop theoretically informed methodologies and contextual approaches to the analysis of lithic scatters, for example, have been advocated in response to perceived inadequacies in off-site analysis (Brown 1995). In this thesis the concept of *chaînes opératoires* has been employed in order to enable the reconstruction of taskscapes through consideration of the spatial organisation of stone working. Within this framework, technological analysis has been used here to split a lithic scatter into its constituent elements. Analysis of the metrical and morphological attributes of lithic debitage can be used to identify discrete stone working traditions (c.f. Brown 1991), which, with reference to comparative material from excavated contexts, can be used to introduce temporality into the distribution of lithic artefacts. Isolation of groups of artefacts which are broadly contemporary with one another can enable identification of the activities which are represented with a lithic scatter. Consideration of the spatial organisation of these activities, together with other evidence for past human activity, can in turn inform understandings about the nature of the inhabited landscape.

The complex taphonomic processes that have resulted in the formation of lithic scatters have presented a problem for many archaeologists. However, the impact of post-depositional processes, including erosion (Bell 1983; Bispham, Swift, and Wolff 2008), slope (Allen 1991; Boismier and Reilly 1988) and ploughing effects (Boismier 1997; Taylor 2000), on the visibility,

preservation and spatial distribution of artefacts from surface contexts has been thoroughly documented. These studies have demonstrated that, despite extensive disturbance, the distribution of artefacts from surface contexts maintains its overall spatial integrity. Excavation and geophysical survey on the Dorset Cursus have also highlighted the relationship between surface artefacts and sub-surface features (Bradley 1987). Lithic scatters would therefore appear to represent a viable dataset for the study of the inhabited landscape. Analysis of the spatial structure of lithic scatters has been dominated by intra-site and inter-site approaches. Whilst operating at different scales, both approaches maintain that the distribution of surface artefacts is indicative of the spatial patterning of past human activity. Interpretation of this activity must be tempered by an understanding of the context within which deposition of the material took place, as well as the post-depositional processes that have subsequently impacted upon the distribution of artefacts.

Intra-site analysis has typically been carried out at the level of an individual site. Observations at this level are problematic: the notion that the spatial distribution of artefacts at an archaeological site will be preserved as was (the *Pompeii premise*) is highly contentious (Binford 1981); and, secondly, localised spatial patterning associated with individual hearths or clusters of knapping debris will be rapidly lost through ploughing. Routine activities such as middening or pit-digging would appear to have played an important role in the creation of a sense of place during the Neolithic, demonstrating a long-term commitment to a particular locale (Garrow 2007; Harding 2006; McFadyen 2006; Pollard 1999). Where exposed on the surface, material from individual episodes of activity will coalesce resulting in the formation of an aggregated scatter of artefacts comparable to that associated with the Late Neolithic occupation site excavated along the line of the West Kennet Avenue (Smith 1965; Pollard 2005). Despite the loss of fine-grained spatial information through ploughing, localised concentrations of artefacts have also been identified within scatters of worked flint from surface contexts. Two discrete knapping clusters thought to correspond to specialist workshops, for instance, were identified at North Dale on the Yorkshire Wolds through surface survey (Durden 1994, 1995, 1996).

Inter-site analysis has typically been carried out at the level of the geographic region. Ethno-archaeological studies of Nunamiut Eskimo settlement mobility have identified regional settlement patterns, typically differentiating between residential base camps and seasonal or temporary sites (Binford 1978). Within this framework, particular locales are often associated

with specific tasks such as hunting or butchery. These activities are embedded within annual or seasonal routines that would have incorporated aggregation sites where individual settlement units both gathered and interacted. Although stone working is embedded within these routines, seasonality is often tied to the exploitation of economic resources (c.f. Mellars and Andrews 1987) and is therefore difficult to identify within lithic assemblages from surface contexts. Marked differences, however, can be seen in the repertoires of artefacts recovered from extraction sites and areas of domestic activity. Analysis of lithic scatters recovered from the immediate vicinity of the Mesolithic site at Star Carr, for example, has suggested that particular locales were associated with testing flint nodules to the exclusion of other activities (Conneller 2000a). Overlapping seasonal routines have also been cited as a possible mechanism whereby specialist artefacts such as Group VI axes from Great Langdale were circulated during the Neolithic (Bradley and Edmonds 1993).

Understanding of the scales at which human activity takes place is fundamental to the development of appropriate sampling strategies for the study of lithic scatters. Whilst the probability of detecting lithic scatters using different sample strategies or configurations of collection units can be assessed statistically (Sundstrom 1993), archaeologists have struggled to reconcile the need for both coverage and intensity. Reductive analysis, with discussion of regional settlement patterns on the basis of the presence or absence of chronologically diagnostic artefacts, has predominated where material can only be located to a particular field or locality (c.f. Arnold et al. 1988). Where more intensive survey has been carried out, 'off-site' approaches have been employed to identify differential spatial patterning in the distribution of lithic artefacts from surface contexts (c.f. Foley 1981a, 1981b). Both approaches, however, make a differentiation between 'sites' and the general background scatter. They are based on the definition of a site as a discrete, often high-density, cluster of artefacts. However, recent surveys have shown that lithic scatters often form part of a much more extensive spread of surface material (e.g. Edmonds, Evans, and Gibson 1999).

Lithic scatters have been characterised either as 'sites' with one dimension missing (Bradley 1987) or as a palimpsest of traces of past human activity (Edmonds, Evans, and Gibson 1999). At first glance, these two descriptions appear contrary to one another – the first recognises that the context from which the artefacts were derived has been destroyed by the action of the plough, resulting in the loss of any (vertical) stratigraphic relationships, whilst the second surmises that two or more successive episodes of deposition may be represented in an

artefact scatter, identifiable through differentiated (horizontal) spatial patterning. Both, however, acknowledge the temporality implicit in the distribution of artefacts within a lithic scatter – one outlining a problem, the other presenting a potential solution. The notion of temporality has been brought to the fore by recent discourse on prehistoric society (e.g. Gosden 1994; Thomas 1996). Temporal rhythms are inscribed in the landscape through cumulative or repeated patterns of activity (Ingold 1993). However, these rhythms are structured differently according to the context in which that activity takes place. An understanding of the various temporal structures represented in settlement practices, ceremonial activity and domestic routines is therefore required (Bradley 1991).

Models of settlement practice reflect a gradual transition from episodic or seasonal migration during the Mesolithic to continuous, but not necessarily permanent, occupation in the Bronze Age. Three models have predominated, namely seasonal transhumance, periodic shift of settlement locale and full sedentism (Pollard 1999). Seasonal transhumance, typically involving the movement of people and animals between upland and lowland regions or along river valleys, implies a high degree of fluidity. In contrast, periodic shift of settlement locale suggests a greater degree of continuity, with the repeated re-use of particular locales through time (c.f. Tilley 1994). Settlement practices may be differentiated by the longevity of the use of a locale. Mesolithic sites, for instance, tend to be used over a much more protracted time-scale than their Neolithic counterparts. Calibrated radiocarbon dates from Star Carr indicate that the site was used on a seasonal or episodic basis over a period of approximately 800 years (Milner et al. 2018). Full sedentism, on the other hand, implies long-term continuity and is often associated with the establishment of enclosed settlements. Nucleated settlements are incorporated into the systems of land division which were established from the Middle Bronze Age onwards (Fleming 1988; Bradley, Entwhistle, and Raymond 1994; Fenton-Thomas 2003).

Prehistoric monumentality is also intrinsically linked to notions of temporality. The development of monument complexes, such as that at Dorchester-on-Thames (Bradley and Chambers 1988), demonstrates a long-term commitment to particular locales, both reflecting an element of forward planning and making references to what had gone before (Gosden and Lock 1998). Temporal rhythms are also evident in the structural and stratigraphic sequences associated with individual monuments or groups of monuments (Barrett 1990). Communal burial in mortuary houses or long barrows involves repeated interments over a prolonged period of time. Skeletal material may subsequently be removed from these repositories for

use in ceremonial events or more protracted rituals. Individual burial in round barrow cemeteries is indicative of different temporal structures (Barrett 1994). Whilst multiple burials may be made in a barrow before closure, the inhumations and cremations typically represent a much shorter time-span. It has been suggested that linear genealogies could have been constructed through subsequent burials in the upper levels of the mound or by the establishment of a new monument within the cemetery (Mizoguchi 1993). Monuments encapsulate both finite moments in time and longer episodes of activity.

Temporal rhythms are also embedded in domestic routines such as the production, procurement and usage of stone tools. The reduction sequence, by its very nature, is both reductive and sequential (Schofield 1994). Although individual actions or sequences of actions can be identified through refitting, few conjoined pieces are likely to be identified in an artefact scatter given the small proportion of material visible on the surface at any given time. These actions represent finite moments in time, in effect events, providing a detailed insight into the life history of one or more individual artefacts (Whittaker 1994). Longer trajectories can be identified through consideration of the ways in which the procurement of raw materials and production of stone tools were incorporated into seasonal or annual routines (Edmonds 1995). Rejuvenation of cores and the re-use of debitage and implements are also not uncommon in the archaeological record. However, much of our evidence for stone tool manufacture is derived from surface scatters which represent the cumulative product of numerous/repeated patterns of activity over a more protracted period of time (Schofield 1995). Interpretation of these patterns of activity is reliant upon the identification of artefacts with traits which are characteristic of different stone working traditions.

Analysis of lithic technology has been dominated by two traditions: an American tradition grounded in the study of the life history of individual artefacts, and a French tradition based upon the notion of *chaînes-opératoires* (Grimaldi 1998). The American tradition is grounded in the mechanics of tool manufacture and is concerned with the physical properties of stone. Flint knapping, for instance, is typically discussed in reference to modes of percussion or analysed with respect to the application of force to striking platforms (Whittaker 1994). In contrast, the French tradition is more intuitive, based on qualitative observations related to the various stages of core working or tool manufacture. Analysis of stone working is based on the identification of the elements of the reduction sequence which are represented with a lithic assemblage (Tixier, Inizan, and Roche 1980). Until recently quantitative approaches

comparable to those of the American tradition have dominated discussions of stone working in British prehistory. The potential of contextual approaches akin to the French tradition, however, has been highlighted with regard to the study of technological change amongst the lithic assemblages from Cranborne Chase (Brown 1991).

Emphasis has often been placed on the use of stone tools as chronologically diagnostic artefacts. Morphological analysis of specific categories of lithic artefact has been used to construct relative chronologies (e.g. Green 1980). Resultant typologies have been refined with reference to associated material from excavated contexts through both ceramic phasing and radiocarbon dating. Repertoires of stone tools associated with broad chronological periods are consequently well documented, with a proliferation of artefact types during the Late Neolithic and Early Bronze Age (Richards and Allen 1990). Specific categories of stone tool are thought to be indicative of particular types of activity. For example, scrapers are regarded as utilitarian and are often equated with domestic activity, whilst arrowheads and knives are typically associated with hunting (Schofield 1987). Stone tools, however, represent the end product of the technological process and typically represent only a small proportion of the total assemblage of artefacts. Stages of core working and tool manufacture, including knapping operations associated with both flaking and shaping, can be reconstructed through analysis of the associated lithic debitage, enabling discussion of the contexts within which the production and usage of stone tools took place.

The study of lithic debitage has been dominated by the discussion of core working traditions and flake morphology. Variability in core morphology has been attributed to the production of different classes of artefact. Levallois-like or 'tortoise shell' cores, for example, are associated with the production of flakes suitable for use as blanks for ripple-flaked transverse arrowheads during the Late Neolithic (Durden 1994). Technological analysis has also suggested that earlier core working traditions place a greater degree of emphasis on the maintenance of striking platforms than their later counterparts. This shift in emphasis is typically associated with the evolution of flake morphology, from the production of 'blade-like' flakes in the Mesolithic to short, squat flakes in the Bronze Age. Relationships between flake morphology and core working traditions, however, are more complex. Whilst there is little or no differentiation between Late Neolithic and Bronze Age flakes in terms of ratio of length to width, metrical analysis has shown a marked contrast in the degree of regularity (Woodward 1978). Differences in flake morphology can also be attributed to modes of

percussion. Hard hammer/soft hammer techniques and indirect percussion, for example, can be differentiated by consideration of a series of morphological attributes.

Analysis of the spatial structure of lithic scatters has been dominated by the production of point-provenance distribution plots (Boismier and Reilly 1988). Distributions of individual classes of artefact can be represented by symbol style or colour, whilst artefact frequencies or densities can be visualised using graduated symbols. Analysis of lithic artefacts scatters from Cranborne Chase was highly reductive with the construction of period based landscapes based on the presence or absence of chronologically diagnostic artefacts (Barrett, Bradley, and Green 1991). Early Neolithic settlement, for instance, was represented by a distribution plot showing the locations where leaf-shaped arrowheads had been found. Conversely, the Stonehenge Environs Project adopted a more expansive approach with consideration of variability in the cumulative frequency of lithic artefacts across the landscape (Richards and Allen 1990). Broad spatial differentiation of activity was suggested on the basis of differences between the distribution of all lithic artefacts and the distribution of specific categories of artefacts such as cores and implements. In both instances, the resultant distribution plots were overly simplistic. Neither adequately reflected the nature of the individual phases of activity represented within the respective lithic scatters.

Contextual approaches to the analysis of lithic scatters have been heavily influenced by landscape perspectives, most notably through the adoption of the concept of taskscapes (e.g. Schofield 1995; Edmonds, Evans, and Gibson 1999). Routine activities are embedded in a network of locales, commonly referred to as taskscapes, which are displaced in both space and time (Ingold 2000). Within this framework, the organisation of activities such as stone working can be understood through reconstruction of their associated taskscapes. The relative proportions of primary, secondary and tertiary flakes within lithic scatters are commonly used to differentiate between locales used for the procurement of raw materials or roughing out and those associated with later stages of manufacture. However, there has been little wider discussion of the spatial organisation of the methods and techniques associated with particular stone working traditions or suggested by differences in flake morphology. Where detailed technological analysis has been attempted, emphasis has typically been placed on the production of specialist artefacts through the identification of lithic debitage characteristic of methods and techniques which are peculiar to individual locales (Durden 1994).

Analysis of the spatial organisation of stone working is intrinsically linked to the discussion of prehistoric settlement practice. The growth in evidence for domestic activity from excavated contexts (Waddington et al. 2003; Whittle et al. 2000) has coincided with a decline in reliance upon ethnoarchaeological models of settlement practice (c.f. Pollard 1999; Conneller 2007; Garrow 2007). Attitudes to Neolithic settlement practice, for instance, have changed with increased recognition of the significance of the knapping debris recovered from the buried land surfaces beneath burial mounds such as Avebury G55 and midden deposits such as those incorporated into the West Kennet Avenue (Thomas 1999; Pollard 2005), and are likely to change further as a result of the excavation of the Neolithic houses at Durrington Walls as part of the Stonehenge Riverside Project (Parker Pearson et al. 2005, 2006). However, in the case of the Neolithic structures excavated at Sewerby Cottage Farm, near Bridlington, between 1999 and 2004, it has been observed that our understanding of contemporary settlement practice can only be furthered by placing these sites within their broader context through surface survey and comparative analysis (Dickson and Edmonds 2009, 147).

Lithic scatters can provide a detailed insight into contemporary settlement practice, challenging perceived wisdom based on a relatively small number of excavated sites. Different areas of activity, for example, have been noted in lithic scatters from the Avon Valley, based on the distribution of particular categories of artefact and intuitive observations about the composition of associated assemblages of lithic debitage (Schofield 1987). Similarly, domestic occupation associated with Bronze Age ring ditches in the Great Ouse Valley have been identified through consideration of the relative distributions of 'blade-like' flakes and short squat flakes (Woodward 1978). All of these approaches are based on static distribution maps; however, the adoption of spatial technologies has allowed more complex analysis. Methodologies for modelling data from surface artefact survey using GIS have been developed as part of the *Sangro Valley Project* (Lock, Bell, and Lloyd 1999; Lock and Daly 1999) and the *Boeotia Project* (Gillings and Sbonias 1999; Gillings 2000). Although these methodologies have great potential, several hurdles must be overcome before they can be applied to the analysis of the spatial distribution of lithic artefacts from surface contexts.

Accounts of Neolithic occupation on the Yorkshire Wolds have been dominated by discussion of pit contexts, most notably the groups of Late Neolithic pits at Rudston Wold (Manby 1974, 1975) and Low Caythorpe (Abramson 1996), and occupation sites, including the Middle or Late Neolithic houses at Beacon Hill, Flamborough (Moore 1964), Kings Mill Street, Driffield

(Manby 1988) and Sewerby Cottage Farm, Bridlington (Fenton-Thomas 2009). This emphasis on pit contexts and occupation sites excavated during the twentieth century has perpetuated models of settlement practice and stone working that give undue weighting to the Low Wolds, the eastern part of the Great Wold Valley and the Holderness coast (c.f. Manby 1988; Harding 2006; Carver 2012). These models often incorporate the burial mounds excavated on the High Wolds and the Central Wolds during the mid to late nineteenth and early twentieth centuries (Harding 1996; Gibson and Bayliss 2010) but not the vast quantities of lithic artefacts that were collected from the Yorkshire Wolds by farm labourers paid by the archaeologists that excavated the burial mounds (Greenwell 1877, 1890; Evans 1897; Mortimer 1905). Although stray finds and lithic scatters have been widely documented on the Yorkshire Wolds (Loughlin and Miller 1979), little attention has been paid to this material with a few notable exceptions (e.g. Durden 1995; Hayfield, Pouncett, and Wagner 1995).

A comprehensive review of stray finds and lithic scatters from the Yorkshire Wolds is long overdue and a similar review of lithic artefacts from surface contexts has made a valuable contribution to the understanding of Neolithic occupation in the Cotswolds (Snashall 2004). Two key issues, however, must be resolved before lithic artefacts from surface contexts can be incorporated into models of Neolithic occupation on the Yorkshire Wolds: 1) lithic scatters on the High Wolds are typically characterised by low densities of artefacts, limiting the efficacy of spatial statistics that might otherwise be used to identify patterning in the distribution of artefacts, and 2) lithic scatters are typically dominated by utilitarian tools and classes of debitage which are not chronologically diagnostic but are critical to understanding changes in the nature of settlement practice or spatial organisation of stone working. This thesis develops a methodology to solve these issues in order to maximise the interpretative potential of lithic scatters, with the following aims and objectives:

1) To develop a method that allows surface finds to be incorporated into models of Neolithic occupation and stone working on the Yorkshire Wolds and in doing so:

    a. Ascertain whether differences between the High Wolds and Low Wolds identified from excavated evidence are reflected in surface scatters;

    b. Determine how occupation and stone working on the Yorkshire Wolds fit into the broader context of the Neolithic of Eastern Yorkshire.

2) To develop a method that allows spatial statistics to be applied to low density scatters through the applications of spatial filters to polygon features;

3) To develop a method to characterise Early Neolithic and Late Neolithic stone working traditions on the Yorkshire Wolds and in doing so:

    a. Assess how the constraints imposed by the nature of raw materials used by local industries impacts upon stone working traditions;

    b. Reconstruct the sequences of knapping operations represented by the stone tools from Early Neolithic and Late Neolithic contexts;

    c. Define debitage signatures that reflect the methods and techniques employed in Early Neolithic and Late Neolithic stone working traditions;

    d. Identify a series of diagnostic traits that can be used to discriminate between artefacts characteristic of different stone working traditions.

4) To develop a method to date stone tools and lithic debitage from surface contexts in order to reintroduce some of the time depth lost through ploughing.

The methodology was developed using case studies drawn from a study area on the High Wolds which had previously been investigated in the nineteenth century by J. R. Mortimer (1905). A systematic review of stray finds and lithic scatters recorded within the study area was conducted to provide baseline conditions for the development of the methodology and a lithic scatter at Wharram-le-Street was identified as a suitable site to test the methodology. The lithic scatter was located close to the former source of the Gypsey Race at the head of the Great Wold Valley and lies approximately 1.5km to the south-west of Duggleby Howe. A systematic survey of the lithic scatter was carried out between 2002 and 2003 by the author for the purposes of this thesis, under the auspices of the Wharram Research Project. Assemblages of worked flint from fifteen of the burial mounds excavated by Mortimer were used to characterise Neolithic stone working traditions and identify diagnostic traits that could be used to date stone tools and lithic debitage from surface contexts.

Analysis of lithic assemblages from Eastern Yorkshire has previously suggested that there are differences between the assemblages from the different parts of the Yorkshire Wolds, with the raw materials available to communities further inland from the Holderness coast placing

constraints on the maximum size of stone tools and cores (Makey 1989, 1996). Despite the richness of the assemblages of worked flint from the pit contexts at Rudston and Low Caythorpe and occupation sites at Beacon Hill, Kings Mill Street and Sewerby Cottage Farm, these sites are located on the Holderness coast or the Low Wolds and as such were not included in the analysis below. Although the relative chronology established for the purposes of the analysis of the assemblages of worked flint from the Neolithic burial mounds would support differentiation between Early Neolithic (Phases 1 and 2), Middle Neolithic (Phases 3 and 4), Late Neolithic (Phases 4 and 5) and the Final Neolithic or Chalcolithic (Phase 6) stone working traditions, the small sample size for some phases in the chronology does not permit analysis at this level of temporal resolution. Consequently, a simple distinction was made between Early Neolithic (Phases 1 to 3) and Late Neolithic (Phases 4 to 6). The methodology developed in this thesis, however, could be applied at a higher level of temporal resolution in instances where larger sample sizes are available for each chronological period.

Evidence for stone working from surface scatters and burial mounds

This chapter introduces the case studies which are used in this thesis and highlights their relevance to the research questions outlined in the introduction. These case studies can be divided into two groups, namely stray finds and lithic scatters from surface contexts and comparative assemblages of worked flint from excavated contexts. The first part of the chapter describes the study area from which the case studies are drawn, placing it within the broader context of the Neolithic of Eastern Yorkshire and defining the topographic zones which form the basis of existing models of Neolithic settlement practice on the Yorkshire Wolds. The second part of the chapter assesses the stray finds and lithic scatters from surface contexts, identifying a series of recurrent themes which highlight the problems inherent in the analysis and interpretation of lithic scatters which are characterised by low frequencies of artefacts or which represent more than one phase of activity. The third part of the chapter reviews the comparative assemblages of worked flint from excavated contexts, assessing the integrity of the assemblages of worked flint and the validity of the relative chronology used to identify traits which are either chronologically or technologically diagnostic.

1.1 The Neolithic of Eastern Yorkshire

The case studies for this thesis are drawn from a study area on the Yorkshire Wolds to the west of Driffield, East Yorkshire (Figure 1). This study area is based on the study area used in *Forty Years' Researches in British and Saxon Burial Mounds of East Yorkshire*, referred to hereafter as *Forty Years' Researches* (Mortimer 1905). It covers an area 30km by 22.5km centred roughly on the village of Fimber where Mortimer lived. Pronounced topographic variation can be seen within the study area. The Yorkshire Wolds form a distinctive crescent, defined by a steep escarpment to the north and west, overlooking the Vale of York, the Howardian Hills and the Vale of Pickering, and a gentle dip slope to the south and east, skirting the edge of Holderness. To the west, the area of high ground adjacent to the Wold edge (the High Wolds) is incised by a dendritic network of deep, steep-sided dry valleys. To the east, the lower-lying hills of the dip slope (the Low Wolds) are cut by a series of shallower valleys

known locally as 'slacks'. This east-west topographic differentiation is pivotal to models of settlement practice on the Yorkshire Wolds.

A geographic shift has been identified in the locations of funerary monuments in Eastern Yorkshire during the Neolithic (Harding 1996). Long barrows and earlier developments in the round barrow tradition are found throughout the Yorkshire Wolds. Earlier developments in the round barrow tradition share common structural elements (e.g. non-megalithic chambers and linear zones) and ancillary features (e.g. timber façades and post avenues) with non-megalithic long barrows (Kinnes 1979, 1992). They are broadly contemporary with the Early Neolithic enclosures which emerge in Britain and other parts of north-western Europe during the early fourth millennium BC, with the majority of causewayed and related enclosures in Southern Britain and Ireland constructed between the late 38th century BC and the mid to late 36th century BC (Darvill and Thomas 2001; Varndell and Topping 2002; Whittle, Healy, and Bayliss 2011). These enclosures have been interpreted variously as settlements, cattle compounds or aggregation sites and have been linked to both the circulation of 'prestige' goods and the practice of excarnation (Edmonds 1999).

Only one Neolithic enclosure, a circular enclosure centred on Duggleby Howe at the head of the Great Wold Valley, has been identified within Eastern Yorkshire (Oswald, Barber, and Dyer 2001, 157). This enclosure has been interpreted as either a causewayed enclosure or a henge monument (Riley 1980; Kinnes et al. 1983; Manby, Moorhouse, and Ottaway 2003; Gibson and Bayliss 2009). Radiocarbon dates from fragments of hazelnut shell and antler picks from the top of the primary ditch silts suggest that the circular enclosure at Duggleby Howe was constructed between the 25th century BC and the 23rd century BC (Gibson et al. 2011). The dates for the construction of the circular enclosure fall within the first period of the Beaker tradition (Needham 2005) and suggest a stronger affinity with the henge monuments of the Late Neolithic and Early Bronze Age than the causewayed enclosures of the Early Neolithic.

In contrast, later developments in the round barrow tradition are predominately found on the High Wolds and at the head of the Great Wold Valley (Harding 1996). Later developments in the round barrow tradition are heralded by the appearance of graves, simple burials and cumulative cemeteries, characteristic of the Late Neolithic and Bronze Age (Kinnes 1979). The development of cumulative cemeteries has been linked with the appearance of the emergent henge series during the mid to late third millennium BC (Clare 1986; Harding and Lee 1987).

Hengiform enclosures and henge monuments often form part of more extensive monument complexes. They are smaller and more abundant than the causewayed and related enclosures of the Early Neolithic, reflecting broader changes in settlement practice and the nature of the inhabited landscape. Increased evidence for permanent or semi-permanent settlement can be identified from the Late Neolithic onwards. The distribution of henge and hengiform monuments within Eastern Yorkshire would appear to have been centred upon the Rudston area (Stoertz 1997, 30–33). Only two other henge or hengiform monuments are known from the rest of the Yorkshire Wolds; one at Huggate, on the High Wolds, and the other at Walkington, on the edge of Holderness.

The range of monumentality in the Rudston area is unprecedented on the Yorkshire Wolds. Rudston lies immediately to the north-east of the study area. It occupies a strategic position on the floor of the Great Wold Valley, close to the apex of a sharp bend in the course of the Gypsey Race. Four cursus monuments (Cursuses A to D) converge on a large standing stone, the Rudston Monolith, in the graveyard at All Saints Church (Dymond 1966; Riley 1988). Two further cursus monuments (Cursuses E and F) have been identified on the floor of the Great Wold Valley near Rudston. The only confirmed Class II henge monument on the Yorkshire Wolds, Maiden's Graves, lies midway between the Gypsey Race Cursus (Cursus D) and the Gypsey Race. Again, as with henges and hengiform monuments, the distribution of cursus monuments within Eastern Yorkshire would appear to have been centred upon the Rudston area (Stoertz 1997, 25–27). Only two other cursus monuments have been identified on the Yorkshire Wolds; one at Uncleby Brow, close to the Wold edge, and the other at Fimber, in the base of a dry valley.

Differences between the High Wolds and the Low Wolds become more pronounced with time. The late prehistoric and early historic landscape of the Yorkshire Wolds was divided into a series of linear zones (Fenton-Thomas 2003). These linear zones form the basis of the models of Iron Age land use developed for the Yorkshire Wolds, with low-lying land to the east used for settlement and cultivation, and the high ground to the west used primarily for pasture (Dent 1988; Bevan 1997). Strong parallels can be drawn with the models of settlement practice proposed for the Neolithic on the basis of the spatial distribution of funerary monuments (Harding 1996; Manby 1988). Whilst this system of land division is generally thought to have been established during the Middle to Late Bronze Age or Early Iron Age, it may have earlier origins. The linear zones are defined by a series of trackways and boundaries

which follow prominent topographic features such as the Towthorpe Ridge (Cole 1888, 1892). These topographic features were often a focus for monument building during the Neolithic and Bronze Age and many of the trackways and boundaries would appear to respect alignments which were established by earlier monuments.

Models of settlement practice based on the spatial distributions of contemporary monuments and/or parallels with later chronological periods have obvious limitations. Comparatively little evidence for Neolithic settlement, however, has been identified from excavated contexts in Eastern Yorkshire (Darvill 1996, 105). Middle or Late Neolithic houses have been excavated at Beacon Hill, Flamborough (Moore 1964), Kings Mill Street, Driffield (Manby 1988) and Sewerby Cottage Farm, Bridlington (Fenton-Thomas 2009). Although a rectangular structure tentatively interpreted as a Neolithic house was also identified beneath the long barrow at Kemp Howe (Mortimer 1880), the interpretation of this structure has been disputed (Manby, King, and Vyner 2003, 47). Several groups of Late Neolithic pits have also been excavated on Rudston Wold (Manby 1974, 1975) and Low Caythorpe (Abramson 1996). The nature of activity represented by these groups of pits and the associated assemblages of artefacts is open to debate. Two modes of interpretation have predominated – functional interpretations based on the premise that the groups of pits corresponded to occupation sites and symbolic interpretations which highlight their role in the negotiation of the identities of people and places (Harding 2006). These interpretations are not mutually exclusive. All of these sites are located in the eastern part of the Yorkshire Wolds.

The confined distribution of the Neolithic houses and groups of Late Neolithic pits in the eastern parts of the Yorkshire Wolds and the apparent nucleation of Late Neolithic funerary monuments in the western part of the Yorkshire Wolds would appear to be consistent with the notion that the High Wolds were marginal to the main area of settlement in Eastern Yorkshire. However, it is unclear whether this model reflects Neolithic settlement practice or whether it is a product of the tradition of archaeological research. Recent research has focused heavily on the Low Wolds, in particular the Rudston area and the Great Wold Valley. With the exception of burial mounds and linear earthworks, research into the Neolithic of the High Wolds was largely neglected during the twentieth century. The surface of the Yorkshire Wolds is mantled by a near continuous scatter of worked flint. Two obvious questions arise: is the distribution of stray finds and lithic scatters consistent with existing models of settlement practice? and; is there a change in the nature of settlement activity on the High

Wolds during the Neolithic? The extent to which these questions can be answered is determined by the nature of the evidence itself.

1.1.1 Stray finds and lithic scatters

A gazetteer of stray finds and lithic scatters (Appendix A) was compiled for the parishes corresponding to the Wolds study area based on records held in the Historic England National Record of the Historic Environment (NRHE). Data from the Portable Antiquities Scheme (PAS) and Historic Environment Records (HERs) was collated but later discarded due to biases in the datasets or incomplete coverage of the study area. Data from the PAS was skewed with the bulk of the stray finds and lithic scatters derived from the parishes adjacent to the towns of Malton and Pocklington where metal detectorists have been most active. Similarly, data from HERs was split between two counties and marked differences were noted in the consistency with which stray finds and lithic scatters were recorded. Whilst the NRHE data is not without its biases, as will be shown later in this thesis, it provides comprehensive coverage of the study area and does not appear to have been unduly influenced by modern political boundaries. The stray finds and lithic scatters identified within the study area were aggregated by parish using polygon data derived from the 2001 Census boundary dataset[1].

Locations of stray finds and lithic scatters were recorded either as a grid reference (typically a 6 figure NGR) or to the nearest locality (a field or place name) or parish (a township or parish). Embedded within this hierarchy is the notion of scale, with an increase in resolution and decrease in precision which have fundamental implications for spatial analysis. Where the location of a stray find or lithic scatter was recorded as a grid reference, the locality or parish from which it was derived can be inferred from the corresponding numeric co-ordinates. Conversely, where the location of a stray find or lithic scatter was recorded to the nearest locality or parish, an accurate grid reference cannot be obtained and numeric co-ordinates can only be estimated approximately. This observation is highlighted by the precision of the grid references (typically a 4 figure NGR) which had retrospectively been obtained for the records identified during the mid to late nineteenth or early twentieth century, prior to the establishment of the British National Grid in 1936.

[1] https://borders.ukdataservice.ac.uk/lut_download_data.html?data=eng_cas_parish (visited 20/9/2018).

The precision of a grid reference is signified by the number of figures which are given: 4 figure and 6 figure NGRs, for example, can be located to within 1km and 100m respectively. Although a grid reference can be converted to numeric co-ordinates and therefore plotted on a map, it should be emphasised that these co-ordinates do not correspond to a point but to the south-west corner of a 1km or 100m grid square. Each of the levels in the spatial hierarchy can therefore be represented as an areal unit, with an increase in the size of areal units from one level to the next. In order to combine the locations of stray finds and lithic scatters which are recorded at different levels of spatial resolution it is necessary to select the highest common denominator, in this case the level of the parish. Even then, it should be recognised that parish boundaries are not constant and that the location of a stray find or lithic scatter recorded to the nearest parish is in part dependent upon the configuration of the parishes at the time it was identified.

A total of 128 stray finds and lithic scatters was identified within the study area from the records held in the NRHE (Figure 2). Stray finds and lithic scatters were classified according to the criteria used for the *Lithics Scatters Project* (Schofield 1995). A stray find is defined as a single lithic artefact from a locality, while a lithic scatter is defined as two or more lithic artefacts from the same locality. This definition, although simple and robust, is not without its difficulties. Stray finds and lithic scatters from both systematic surface artefact survey and unsystematic surface collection were included in the NRHE records. As will be highlighted later in this thesis, it is difficult to differentiate between single artefacts which correspond to stray finds and those which correspond to part of a low-density lithic scatter. This is particularly true where artefacts have been recovered through unsystematic surface collection. Similarly, approximately a third of the lithic scatters were comprised of just two artefacts – these artefacts were typically axes or arrowheads located to the nearest parish and in practice may correspond to two stray finds rather than a lithic scatter.

Like-for-like comparison of stray finds and lithic scatters is problematic: a stray find may simply represent casual loss, while a lithic scatter might indicate persistent or sustained occupation. In principle, it should be possible to differentiate between different types of activity by weighting locations based on a function of the frequency of artefacts and the number of classes of stone tools and lithic debitage recovered. In practice, this information cannot be determined from the records held in the NRHE and interpretations of the nature of settlement activity are reliant upon analysis of the relative frequencies of stray finds and lithic scatters

identified in any given location. Even in the case of a lithic scatter identified through systematic survey, the frequency of artefacts recovered is meaningless without information about the sampling strategy employed or the extent of the survey area. There is also a disparity in the level of quantitative information recorded for different classes of artefacts. Although the frequency of stone tools will typically be recorded, often only the presence of lithic debitage will be noted. Classes of artefacts which are not deemed to be significant are often not recorded let alone quantified.

Further problems are introduced by the temporal depth represented by the stray finds and lithic scatters identified within the study area. Dates recorded for the stray finds and lithic scatters were based on the Historic England Periods List (Table 1). Four levels of temporal resolution are represented within the Historic England Periods List:

- Level 1 – stray finds and lithic scatters which could be dated to anywhere between the Palaeolithic and the Iron Age;
- Level 2 – stray finds and lithic scatters which could be dated to either the Palaeolithic or Mesolithic (Early Prehistoric) or the Neolithic to Iron Age (Later Prehistoric);
- Level 3 – stray finds and lithic scatters which could be dated to a specific chronological period e.g. Neolithic;
- Level 4 – stray finds and lithic scatters which could be dated to an individual subdivision of a particular chronological period, e.g. Early Neolithic.

The majority of the stray finds and lithic scatters could be dated to Level 3, i.e. the nearest chronological period. Uncertainty exists even at this crude level of temporal resolution: a lithic scatter may contain artefacts from two or more chronological periods; and classes of artefacts can be dated to more than one chronological period.

Together the stray finds and lithic scatters identified from records held in the NRHE represent past human activity from the beginning of the Mesolithic to the end of the Bronze Age. Over two thirds of the stray finds and lithic scatters could be dated to the Neolithic or contained artefacts of probable Neolithic date. These stray finds and lithic scatters alone represent the cumulative product of 2,000 years of past human activity. Dating of stray finds and lithic

scatters is reliant upon the presence of chronologically diagnostic artefacts. The presence of an artefact which can be dated to the Neolithic, however, does not mean that all of the artefacts in a lithic scatter are of Neolithic date. The problems inherent in the classification of stray finds and lithic scatters are compounded where a lithic scatter contains artefacts which are not chronologically diagnostic. Furthermore, continuity has been identified between both Late Mesolithic and Early Neolithic stone working traditions, and Late Neolithic and Early Bronze Age stone working traditions. Stray finds and lithic scatters dated to the Mesolithic or Bronze Age cannot therefore necessarily be precluded from the analysis of the spatial distribution of Neolithic artefacts from surface contexts.

A higher level of temporal resolution is required in order to identify changes in settlement practice based on the spatial distribution of stray finds and lithic scatters. Nevertheless, general observations about the intensity and/or nature of settlement activity can be made on the basis of spatial variation in the ratio of lithic scatters to stray finds (Figure 2). In the northern part of the study area, the ratio of lithic scatters to stray finds is higher in the parishes to the east on the Low Wolds than those to west on the High Wolds. In the southern part of the study area, this pattern is reversed and the ratio of lithic scatters to stray finds is higher in the parishes to the west in the Vale of York than those to the east on the edge of Holderness. At face value the variation in the ratio of lithic scatters to stray finds in the northern part of the study area is consistent with existing models of settlement practice for the Yorkshire Wolds during the Neolithic. A case study was chosen in the north-western part of the study area in order to assess the nature of activity represented by the lower frequency of lithic scatters and higher frequency of stray finds on the High Wolds.

1.1.2 Wharram-le-Street case study

Wharram-le-Street is located at the head of the Great Wold Valley, immediately to the west of the source of the Gypsey Race (Figure 3). The Gypsey Race is an intermittent surface stream which flows eastwards down the Great Wold Valley towards the coast. It is fed by a natural spring surfacing at the interface between the Kimmeridge clay and the overlying Hunstanton and Ferriby chalk formations. This spring is no longer visible and has been replaced by an artificial pond close to the northern edge of the field. The Gypsey Race is the only surviving surface watercourse on the Yorkshire Wolds and is therefore perceived as a significant economic resource. Extensive evidence for prehistoric activity has been identified along the course of the Gypsey Race, most notably the monument complex at Rudston and the round

barrows at Duggleby Howe, Wold Newton and Willie Howe. The round barrow at Duggleby Howe is located approximately 1.5km to the north-east of the source of the Gypsey Race and lies at the centre of a circular enclosure that was constructed during the Late Neolithic or Early Bronze Age (Riley 1980; Gibson and Bayliss 2009; Gibson et al. 2011).

A complex of cropmarks has also been identified in the plot of land corresponding to the source of the Gypsey Race (Figure 4). This complex included a circular enclosure tentatively interpreted as a Bronze Age shrine and a rectilinear enclosure associated with a Roman villa or temple/shrine. A smaller circular cropmark, tentatively thought to correspond to a ring ditch or the site of an earlier pond, was identified within the interior of the circular enclosure (Rahtz and Bateman 1986). The rectilinear enclosure lay at the intersection of two trackways defined by two pairs of parallel cropmarks. Roman pottery and building material, including a fragment of mosaic, were recovered from the area of the rectilinear enclosure during the course of the Wharram Parish Survey (Hayfield 1987). Although the sampling strategies employed in this survey were aimed at understanding the development of the Roman and Mediaeval landscapes, stray finds and lithic scatters were identified at a number of localities within the parish. Eight pieces of worked flint, including several heavily patinated blades and a barbed and tanged arrowhead, were recovered from the area of the former source of the Gypsey Race at Wharram-le-Street (Hayfield 1987, 83–85).

A magnetometer survey of the complex of cropmarks was subsequently carried out by the Ancient Monuments Laboratory in 1979 (Rahtz and Bateman 1986). This survey identified an extensive network of geophysical anomalies characteristic of archaeological features, including the site of a stone building in the area of the rectilinear enclosure (Figure 5). The geophysical response in the area of the circular enclosure was much weaker, suggesting that any archaeological features in this area were either heavily truncated or were sealed by overlying deposits. A series of test pits were later excavated on the basis of the geophysical survey (Rahtz and Bateman 1986). Twenty test pits were excavated at Wharram-le-Street. Two discrete phases of activity were proposed on the basis of the excavated evidence. Prehistoric activity was represented by relict land surfaces in the area of the sub-circular enclosure and a substantial ditch identified towards the southern extent of the site. The rectilinear enclosure, stone building and associated structures were Roman in date and were thought to have formed part of a villa or a temple/shrine. Until recently emphasis had largely been placed on the evidence for Roman activity at the site.

Surface survey carried out between 2002 and 2003, however, focused on the evidence for prehistoric activity at Wharram-le-Street (Pouncett 2010). This survey had two main objectives: 1) to determine the nature and extent of the activity represented by the lithic scatter identified in the area of the former source of the Gypsey Race, and; 2) to assess the continued impact of ploughing on the stratified deposits from which the vast majority of the worked flint was derived. Systematic coverage of the survey area was obtained using transects 10m apart, with collection units spaced at 20m intervals along each transect. Artefacts were collected from a corridor, 1m either side of the centre line of each transect, providing a 20% sample of the material visible on the surface at the time of the survey. Collection units were set out on the British National Grid to allow rapid plotting of the survey data and to simplify integration with data from adjacent plots of land at a later date. The survey was carried out shortly after ploughing, with only a minimal period of weathering to expose artefacts on the surface, in an attempt to recover prehistoric pottery.

A total of 340 lithic artefacts was recovered from the plot of land corresponding to the complex of cropmarks at Wharram-le-Street (Appendix B). Although the quantity and range of material visible on the surface changes with each episode of ploughing, such variation would not account for the significant increase in the frequency of artefacts since the previous survey of the site between 1978 and 1980 (Rahtz and Bateman 1986). A dramatic change would appear to have taken place during the intervening decades and it is likely that the relict land surfaces identified through test-pitting have been truncated by continued ploughing. The artefacts recovered during the course of the surface survey form part of a low-density lithic scatter centred on the area of the former source of the Gypsey Race and the circular enclosure identified from aerial photographs (Figure 6). Marked variation can be seen in the spatial distribution of lithic artefacts, with higher frequencies of artefacts recovered from the collection units in the north-eastern part of the survey area and lower frequencies of artefacts recovered from the collection units along the southern and western edges of the survey area. Two concentrations of artefacts were identified in the north-eastern part of the survey area, one in the immediate vicinity of the site of the sub-circular enclosure and the other to the east of the site of the natural spring which fed the Gypsey Race.

An average of 0.8 artefacts was recovered from each of the collection units within the survey area, equivalent to a density of 0.022 artefacts per metre square or c.220 artefacts per hectare. It has long been recognised that the artefacts visible on the surface of ploughed fields

(the *sample frame*) represent a 'sample' of the artefacts circulating within the ploughsoil (the *target population*), and that the artefacts recovered through surface artefact survey (the *sampled population*) represent a 'sub-sample' of the artefacts visible on the surface (Haselgrove 1985). The relationship between the sample frame and target population has been the subject of intense debate, with repeated attempts to estimate the recovery rate or surface to content ratio of the ploughsoil through survey and excavation, experimental archaeology and computer-based simulations (Orton 2000, 57–65). Estimates of the recovery rate or surface to content ratio vary widely, ranging between 2.79% based on comparison of the results of the survey and excavation of a lithic scatter at Lambourn, West Berkshire, during the course of the Maddle Farm Project (Tingle 1987, 89) and 16.67% based on the decrease in the number of sherds of pottery recovered in successive surveys over a four-year period as part of the Butser Ancient Farm Research Project (Reynolds 1982, 332).

The proportion of the total number of artefacts circulating within the ploughsoil that are visible on the surface is dependent on a wide variety of factors, including artefact type, topographic position and ploughsoil depth. Experiments carried out under controlled conditions have shown that typically between 5% and 6% of the material circulating within the ploughsoil is visible on the surface at any given moment in time and can therefore be recovered through surface artefact survey (Orton 2000, 57–65). Three experiments, each carried out under different conditions, have yielded strikingly comparable results:

1. 1,000 ceramic tiles were placed at a depth of 20mm beneath the modern land surface on part of a known Neolithic site at Acconia in Calabria, southern Italy, and monitored over the course of a four-year period (Ammerman 1985, 35–37). The size of the tiles (25mm square and 5mm in thickness) was intended to replicate a range of artefact types, being smaller than the sherds of pottery and larger than the pieces of obsidian generally recovered from contemporary sites within the region. Estimates of the surface to content ratio of the ploughsoil ranged between c.1:14 (7.4%) after the first year of ploughing and c.1:23 (4.4%) after the third year of ploughing, with a mean value of c.1:18 (5.7%) over the course of the duration of the experiment;

2. 1,000 pieces of worked stone from knapping experiments were buried at a depth of c.100 to 150mm below the surface of a level field in Silver Creek, West Illinois

in the American Midwest and were monitored after twelve episodes of ploughing (Odell and Cowan 1987, 457–61). The pieces of worked stone were chosen to reflect the range of artefacts typically recovered from prehistoric sites in the region and deliberately excluded smaller pieces of debitage which are not routinely recovered through surface artefact survey. Each of the pieces of worked stone was painted blue in order to maximise the chances of recovery and eliminate collector bias. Estimates of the recovery rate ranged between 3.02% after the sixth episode of ploughing and 9.40% after the third episode of ploughing, with a mean value of 5.63% for all twelve episodes;

3. 1,030 flint nodules, pebbles and flakes were placed at a depth of 200mm in a field under intensive cultivation at Teffont-Magna near Salisbury, Wiltshire and were monitored over a three-year period after ploughing and/or cultivation (Clark and Schofield 1991, 95–100). The pieces of flint, ranging between 20 and 200mm in length, were chosen to mimic the movement of different classes of stone tools and lithic debitage within the ploughsoil. Whilst marked differences could be seen in the surface representation of the nodules and pebbles[2], the percentages of flakes represented on the surface were more consistent ranging between 4.42% after the first and fifth episodes of ploughing and/or cultivation and 5.84% after the third and fourth episodes of ploughing and/or cultivation, with a mean value of 5.20% over the entire three-year period.

If it is assumed that the transect data from the lithic scatter at Wharram-le-Street are representative of the survey area (i.e. that the sampled population is representative of the sample frame – the very premise which underpins the use of a sampling strategy), it is estimated that c.1,700 artefacts would have been exposed on the surface at the time of the survey and that between c.26,500 and c.32,500 further artefacts would have been circulating within the ploughsoil. These estimates are consistent with the estimates of the frequency of

[2] The results of the experiments were skewed by the low percentages of pebbles represented on the surface after each episode of ploughing and/or cultivation (0.70%, not specified, 9.53%, 0.00%, 0.47% and 0.47%). Whilst it was argued that the movement of these pebbles mimic the behaviour of cores (Clark and Schofield 1991, 100), core morphology varies dramatically and the assumption that all abandoned cores were regular is erroneous. The vast majority of the stone tools and lithic debitage found in surface contexts are irregular, resembling the form of the flakes included in the experiment rather than the nodules or pebbles.

artefacts sealed within stratified deposits and incorporated into the ploughsoil based on the results of the test-pitting (Rahtz and Bateman 1986).

To put these figures in context, the estimated size of the lithic assemblage from Wharram-le-Street is comparable to that for the excavations of the Early Mesolithic site at Star Carr which yielded 24,883 pieces of worked flint (Conneller et al. 2018) and over three times that for the excavation of the Middle Neolithic site at Sewerby Cottage Farm which yielded 8,870 pieces of worked flint (Dickson and Edmonds 2009). The lithic scatters and stray finds identified in the parish of Wharram from records held in the NRHE do not adequately reflect the nature or intensity of settlement activity on the Yorkshire Wolds. The lithic scatter from the former source of the Gypsey Race at Wharram-le-Street represents a significant assemblage of worked flint, with tens of thousands of pieces of worked flint derived from a single plot of land. Stone tools and lithic debitage indicative of Mesolithic, Neolithic and Bronze Age activity were represented amongst the assemblage of worked flint. Spatial differentiation can be seen in the distribution of diagnostic artefacts – artefacts characteristic of Mesolithic and Early Neolithic industries were predominantly found in the central and north-eastern parts of the survey area, while artefacts characteristic of Late Neolithic and Bronze Age industries were more widely distributed throughout the survey area (Figure 7).

The spatial distribution of Mesolithic and Early Neolithic artefacts would appear to be closely related to the concentrations of artefacts identified in the area of the sub-circular enclosure and the area to the east of the former source of the Gypsey Race. In contrast, the spatial distribution of Late Neolithic and Bronze Age artefacts would appear to have been dispersed along a corridor aligned from north-east to south-west which was tentatively thought to have corresponded to the line of a path or trackway leading towards the circular enclosure at Duggleby Howe. A dramatic change in the nature and/or intensity of occupation would appear to have taken place during the course of the Neolithic. In order to better understand this change, it is necessary to isolate groups of artefacts which are broadly contemporary with one another. Only a small proportion of the stone tools and lithic debitage recovered during the course of the survey, however, could be dated unequivocally to either the Early Neolithic or the Late Neolithic. Calibration of the lithic scatter is required based on lithic assemblages from excavated contexts which can be dated independently.

1.2 Neolithic burial mounds on the Yorkshire Wolds

The range of sites that can be used for the purposes of the calibration of the distribution of lithic artefacts from surface contexts is largely determined by previous traditions of research. Whilst few Neolithic occupation sites have been excavated within Eastern Yorkshire, over 500 burial mounds were excavated on the Yorkshire Wolds during the mid to late nineteenth century (Appendix C). Fifty-two burial mounds excavated within the study area have been dated to the Neolithic or yielded evidence for Neolithic activity. Forty-six of these burial mounds were excavated by John Robert Mortimer, a corn merchant from Driffield (Mortimer 1905). The majority of the burial mounds excavated by Mortimer were divided into topographic groups thought to correspond to barrow cemeteries (Appendix D). All but two of these barrow cemeteries were located in parishes on the High Wolds in the western part of the study area. Six 'Neolithic' burial mounds were also excavated by the Reverend William Greenwell, late Canon of Durham Cathedral (Greenwell 1877, 1890). The burial mounds excavated by Greenwell were typically located in the parishes adjacent to the Great Wold Valley in the north-eastern corner of the study area.

Fifteen Neolithic burial mounds[3] from the study area were selected for the purposes of the analysis of stone tools and lithic debitage from excavated contexts (Figure 8). Preference was given to the burial mounds which were excavated by Mortimer. Unlike Greenwell, Mortimer had a good understanding of stratigraphy and routinely attributed artefacts to the individual features or deposits within which they were found. The material recovered during the course of Mortimer's excavations is held in the Mortimer Collection at the Hull and East Riding Museum. Two catalogues of the Mortimer Collection have been published: the first catalogue lists the contents of the collection which was initially housed in a purpose-built museum on Lockwood Street in Driffield (Sheppard 1900); the second catalogue lists the contents of the collection after it had been moved to the Victoria Art Gallery at Hull City Hall (Sheppard 1929). Hull City Hall was badly damaged by bombing during the Second World War and the collection was subsequently transferred to the Hull and East Riding Museum. Neither of the published

[3] Sixteen of the Neolithic burial mounds excavated by Mortimer were either not directly associated with lithic assemblages or the worked flint from the burial mounds was on loan at the time the analysis was carried out. Fifteen of the remaining burial mounds were selected to provide a representative sample of the stone tools and lithic debitage described in the published accounts of the excavations of the burial mounds.

catalogues provides a complete and up to date record of the holdings of the Mortimer Collection.

In total, thirty-seven lithic assemblages were identified from the Neolithic burial mounds (Appendices E and F). These assemblages ranged in size from 1 artefact to 79 artefacts, with an average of 5.56 artefacts per assemblage for the lithic assemblages from funerary contexts and an average of 12.68 artefacts per assemblage for the lithic assemblages from domestic contexts. Three larger lithic assemblages were identified, namely: a cache of worked flint found with Burial 1 at Aldro C75 which could be dated to the Early or Middle Neolithic; residual occupational debris incorporated into the fabric of the burial mound at Riggs 20 which could be dated to the Late Neolithic; and, knapping debris recovered from the surface of the interim mound at Calais Wold 275 which contained artefacts that could be dated to both the Early Neolithic and the Late Neolithic or Bronze Age. The remainder of the assemblages were smaller and it was consequently decided to aggregate the stone tools and lithic debitage from excavated contexts by chronological period. Aggregation also served to minimise the impact of any variation between individual assemblages or burial mounds.

Eighteen lithic assemblages from the Neolithic burial mounds were derived from funerary contexts. With the exception of a cache of worked flint found with one of the simple burials (Burial 1) at Aldro C75, these assemblages were dominated by stone tools. The assemblages from funerary contexts can be divided into two groups: 1) grave goods that were directly associated with mortuary deposits, e.g. Towthorpe 18 (Non-Megalithic Chamber) and Duggleby Howe (Towthorpe 273, Simple Burials); and, 2) residual artefacts which were incorporated into the fill of graves, e.g. Riggs 20 (Grave). In the first instance, the range of artefacts was limited with the persistent selection of artefacts, most notably arrowheads and polished implements. In the second instance, a wide range of artefacts was represented reminiscent of the lithic assemblages derived from domestic contexts. A contrast can be seen between the stone tools that were used as grave goods and those which were used on a routine basis in everyday life. This contrast is manifest in both the final forms of the stone tools, and the methods and techniques that were employed in their manufacture.

Nineteen lithic assemblages from the Neolithic burial mounds were derived from domestic contexts. These assemblages can be divided into three categories, namely: 1) artefacts derived from features or deposits which pre-date the construction of the burial mounds, e.g.

Acklam Wold 211 (Circular Pit); 2) occupational debris deposited on the surface of interim mounds or incorporated into the fabric of the burial mounds, e.g. Calais Wold 275 (Interim Mound) and Riggs 20 (Burial Mound); and, 3) miscellaneous artefacts recovered during the course of the excavation of the burial mounds, e.g. Duggleby Howe (Towthorpe 273, Outer Mound). They were typically larger than the lithic assemblages from funerary contexts and had a higher ratio of lithic debitage to stone tools. A greater range of stone tools and lithic debitage was also represented amongst the lithic assemblages from domestic contexts than those from funerary contexts. The majority of the stone tools from domestic contexts were of comparatively crude manufacture and consequently were typically poor chronological indicators.

Dating of the lithic assemblages from the Neolithic burial mounds is reliant upon a relative chronology based on a combination of structural associations and ceramic phasing (Table 2). Seriation of mortuary structures and grave goods through correspondence analysis has yielded a robust framework for the characterisation and dating of Neolithic round barrows and ring ditches (Kinnes 1979). This framework does not establish an absolute chronology but instead highlights underlying trends in the development of monumentality, funerary practice and material culture during the Neolithic. A contrast is drawn between earlier developments (Stages A to C) that share affinities with non-megalithic long barrows and later developments (Stages D to F) which form part of a distinctive round barrow tradition that continued into the Bronze Age. These developments can be correlated with discrete ceramic traditions or regional variants in the typology established for the purposes of the classification of Neolithic pottery (Gibson and Woods 1997). In its simplest form this typology can be reduced to a distinction between the Grimston-Lyles Hill tradition of the 4th millennium BC and the Late Neolithic Impressed Ware, Grooved Ware traditions and the Late Neolithic and Early Bronze Age Beaker tradition which emerged during the 3rd millennium BC.

At the time the analysis of the lithic assemblages was undertaken, five radiocarbon dates were available for the Neolithic burial mounds. All five dates related to the burial mound at Calais Wold 275, which was re-excavated between 1974 and 1975 in advance of the extension of the farm buildings at High Callis (*sic.*) Wold (Coombs 1976a, 1976b). These dates relate to two separate monuments, an Early Neolithic mortuary enclosure and a Late Neolithic or Early Bronze Age round barrow. The calibrated radiocarbon dates from Calais Wold 275 underline the time depth which may potentially be represented by an individual burial mound, with the

dates spanning the entire Neolithic from 4,000BC to 2,000BC as defined in the English Heritage Periods List. Twenty-three additional radiocarbon dates have subsequently been published, including dates for the burials from Towthorpe 18 (Gibson and Bayliss 2010) and Duggleby Howe (Gibson and Bayliss 2009). Six further radiocarbon dates, including a date for one of the simple burials at Aldro C75 (Burial 2), will be published as part of the *Beaker People Project* but are not currently available (Parker Pearson et al. 2018). The radiocarbon dates (Figure 9) correlate well with the phasing of the Neolithic burial mounds with one exception – the burial from Grave A at Duggleby Howe (Burial C) which was associated with five transverse arrowheads and a broken scraper. Transverse arrowheads are characteristic of Late Neolithic stone working traditions and incomplete tools were excluded from further analysis. As such, the incorrect date for this burial does not impact on the results below.

The level of temporal resolution represented by the relative chronology established for the Neolithic burial mounds is considered to be more than sufficient for the purposes of identifying the changes in the nature of stone working which took place during the Neolithic. It is significantly higher than the level of temporal resolution represented by the stray finds and lithic scatters identified within the study area or the stone tools and lithic debitage from the Wharram-le-Street case study. Each phase of activity is thought to represent a period of between c.300 years and c.500 years, broadly equivalent to the ranges of the calibrated dates for the mortuary enclosure and round barrow at Calais Wold 275. In practice, whilst similarities and differences may exist between the lithic assemblages from successive phases of activity, it is likely that it will only be possible to identify changes in the nature of stone working between the assemblages dated to the Early Neolithic (Phases 1 to 3) and those dated to the Late Neolithic (Phases 4 to 6).

1.2.1 Early Neolithic (Phases 1 to 3)

Thirteen of the lithic assemblages from the Neolithic burial mounds could be dated to the Early Neolithic (Table 3). Small assemblages of worked flint were recovered from the non-megalithic chambers at Towthorpe 18 and Aldro 88. Six leaf-shaped arrowheads and two Towthorpe bowls were found with the flexed inhumations within the non-megalithic chamber at Towthorpe 18. Three deposits of worked flint, including five serrated blades and a serrated flake, and three hammerstones were also found close to the sides of the non-megalithic chamber. The distribution of these artefacts was thought to be indicative of deposition against the chamber walls. Three blades, including the distal end of a broken crested blade,

and a Towthorpe bowl were found with one of the inhumations (Burial C) in the non-megalithic chamber at Aldro 88. A broken leaf-shaped arrowhead, with part of the tip of the shaft of the arrow, was found with another of the inhumations (Burial D) in the non-megalithic chamber. Traces of light walling were identified at the south-west corner of the clay floor which formed part of the non-megalithic chamber.

Both of these structures could be dated to the Early Neolithic (Phase 2) and the range of stone tools was consistent with contemporary industries. Leaf-shaped arrowheads are generally found in Early Neolithic contexts and their association with long barrows has long been recognised (Green 1980, 75–79). Similarly, serrated blades/flakes are predominantly found in lithic assemblages from Late Mesolithic or Early Neolithic contexts (Butler 2005, 110 and 130). Three leaf-shaped arrowheads were also found with the inhumations on the limestone pavement associated with the linear zone at Calais Wold 275. The linear zone lay within a larger mortuary enclosure which was defined by a façade trench to the front and a curved bedding trench to the rear (Figure 10). Several sherds of Towthorpe Ware were recovered from the fill of the façade trench and the mound of chalk rubble which sealed the mortuary enclosure. Radiocarbon dates suggest an Early Neolithic (Phase 2) date for the mortuary enclosure. Confusingly, however, the mortuary enclosure at Calais Wold 275 has been assigned to the Middle Neolithic in the chronology proposed for the Neolithic and Bronze Age of the region (Manby, King, and Vyner 2003).

Methods and techniques which are characteristic of Late Neolithic stone working traditions are represented amongst the stone tools from subsequent phases of activity. A continued affinity with Early Neolithic stone working traditions, however, is suggested by the presence of leaf-shaped arrowheads and evidence for blade manufacture. Incipient changes associated with the emergence of a discrete round barrow tradition are heralded by the appearance of prestige goods, including polished knives, boar tusk blades and beaver incisors, in contemporary burials (Kinnes 1979). A polished-edge knife and a Towthorpe bowl were found with the inhumations on the clay floor associated with the linear zone at Aldro 94. Polished-edge knives are generally considered to be of Late Neolithic date and are often found with burials associated with jet sliders (Pollard 1994, 51). Polished implements were also found with the simple burials at Duggleby Howe (Towthorpe 273, Burials D and G) and Aldro C75 (Burials 1 and 2). Duggleby Howe was a lynch-pin in the framework established for the classification and dating of Neolithic round barrows and ring ditches (Kinnes 1979). The

inhumations and cremation deposits from the site represent the full spectrum of Middle and Late Neolithic funerary practices (Loveday 2002).

Three different sequences have been proposed for the inhumations and cremation deposits from Duggleby Howe (Piggott 1954; Kinnes et al. 1983; Manby 1988). These sequences differ in terms of both the order in which interments took place and the temporal depth represented by the inhumations and cremation deposits. The earliest burials at the site, however, are generally considered to be those associated with the large shaft grave (Grave B) close to the centre of the burial mound (Figure 11 and Figure 12). A small assemblage of worked flint, including two serrated blades, and a Towthorpe bowl were found with the inhumation (Burial K) at the base of the shaft grave. Two simple burials were later placed on the old land surface beneath the burial mound. A leaf-shaped arrowhead, a polished flint adze and a perforated antler macehead were found with the crouched inhumation (Burial G) inserted into the upper levels of the shaft grave. A polished discoidal knife was found with the crouched inhumation (Burial D) which overlapped the eastern edge of the shaft grave. The basal inhumation from the shaft grave and the simple burials at Duggleby Howe could be dated to the Early Neolithic (Phase 3).

Two simple burials were also encountered on the old land surface beneath Aldro C75 (Figure 13). An edge-retouched flake knife and a polished-edge blade were found with one of these burials (Burial 1) and a polished discoidal knife was found with the other (Burial 2). A cache of worked flint, including several re-fitting blades and flakes, was also found with Burial 1 at Aldro C75. Five of the re-fitting blades and flakes would appear to have been associated with the manufacture of the edge-retouched flake knife which was found with the burial. Two possibilities arise: either the blades and flakes were struck at the site of the burial mound, or; they were struck elsewhere and were curated until they could be included with the burial. In an account of the opening of Duggleby Howe, the Reverend E Maule Cole observed that “it seems a common practice at the funeral for survivors to throw flint flakes into the grave, much the same as we throw earth” (Cole 1901, 60). The discrete nature of the cache of worked flint, however, would appear to suggest that it was either placed in a shallow pit or deposited in a small receptacle.

The stone tools found with the simple burials at Duggleby Howe and Aldro C75 highlight the transitional nature of the lithic assemblages dated to Phase 3. On the one hand, polished

discoidal knives are predominantly found in Middle Neolithic or early Late Neolithic contexts (Clark 1929; Manby 1974; Loveday 2009, 2011). Both polished discoidal knives from the Neolithic burial mounds were thought to have been manufactured from flakes struck from a Levallois-like or tortoise shell core. Evidence for this method of core working from Eastern Yorkshire is largely confined to the area of the Late Neolithic workshops at North Dale and South Landing (Durden 1994). On the other hand, the leaf-shaped arrowhead found with Burial G at Duggleby Howe and refitting blades from the cache of worked flint found with Burial 1 at Aldro C75 are consistent with Early Neolithic industries. Blades or blade segments were used as blanks for a wide variety of stone tools during the Mesolithic and Early Neolithic (Edmonds 1995, 37). Extensive evidence for blade manufacture was identified amongst the cache of worked flint from Aldro C75.

With the exception of the lithic assemblages found with the simple burials from Duggleby Howe and Aldro C75, the assemblages from Early Neolithic funerary contexts (Phases 2 and 3) were associated with Towthorpe Ware. Towthorpe Ware is a regional variant of the Grimston-Lyles Hill ceramic tradition (Gibson and Woods 1997, 63). Small assemblages of worked flint associated with Towthorpe Ware were also recovered from Towthorpe 291, Aldro 116 and Wharram Percy 46. Twenty-eight pieces of worked flint, including two polyhedral cores and a microburin, were recovered from the fabric of the burial mound at Towthorpe 291. Five further pieces of worked flint, including a plano-convex knife and a blunted-back knife manufactured from a piece of epidotised intermediate tuff, were recovered from the fabric of the burial mound at Aldro 116. These pieces of worked flint originally formed part of a much larger assemblage of stone tools and lithic debitage which was described in the account of the excavation of the burial mound (Mortimer 1905, 56). The remainder of these artefacts, however, can no longer be accounted for in the Mortimer Collection and are presumed to have been lost.

A small assemblage of worked flint, including three polyhedral cores and an edge-retouched flake knife, were recovered during the course of the excavation of Wharram Percy 46. This assemblage of worked flint includes artefacts recovered from both the trench excavated through the centre of the burial mound and the old land surface beneath the round barrow. The lithic assemblages from Towthorpe 291, Aldro 116 and Wharram Percy 46 were all thought to correspond to residual occupational debris which had been incorporated into the fabric of the burial mounds. A small quantity of residual occupation debris, including a

transverse arrowhead and a single sherd of Grimston Ware, was also recovered from the outer mound at Duggleby Howe. The outer mound at Duggleby Howe had been heavily disturbed by later activity and was known to contain intrusive material. Whilst the majority of the stone tools identified amongst the residual occupational debris incorporated into the fabric of these burial mounds were consistent with Early Neolithic industries, the transverse arrowhead from Duggleby Howe and plano-convex knife from Aldro 116 are Late Neolithic in date. A degree of caution should be exercised in the analysis of the stone tools and lithic debitage from these assemblages.

1.2.2 Late Neolithic (Phases 4 to 6)

Eleven of the lithic assemblages from the Neolithic burial mounds could be dated to the Late Neolithic (Table 4). In contrast to the assemblages dated to the Early Neolithic, comparatively few of the artefacts from the lithic assemblages dated to the Late Neolithic were derived from funerary contexts. Five transverse arrowheads and a broken scraper were found with the Late Neolithic flexed inhumation (Burial C) in Grave A at Duggleby Howe (Towthorpe 273). This group of arrowheads, possibly once part of a quiver of arrows, is reminiscent of that from the non-megalithic chamber at Towthorpe 18. Six inhumations and fifty-three cremations were interred in the burial mound which was subsequently erected over the graves and simple burials at Duggleby Howe. Whilst no lithic artefacts were found with the inhumations, a transverse arrowhead was found close to one of the cremations (Cremation 3). Transverse arrowheads, including both true petit-tranchet arrowheads and derivative forms are predominantly found in Late Neolithic contexts (Green 1980, 108–16).

The inhumations and cremations interred within the inner mound at Duggleby Howe herald the shift from simultaneous interments to cumulative cemeteries during the Late Neolithic (Kinnes 1979). Small quantities of worked flint were also found with the Late Neolithic inhumations at Calais Wold C70 and Aldro 116. A non-cortical flake and several sherds of Clacton Style Grooved Ware were found with the flexed inhumation (Burial 2) placed on the old land surface beneath the burial mound at Calais Wold C70. The Grooved Ware tradition developed in northern Scotland during the late fourth millennium BC and first appeared in Southern Britain around 2800 BC, continuing in use until c.2000 BC (Garwood 1999; Thomas 2010). A flake fragment, a fragment of a bronze pricker and a crushed Beaker were also found with the crouched inhumation (Burial 1) in Grave A at Aldro 116. Beakers were also found with the flexed inhumation (Burial 2) in Grave B and the crouched inhumations (Burials 3, 4

and 5) in Grave C at Aldro 116. The first period of the Beaker tradition dates to 2500-2250 cal BC and overlaps with the Late Neolithic Grooved Ware tradition (Needham 2005).

Rather unusually, two plano-convex knives were found with one of the cremations in the upper levels of the burial mound at Painsthorpe Wold 98 (Cremation 3). Four further cremations, thought to form part of a Late Neolithic cremation cemetery, were also found within the upper levels of this burial mound. Plano-convex knives are generally found in Early to Middle Bronze Age contexts and are often associated with Food Vessels (Clark 1932a, 159–60). Several examples, however, have been found in Neolithic contexts, including that from the Early Neolithic mortuary structure beneath the Dalladies long barrow (Piggott 1973, 76). Both of the plano-convex knives found with Cremation 3 at Painsthorpe Wold 98 were thought to be Late Neolithic (Phase 6) in date. The rim of an inverted Beaker was found with one of the other cremations from the cremation cemetery (Clarke 1970). Two plano-convex knives and a beaver incisor were also found with the crouched inhumation in Grave C at Painsthorpe Wold 98. Beaver incisors are regarded as prestige goods and are commonly found with burials which are characteristic of later stages in the development of the round barrow tradition during the Neolithic (Kinnes 1979).

One of the plano-convex knives found with the crouched inhumation in Grave C at Painsthorpe Wold 98 was placed directly on top of a broad flake[4]. This flake had a trapezoidal cross-section characteristic of the type of flake which was routinely selected as a blank for a plano-convex knife. The superposition of these artefacts, at opposite ends of an idealised reduction sequence, would appear to be an explicit direct reference to stone working. Similar groups of artefacts have been identified at other sites in the region, most notably at Garton Slack C63 where a group of three large flakes associated with a polished flint axe and a group of four flakes associated with a pebble hammerstone were found with the inhumations in Grave C (Mortimer 1905, 215). Obvious parallels can be drawn with the 'flint knapper' burial at Hazleton North, Gloucestershire, where a core and hammerstone were found with an inhumation placed in the entrance to one of the megalithic chambers (Saville 1990, 250). The hammerstones found with the inhumations in the non-megalithic chamber at Towthorpe 18

[4] The flake placed beneath the plano-convex knife was illustrated in *Forty Years' Researches* (Mortimer 1905, Fig. 342), however, could not be accounted for in the Mortimer Collection at the Hull and East Riding Museum.

and the cache of worked flint from Burial 1 at Aldro C75 may also represent comparable references to stone working.

The majority of the artefacts from the lithic assemblages dated to the Late Neolithic were derived from domestic contexts. Three pieces of worked flint, including a plano-convex knife and an edge-retouched flake knife, and several sherds of Peterborough Ware were recovered from the old land surface beneath Aldro 49. An area of burning, tentatively interpreted as a hearth, was noted on the old land surface beneath the burial mound (Manby 1988, 80). No formal hearth setting was recorded in the account of the excavation of the round barrow, however, and the area of burning may instead have been related to the clearance of vegetation in preparation for the construction of the burial mound. A small quantity of worked flint, including a retouched flake, an antler pick and several sherds of Fengate Style Peterborough Ware was recovered from the fill of a circular pit beneath Acklam Wold 211 (Figure 14). Although the nature of activity represented by the artefacts recovered from the fill of this pit is uncertain, recent studies of Neolithic settlement practice have highlighted the role of pit-digging in the creation of a sense of place (Pollard 1999; Harding 2006; Garrow 2007; Carver 2012).

Together with the assemblage of worked flint from the old land surface beneath Aldro 49, the assemblage of worked flint from the circular pit at Acklam Wold 211 would appear to suggest that the Neolithic and Bronze Age barrow cemeteries on the High Wolds were built within an inhabited landscape. Further evidence for settlement activity in the area of the barrow cemeteries is provided by residual occupational debris incorporated into the fabric of burial mounds. Fifty-two pieces of worked flint, including eight scrapers, a serrated blade, a burin and a polyhedral core, and several sherds of Ebbsfleet Style Peterborough Ware were recovered from the fabric of the burial mound at Riggs 20. Small assemblages of worked flint associated with sherds of Peterborough Ware were also recovered from the fabric of the burial mounds at Aldro 30 and Painsthorpe Wold 98. Peterborough Ware is the dominant ceramic tradition in Southern Britain between 3400 BC and 2800 BC (Ard and Darvill 2015) and is a regional variant of the Impressed Ware tradition characteristic of northern Europe during the late fourth and early third millennium BC (Gibson and Kinnes 1997).

Seventy-seven pieces of worked flint, including a leaf-shaped arrowhead, a transverse arrowhead, a thumbnail scraper, five burins and an awl, were recovered from the surface of

the interim mound which sealed the Early Neolithic mortuary enclosure at Calais Wold 275. Several sherds of Towthorpe Ware and over two hundred sherds of All-Over-Combed (AOC) and All-Over-Tooth-Combed (AOTC) Beaker pottery were subsequently found on the surface of this mound when the site was re-excavated between 1974 and 1975, along with charcoal and further knapping debris (Coombs 1976a, 1976b). Radiocarbon dates suggest a Late Neolithic (Phase 6) date for the interim mound. A minimum of thirty vessels, none of which could be completely reconstructed, was represented by the sherds of Beaker pottery recovered from the surface of the interim mound. Although the character of the assemblage of pottery is considered to be indicative of occupational debris (Gibson 1982, 122–26), it is unclear whether this debris is the product of sustained activity or a single intensive event. Widespread evidence for communal feasting has been identified in the Avebury region and feasting was thought to have an increasingly important role in funerary rites from the Late Neolithic onwards (Thomas 1999, 224).

With the possible exception of the serrated blade and burin recovered from the fabric of the burial mound at Riggs 20, the stone tools identified amongst the lithic assemblages associated with Peterborough Ware were consistent with Late Neolithic industries. In contrast, the knapping debris recovered from the surface of the interim mound at Calais Wold 275 contained stone tools characteristic of both Early Neolithic and Late Neolithic industries. Burins are found in Mesolithic and Neolithic contexts and are considered to be a declining element of the Early Neolithic tool kit (Butler 2005, 131–32). Conversely, thumbnail scrapers are found in Late Neolithic and Bronze Age contexts and are frequently associated with Beaker activity (Gibson 1982). The identification of Early Neolithic artefacts, including several sherds of Towthorpe Ware, amongst the occupation debris recovered from the surface of the interim mound is not surprising. Residual material from the Early Neolithic (Phase 2) mortuary enclosure is likely to have been both incorporated into the fabric of the interim mound and exposed on the surface of the mound. The possibility that more than one phase of activity may be represented amongst other lithic assemblages from the Neolithic burial mounds cannot be discounted.

1.3 Aggregation and low-density scatters

A series of recurrent themes which are critical to the research questions outlined in the introduction are highlighted by the case studies used in this thesis. First, the datasets from the case studies are aggregated, either by areal unit (parish, plot of land or collection unit) in

the case of the stray finds and lithic scatters from surface contexts or by stratigraphic unit (funerary or domestic) in the case of the comparative assemblages of worked flint from excavated contexts. Secondly, despite the low frequency of artefacts recovered from any given areal unit or stratigraphic unit, the artefacts from the Wharram-le-Street case study and the Neolithic burial mounds would appear to contradict the notion that the High Wolds were marginal to the main area of settlement in Eastern Yorkshire (see Section 1.1). Thirdly, one or more phases of activity may be represented by an individual lithic scatter or assemblage of worked flint; however, only a small proportion of the total number of artefacts recovered are chronologically diagnostic *per se*. The next chapter considers the methodological and theoretical implications of aggregation and develops a framework for the analysis and interpretation of low frequencies or densities of artefacts.

A resel-based approach to the analysis of low-density lithic scatters

This chapter develops an approach to the analysis of lithic artefacts from surface contexts which treats the areal unit rather than the artefact as the basic unit of analysis. The first part of the chapter introduces the data structure and methods of analysis which underpin this approach and assesses the impact of aggregation on the characterisation of stray finds and lithic scatters at different levels of spatial resolution. Datasets from the case studies introduced in the previous chapter are used to implement Tobler's proposal for a resel-based Geographical Information System (Tobler 1995) and highlight the implications of ecological fallacy and the Modifiable Areal Unit Problem. The second part of the chapter considers the problems posed by the low frequencies of lithic artefacts recovered from the study area and establishes a mechanism through which these problems can be addressed. A robust methodology is defined which can be used to identify underlying trends in the spatial distribution of lithic artefacts from surface contexts, differentiating between single artefacts which correspond to stray finds and those which form part of a low-density lithic scatter.

2.1 Geographic Information: what and where

Geographic models (including both conceptual models and data models) are used to represent real-world geographic phenomena for the purposes of cartographic modelling or spatial analysis (Burrough and McDonnell 1998, 17–34). A degree of generalisation is involved in any such model and the purpose for which a dataset will be used should be considered when choosing a particular model. The most appropriate model is both context and scale-dependent. Different conceptual models may be used for different purposes. The distribution of artefacts from surface contexts, for example, may be represented as either: a continuous field reflecting variation in the distribution of artefacts, or; a series of discrete entities representing locations from which artefacts were recovered. Different data models may also be chosen to represent the same geographic phenomenon at different scales. A lithic scatter, for example, could be represented as either a polygon showing the location and extent of the lithic scatter or a point corresponding to the centroid or geographic centre of the scatter.

Geographic Information Systems (GIS) are routinely used to create, manage and manipulate spatial datasets in order to produce digital maps. Even at this basic level, a distinction can be made between *representation*, i.e. the depiction of the spatial properties of geographic features, and *visualisation*, i.e. the depiction of the non-spatial attributes of geographic features. The widespread availability of software and the ease of push-button solutions has resulted in a proliferation of GIS applications in archaeology and other spatial disciplines. Many of these applications, however, are uncritical and fail to consider the implications of the choice of a particular model for the purposes of spatial analysis. Applications are typically constrained by the limits of the technology rather than dictated by the questions which are being asked by archaeologists or geographers. The conceptual models which underpin GIS make assumptions about the world which we inhabit and, by extension, the world which was inhabited by past populations. These assumptions can be broadly subdivided into two categories: those relating to the representation of real-world geographic phenomena, and; those relating to the nature of the space in which those phenomena occur.

Introductory texts on GIS (e.g. Worboys 1995; Burrough and McDonnell 1998) and their applications in disciplines such as archaeology (e.g. Wheatley and Gillings 2002; Conolly and Lake 2006) typically begin with a theoretical section which seeks to address two fundamental but deceptively simple questions – what? and where? The spatial and non-spatial attributes of geographic phenomena, however, can be defined in many ways. Furthermore, different definitions may be used by different people, at different times and in different contexts. While terms such as hill and peak are routinely used to describe topographic features, geographers have repeatedly asked how the landforms which correspond to these terms can be recognised on the ground, represented on a map or classified using spatial data (e.g. Evans 1972; Wood 1996; Fisher, Wood, and Cheng 2004). Geographic phenomena such as the distribution of artefacts from surface contexts can be conceptualised as either a continuous field or as a series of discrete entities (Burrough and McDonnell 1998, 20–21). Continuous fields can be used to represent phenomena which vary continuously over a given geographic area (e.g. artefact density), whereas discrete entities can be used to represent phenomena which occur in specific locations (e.g. a findspot of a stone axe). Inevitably there is a degree of overlap between these models. Depending upon the conceptual model chosen, geographic phenomena can be encoded as either raster datasets or vector datasets (Burrough and McDonnell 1998, 21–26).

The notion of space is integral to both the structure of raster and vector datasets and the description of the positions of cells or features within those datasets. A distinction is commonly made between the concepts of absolute and relative space (Harvey 1969). Absolute space is invariant and the positions of geographic objects are described with respect to a fixed frame of reference. Conversely, relative space is a manifold within which the positions of geographic objects can only be described in relation to one another. GIS typically describe the positions of cells/features in relation to a known co-ordinate system and are therefore wedded to the concept of absolute space. At a theoretical level, it is this union which lies at the heart of many of the criticisms of the applications of GIS within archaeology and the spatial humanities. Attempts to model visibility and movement have been criticised both for being overtly environmentally deterministic (Gaffney and van Leusen 1995) and for perpetuating the 'God trick' (Haraway 1991). Distance, for instance, may be measured in terms of cost, time or social interaction rather than miles or kilometres (Watson 1955). Equally, the notion that everything is visible at once or at all times is contrary to embodied human experience (Thomas 1993).

Concepts of space also have fundamental implications for the analysis of raster and vector datasets. The techniques used in the analysis of spatial datasets can be broadly divided into two groups, namely cell-based and point-based operations. Cell-based operations include both local functions, based on the analysis of the values of individual cells within multiple raster datasets, and focal functions, based on the analysis of the values of multiple cells within an individual raster dataset (Tomlin 1990). Point-based operations include inverse distance functions, where the influence of a feature is based solely upon its proximity to a specified location, and weighted functions, where the influence of a feature is based upon both proximity and the magnitude of a particular attribute (Bailey and Gatrell 1995). In the case of vector datasets which contain lines and polygons, point-based operations are performed on the centroids or geographic centres of the features rather than the actual features.

2.1.1 Traditional vector and raster data structures

The difficulties in selecting a data structure to represent data from surface survey can be highlighted with reference to the Wharram-le-Street case study. In order to faithfully represent the areas from which artefacts were recovered the survey data could be encoded as either a raster dataset with a resolution of 2m and each collection unit corresponding to ten cells (Figure 15, top left), or a vector dataset with each collection unit corresponding to a

single polygon 20m long and 2m wide (Figure 15, top right). Whilst preserving the geometry of the collection units, both of these data structures are poorly suited to the visualisation of the non-spatial attributes of the collection units (i.e. artefact frequencies) due to the large number of cells with null values or large expanses of white space corresponding to areas from which artefacts were not collected.

The sampling strategy assumes that the artefacts recovered from each collection unit are representative of those which would have been recovered from the surrounding area. It is therefore possible to reduce the overall number of cells and eliminate the white space by generalising the survey data so that it is representative of the sample frame and encoding the data as either a raster dataset with a resolution of 10m and each collection unit corresponding to two adjacent cells (Figure 15, bottom left), or a vector dataset with each collection unit corresponding to a single polygon 20m long and 10m wide (Figure 15, bottom right). Although both of these data structures are well suited to the representation of the spatial distribution of artefacts as a continuous surface, neither is ideally suited to spatial analysis.

Cell-based operations are applied at a cellular level, either to an individual cell in the case of local functions or to neighbouring cells in the case of focal functions, rather than at the level of the collection unit. However, without the ability to specify different x and y cell-sizes, each collection unit is represented by more than one cell due to the unequal spacing between transects and collection intervals. In this instance, the problem can be overcome due to the regular configuration of the collection units, either by using map algebra to apply focal operations to alternate cells in the raster dataset or by resampling the dataset so that each collection unit corresponds to a single cell. But what if irregular collection units were used? If the parishes for the study area used in this thesis were encoded as a raster dataset both the number and configuration of the cells would vary from one parish to the next making it difficult to determine the relationships between individual parishes at the cellular level.

Point-based operations are applied to individual features, with the relationships between features defined in terms of the distance between the position of the centroid of a feature and the positions of the centroids of the other features in a dataset. As with the example of the raster dataset above, problems are introduced by the configuration of the collection units used for the Wharram-le-Street case study, i.e. the unequal spacing between transects and collection intervals. Using an analogy with a chess-board, the neighbours of a collection unit

can be defined as either the collection units which are laterally or longitudinally adjacent to the collection unit (the Rook's case) or the collection units which are laterally, longitudinally or diagonally adjacent to the collection unit (the Queen's case) (Tobler and Kennedy 2010). First neighbours are the collection units which are directly adjacent to the collection unit, while second neighbours are the collection units which are adjacent to the first neighbours.

For gridded data a search radius of 10m would be required to find the first neighbours of a 10m grid square using the Rook's case (Figure 16, top left), whilst a search radius of 14.14m would be required to find the first neighbours of the grid square using the Queen's case (Figure 16, top right). However, the search radii (20m for the Rook's case and 22.36m for the Queen's Case) required to find the first neighbours of a collection unit for the transect data from Wharram-le-Street is at least double the distance between transects and would therefore also find two of the second neighbours (Figure 16, bottom left and Figure 16, bottom right). Whilst generalisation of the survey data does not alter the centroids of the collection units, the distribution of the corresponding points makes it difficult to determine the relationships between collection units in terms of distance. This observation has important implications for analytical techniques based on data interaction.

The conceptualisation of the spatial relationships between geographic objects is critical when performing spatial analysis. In the case of data from surface survey, it is the relationships between collection units which is important rather than the precise locations of the collection units. These relationships become more significant when dealing with survey data from areas where evidence for past human activity is characterised by highly localised or low-density artefact scatters. They are couched in terms of the concept of relative space, akin to the cell-based relationships defined for raster datasets, rather than the concept of absolute space, allied to the distance based-relationships defined for vector datasets. An alternative data structure is required to model these relationships for data from both systematic and unsystematic surveys and regardless of the configuration of the sampling strategies and the regularity of the collection units employed.

2.1.2 Alternative resel and network data structures

It has been argued that it is geographical objects that are of interest to the typical GIS user, rather than the data models which are used to represent those objects (Tobler 1995). Techniques such as spatial filtering (also referred to as convolution) which are routinely used

in the analysis of raster datasets cannot readily be applied to vector datasets. Much of the statistical data analysed by historical geographers and epidemiologists relate to political or administrative units, e.g. census data. These areal units have well-defined boundaries and can consequently be represented as discrete entities (typically contiguous polygons), which will be referred to hereafter as resolution elements or resels. Unlike the cells or pixels in a raster dataset, resels are irregular in size, shape and orientation and, more significantly in this context, do not have a homogeneous number of neighbours.

An alternative approach, using a generalisation of the techniques used in image processing, has been proposed by Tobler to address this problem (Tobler 1995). This approach is based on the analogy of a spreadsheet with a row for each of the features in the dataset and columns containing the values of the non-spatial attributes of the features. The spreadsheet is extended with additional columns defining the relationships between each feature and all of the other features in the dataset, creating an *n* x *n* matrix which is referred to by Tobler as the **L** matrix. Although each cell in the **L** matrix can only contain a single value, multiple matrices can be added to the spreadsheet to define different spatial relationships. This data structure supports a wide range of analytical operations, with global functions applied to the columns which contain the attributes of each of the features and spatial filters (focal functions) applied to the **L** matrices which define the relationships between individual features. Tobler's spreadsheet analogy can be extended using an approach based on topological elements and their logical extension, network datasets, an approach which is considered to have wider analytical utility and greater interpretative potential.

The analysis of raster datasets is simplified by the arrangement of the cells or pixels on a regular grid. Every cell or pixel which forms part of a raster dataset has an identical number of neighbours. The neighbours of an individual cell or pixel (referred to collectively as a neighbourhood) can therefore be identified consistently, providing a robust syntax which can be used for the purposes of map algebra. Neighbourhoods are typically defined in relation to the cell or pixel at the centre of a moving window either using a kernel or n x m matrix (c.f. ArcGIS[5]), or by specifying row/column offsets (c.f. GRASS[6]). First neighbours, cells or pixels

[5] http://pro.arcgis.com/en/pro-app/tool-reference/spatial-analyst/how-focal-statistics-works.htm (visited 2/10/2018).
[6] https://grass.osgeo.org/grass77/manuals/r.mapcalc.html (visited 2/10/2018).

which are adjacent to the cell or pixel at the centre of the window, can be defined using a 3 x 3 matrix or by specifying a ±1 cell offset. Second or higher neighbours can be defined by increasing the size of the kernel or incrementing the row/column offsets.

Spatial filters are focal functions, i.e. functions which are based on the values of the cells or pixels within a neighbourhood (c.f. Tomlin 1990, 96). Whilst it is simple to identify the neighbours of a cell or pixel in a raster dataset, it is more difficult to identify the neighbours of an areal unit in a resel dataset and therefore harder to define a neighbourhood that can be used to apply a spatial filter. Depending upon the criteria used to a define a neighbour, every cell or pixel in a raster dataset will have either four first neighbours and eight second neighbours (Rook's case), or eight first neighbours and sixteen second neighbours (Queen's case). In contrast, the number of first neighbours for the areal units in a resel dataset will vary from one unit to the next. Furthermore, since the number of first neighbours is not constant for every areal unit, the number of second neighbours cannot be predicted.

Take for example the parishes from the Wolds study area. Each of the parishes has between two (Allerthorpe, Fangfoss, Foxholes and Rudston) and nine (Huggate) first neighbours. The parish of Wetwang, one of the parishes close to the centre of the study area, has six first neighbours regardless of the criteria used to define a neighbour (Figure 17). One might anticipate that the parish would have twelve second neighbours if each parish had the same number of first neighbours. However, the number of first neighbours varies from one parish to the next and the parish of Wetwang actually has either thirteen (Rook's case) or fourteen (Queen's case) second neighbours. A set of unique criteria are required in order to define the neighbours of an areal unit and establish a robust syntax which can be used as the basis for map algebra for the analysis of the features in a resel-based dataset.

The geometric properties which define a neighbour can be explained with reference to the resels corresponding to the cells or grid squares in a 3 x 3 window (Figure 18). Each of the resels can be defined as a series of topological elements: an area (a polygon defined by the list of arcs which make up its boundary, i.e. the geographic extent of the resel); a series of arcs (lines defined by an ordered list of vertices linking two nodes, i.e. the edges of the resel); a series of nodes (the start/end point of an arc or the intersection of two or more arcs, i.e. the corners of the resel), and an annotation (a point which is used to attach an attribute to an area, i.e. the label for the resel). The shared geometry of these topological elements can be

used to explicitly define the spatial relationships between each of the cells or grid squares in the 3 x 3 window.

These topological relationships help to maintain the integrity of spatial data and allow spatial operations based on connectivity (arcs connect to each other at nodes), area definition (arcs that connect to surround an area define a polygon) and contiguity (arcs have direction and left/right sides). The neighbours of each of the cells or grid squares in the 3 x 3 window can be identified using one of the following criteria, either cells or grid squares which share an edge (arc) with one another, i.e. the Rook's case, or; cells or grid squares which share a corner (node) with one another, i.e. the Queen's case. In the first instance, the neighbours of a cell or grid square can be identified using the left-right topology which describes the contiguity of the topological elements. In the second instance, the neighbours of a cell or grid square can be identified using the arc-node topology which describes the connectivity of the topological elements.

A spatial weights matrix, **W**, contains a formal expression of spatial dependence between variables for the features in a vector dataset (Anselin 1988). The structure of spatial dependence, i.e. the relationships between each of the features in the dataset, can be conceptualised using a wide variety of schemes, including spatially contiguous neighbours, inverse distances raised to some power and the lengths of shared borders divided by perimeter (Getis and Aldstadt 2004, 91). It is the first conceptual model which is of relevance here, i.e. the artefacts found in one collection unit can best be understood in relation to those found in adjacent collection units. The spatial weights matrix for the cells or grid squares in a 3 x 3 window is shown in Table 5. This matrix is equivalent to Tobler's **L** matrix and can be used to construct a one-mode network which describes the latent structure of the features in the dataset.

In its simplest form a network is a graph comprised of a set of points or nodes (vertices) and a set of lines linking pairs of vertices (arcs and/or edges). The resels corresponding to the cells or grid squares in a 3 x 3 window can be represented schematically as a network with a set of vertices corresponding to the centroids of each of the resels and a set of edges defining the relationships between the individual resels (Figure 19). In contrast to vector or raster-based data structures, a network-based data structure can be applied to any dataset regardless of the configuration of the areal units since each resel is represented as a point or node,

irrespective of its geometry, and may be linked to other resels by any number of arcs and/or edges, with no upper or lower limit. This data structure is a logical extension of Tobler's spreadsheet analogy and was implemented using *Pajek*, an open source application for the analysis and visualisation of large network datasets[7].

The methods used in *Pajek* are based upon the manipulation of a series of data objects (networks, partitions, vectors, permutations, clusters and hierarchies) with origins in basic concepts from graph theory (Nooy, Mrvar, and Batagelj 2005, 8). These data objects can be saved as plain text files (permanent datasets) or can be created on the fly during the course of the analysis of a network (temporary datasets). Network data objects can be constructed rapidly from vector datasets for which spatial weights matrices have been generated. Once a network dataset has been constructed it can be used to perform a wide range of neighbour-based operations, including spatial filtering. The edge list which forms part of the network data object is essentially a list of adjacent vertices and can therefore be used to identify the neighbours of the vertex corresponding to any given feature. Unlike topological elements, second or subsequent neighbours of the vertex corresponding to a feature can be found simply by identifying the neighbours of the first neighbours and so on and so forth.

Low pass filters, for example, can be applied by calculating the average values of the neighbours of each of the vertices in a network data object. The non-spatial attributes of vertices are stored in separate data objects, with the values of continuous variables stored as vectors and the values of categorical variables stored as permutations. Both of these data objects are ordered lists and the values they contain can easily be imported from or exported to fields in the attribute table for the source vector dataset. The results of the analysis of a network are typically output as vector or partition data objects and can either be displayed natively in *Pajek* using graduated or colour-coded symbols, or can be exported to *ArcGIS* in order to generate a thematic map. As with Tobler's initial spreadsheet analogy, the network-based data structure implemented here formally separates the process of analysis and visualisation.

[7] http://mrvar.fdv.uni-lj.si/pajek/ (visited 2/10/2018).

2.1.3 Aggregation and the implications of scale

Data from surface survey is typically aggregated and, contrary to popular belief, it is the areal unit and not the artefact which is the basic unit of analysis. The level at which data is aggregated may vary from one dataset to the next, for example: the artefacts recovered from the transects for the Wharram-le-Street case study were aggregated by collection unit, and; the stray finds and lithic scatters identified within the study area were aggregated by civil parish. Geographers have long recognised that aggregation has important theoretical and methodological implications for the analysis and interpretation of spatial data. The notion of ecological fallacy and its derivative the Modifiable Aerial Unit Problem (MAUP) are of particular relevance in the context of this debate.

Ecological fallacy highlights the impact of scale on the analysis and interpretation of ecological phenomena or, for that matter, geographical or archaeological phenomena (Harris 2006, 47). In particular, it is concerned with the problems inherent in making inferences from higher to lower levels of analysis, for instance the difficulties in making inferences about forest ecosystems from individual plants. These problems are compounded by those associated with the integration of datasets with different coverages or geographic extents and the standardisation of datasets which are captured at different scales (Haggett 1965, 164). Within the context of the analysis and interpretation of lithic artefacts from surface context, ecological fallacy is concerned with the difficulties in moving from the analysis of individual stone tools or pieces of lithic debitage to the analysis of stone working traditions and settlement practice.

Scale underpins both the patterns identified within the spatial distribution of lithic artefacts and processes such as changes in the spatial organisation of stone working which are represented by those patterns. The Modifiable Areal Unit Problem questions the assumption that the patterns and processes which are observed at one scale or level of aggregation are representative of those for the entire population (Alker 1969). Further, are the patterns and processes identified at one scale or level of aggregation the same as those that would have been identified at any other scale or level of aggregation? The Modifiable Areal Unit Problem is comprised of three separate but closely related problems (Openshaw 1983, 8), namely:

1. Scale, i.e. the optimal scale for a survey and the variation introduced by the overall and surface area of areal units;

2. Aggregation, i.e. the configuration of areal units and the variation which may be introduced by different sampling strategies, and;

3. Ecological fallacy, i.e. the inference that the aggregated characteristics of an areal unit are representative of the entire unit.

Often areal units have no intrinsic geographic meaning and since areal units are arbitrary and modifiable then it is reasonable to assume that so too are the results of spatial analysis based on those units. If different rules of aggregation were applied then the resulting patterns may be artefacts of the modifiable units and the aggregation procedures applied rather than the underlying geographic or archaeological data. The methodological implications of the Modifiable Areal Unit Problem are explored below with reference to the changes in the parish boundaries which have taken place in the study area since the mid 19th century.

A total of 128 stray finds and lithic scatters were identified within the study area, the majority of which can only be located at the level of the parish. Many of these stray finds and lithic scatters were identified during the mid to late 19th century and the boundaries of the corresponding parishes have changed dramatically since this time. Parishes were re-organised as a result of the New Parishes Act 1843, Poor Law Amendment Act 1844, Divided Parishes and Poor Law Amendment Acts (1876 and 1882) and Local Government Act 1894 (Kain and Oliver 2001). Comparison of the ancient and civil parish datasets compiled as part of the Great Britain Historical Geographic Information System[8], reveals that a significant number of parishes have been consolidated, dissolved, enlarged, renamed, shrunk or subdivided since the mid 19th century (Figure 20).

A decrease in the frequency of the parishes and increase of the average area of the parishes can be seen within the study area between 1851 and 1971 (Table 6). The frequency of parishes decreased rapidly during the mid to late 19th century, with the rate at which the frequency decreased slowing dramatically during the first half of the 20th century. Whilst many of the parishes had been combined to form larger parishes by 1871 (e.g. the parishes of Raisthorpe and Burdale, Wharram Percy and Wharram-le-Street were merged to form a single parish), a handful of divided parishes still survived in 1921 several decades after the Divided

[8] http://www2.port.ac.uk/research/gbhgis/ (visited 2/10/2018).

Parishes Act had been passed (e.g. Burythorpe). The decrease in the frequency of parishes was accompanied by an increase in the average area of the parishes from 68.394 hectares in 1851 (141 ancient parishes) to 165.664 hectares in 1991 (58 civil parishes).

The decrease in the frequency and increase in the average area of the parishes has obvious implications for the analysis and interpretation of datasets which are aggregated by parish. Approximately a third of the stray finds and lithic scatters which were located to a specific locality correspond to parishes which no longer exist – a loss of spatial resolution which could mask important trends. The stray finds and lithic scatters from the parish of Luttons, for example, were not uniformly distributed throughout the parish. Luttons was formerly divided into three parishes, the parishes of East Lutton and West Lutton (later merged to form the parish of Luttons Ambo) and the parish of Helperthorpe. Five of the stray finds and lithic scatters from Luttons were derived from the parish of Helperthorpe. In contrast, only one of the stray finds and lithic scatters was derived from the parish of West Lutton.

Discrete patterning can be identified in the spatial distribution of the counts of the stray finds and lithic scatters aggregated by civil parishes (Figure 21). The combined distribution of stray finds and lithic scatters masks some underlying variation, with the distribution of lithic scatters confined largely to the parishes at the north-east corner of the study area and the distribution of stray finds dispersed more widely throughout parishes in different parts of the study area. Together, the aggregated data suggest that the highest concentrations of artefacts from surface contexts are found in the parishes clustered along the line of the Great Wold Valley, most notably the parishes of Luttons and Thwing, and the low-lying parishes to the north and west of Driffield on the edge of the Wolds, including the parishes of Cottam and Garton. Both of these areas are known foci for prehistoric activity.

The distribution of stray finds and lithic scatters can be contrasted with the distribution of the burial mounds which were excavated during the mid to late 19th and early 20th centuries (Figure 22). At face value there would appear to be a stark contrast between the distributions of artefacts from surface contexts and burial mounds, consistent with the notions of domain of the living and domain of the dead suggested for the Stonehenge region (Parker Pearson and Ramilisonina 1998). While this contrast is true for the burial mounds excavated by Mortimer, closer inspection reveals a strong correlation between the distributions of artefacts from surface contexts and the burial mounds excavated by Greenwell. This correlation is not

surprising as over a sixth of the stray finds and lithic scatters were identified from the accounts of the excavations published in *British Barrows* (e.g. Evans 1897) or from collections which had been formerly purchased or acquired by Greenwell (e.g. Smith 1931). Many of the other stray finds and lithic scatters were identified from sources which pre-dated the publication of *Forty Years' Researches* but were not directly attributed to Greenwell.

First impressions can be misleading and a dataset can tell an entirely different story when understood in its proper context. In this instance, the fragmentary picture gleaned from the distribution of stray finds and lithic scatter would appear to be more indicative of mid 19th century barrow digging than prehistoric settlement practice. The difficulty in interpreting the distribution of artefacts from surface contexts is compounded by a wide range of problems, including the integration of material from both systematic and unsystematic surveys and the aggregation of artefacts from multiple phases of activity. Furthermore, whilst there is a strong correlation between prehistoric monuments and parish boundaries on the High Wolds (Pouncett 2007), it is unlikely that ancient or civil parishes correspond directly to prehistoric land use. The implications of ecological fallacy need to be considered when interpreting data aggregated by parish. One potential solution is to use focal functions or spatial filters to identify underlying trends in the distribution of surface artefacts.

These implications are equally applicable to data from systematic surface survey which is aggregated by grid square or collection unit. Field experiments and computer-based simulations have demonstrated that ploughing can distort artefact distributions and introduce spurious spatial patterning. However, little consideration has been given to the impact of the aggregation schemes represented by different sampling strategies. Emphasis has been placed upon the efficacy of sampling strategies for the detection of sites rather than their suitability for the representation of the distribution of artefacts from surface contexts as a continuous field. Any impact is going to be particularly acute in instances where evidence for past human activity is characterised by low-density artefact scatters. The configuration of grid squares or collection units will influence both the size and distribution of areal units and the aggregated values upon which spatial analysis is based.

2.2 Visualisation and analysis of surface scatters

A wide variety of methods can be used to visualise the non-spatial attributes of spatial datasets, in this instance the distribution of lithic artefacts from surface contexts. Traditional

methods, such as thematic mapping, respect the geometry or spatial attributes of a dataset. Attributes are displayed for either polygons or the points corresponding to the centroids of polygons, with colour coding or symbols representing either unique or classified values (Dent, Torguson, and Hodler 2008). Depending on the geographic models used to represent data from surface survey, thematic maps can be generated as either a point provenance plot with graduated symbols showing the frequency of artefacts (e.g. Boismier and Reilly 1988), a chorochromatic map with graduated colours showing the frequency of artefacts (e.g. Gillings and Sbonias 1999) or a kernel density map with isolines or solid contours showing the density of artefacts (e.g. Wheatley 1996).

Non-traditional methods, such as cartograms, emphasise the non-spatial attributes of a dataset at the expense of its geometry. A variety of algorithms can be used to change the shape of polygons so that their size is based on the value a particular attribute (Dorling 1996). Where data from surface survey have been encoded as a series of contiguous polygons, cartograms can be generated where the size of each polygon or areal unit is proportionate to the frequency of artefacts which were recovered. Cartograms, also known as value by area or density equalising maps, cross the divide between absolute and relative concepts of space. Whilst the size and shape of polygons are changed, the algorithm used to generate the cartogram should preserve the relationships between individual polygons (Gastner and Newman 2004). Cartograms prioritise topology, giving greater weighting to the relationships between areal units rather than their geographic extent or precise location.

Both thematic mapping and cartograms allow rapid visualisation of the results of surface survey, allowing intuitive identification of spatial patterning. Unless unique values are used, a robust method of classification is required in order to subdivide the data into meaningful bins or classes (Dent, Torguson, and Hodler 2008, 85–92). Common methods used to define the break values between bins or classes include: natural breaks (Jenks), where break values are defined using inflection points in the histogram for the dataset; equal intervals, where break values are defined so that each bin or class has an identical range; quantiles, where break values are defined so that each bin or class contains the same number of features, and; standard deviations, where break values are defined as standard deviations above or below the mean. These methods of classification have been applied to data from surface survey and used to differentiate between areal units which correspond to sites and areal units which correspond to the background scatter (e.g. Millett 1991; Lock and Daly 1999).

Whilst the distinction between sites and the background scatter is contrary to the notion of the continuity of past human activity which lies at the heart of off-site archaeology (Foley 1981b), discretized values are necessary in order to define statistical models which describe variation in the frequency of artefacts from surface contexts. The simplest method of reclassifying the values of the artefact frequencies for the areal units corresponding to the collection units from the Wharram-le-Street case study would be to define two bins or classes using natural breaks (Dent, Torguson, and Hodler 2008, 87–88). Using this method of classification areal units with 2 or more artefacts are classified as part of a site, while those with 0 or 1 artefacts would be classified as part of the background scatter.

This threshold between the background scatter and sites corresponds to the break value used to differentiate between stray finds and lithic scatters as part of the *Lithic Scatters Project* carried out by English Heritage. Unlike the data from the *Lithic Scatters Project*, where each of the stray finds come from a different locality, the survey data for the Wharram-le-Street relates to the same plot of land. Classification is another form of aggregation and the implications of the Modifiable Areal Unit Problem must be considered when interpreting datasets which have been aggregated by bin or class. If single artefacts were recovered from two areal units located at opposite ends of the plot of land it is easy to reconcile the artefacts with stray finds. However, if single artefacts were recovered from two areal units located next to one another the artefacts could potentially have corresponded to part of a site.

Given the variability in the frequency of the artefacts introduced by the use of different aggregation schemes, the threshold between sites and the background scatter is arbitrary. In the second instance, both artefacts could have been recovered from the same areal unit if a different sampling strategy or configuration of collection units had been employed during the course of the survey. Again, as with the stray finds and lithic scatters from the wider study area (see Section 1.1.1.), this example raises the question: how can single artefacts which form part of a low-density lithic scatter be differentiated from those which simply correspond to stray finds? It also provides a potential solution: areal units with single artefacts which form part of a lithic scatter are likely to be adjacent to other areal units which yielded lithic artefacts, while those which correspond to stray finds are not.

In contrast to a raster or vector-based data structure, this solution can be implemented easily for a resel-based data structure using the network-based implementation of Tobler's

spreadsheet analogy developed here. Adjacency or connectivity is one of the basic concepts of graph theory which underpins network analysis (Nooy, Mrvar, and Batagelj 2005, 63–64). The degree of a vertex indicates the number of vertices to which a vertex is connected (k neighbours). Vertices with a high degree are more likely to be found in a dense or strongly connected part of the network. Conversely, vertices with a low degree are more likely to be found in a less dense or weakly connected part of the network. In this context, the degree of a vertex can be used to establish a measure of confidence that a vertex corresponding to an areal unit which yielded a single artefact formed part of a site – the higher the degree of the vertex, the greater the confidence that the artefact was part of a low-density lithic scatter rather than a stray find and *vice versa*.

This measure of confidence is based on the relationships between each areal unit and the adjacent areal units which yielded artefacts and therefore requires reduction of the network to include only vertices with non-zero values (Figure 23). Since the areal units at the edge of the survey area have fewer neighbours than those in the centre of the survey area, this measure is perhaps better expressed as the ratio of the degree of a vertex to the total number of neighbours. Two of the vertices corresponding to areal units with single artefacts were not connected to another vertex (degree or ratio = 0) and could be interpreted as stray finds. However, the vast majority of the areal units with single artefacts were connected to at least one other vertex (degree or ratio > 0) and could potentially have formed part of a low-density scatter.

The exclusion of zeros for the purposes of differentiating between single artefacts which formed part of a low-density lithic scatter, i.e. areal units which corresponded to part of a site, and those which were simply stray finds, i.e. areal units which corresponded to part of the background scatter, raises further methodological issues. Zero is a legitimate value indicating that no artefacts were recovered from the areal unit corresponding to a collection unit rather than that the collection unit was not surveyed. It is important to recognise that the areal units which were classified as part of the background scatter using natural breaks (Jenks) included areal units with both single artefacts and zero values. This observation is a product of ecological fallacy. An areal unit with a value of zero does not signify the absence of artefacts, merely that no artefacts were recovered from the collection unit during the course of the survey.

The problems associated with handing null values for raster datasets or missing values for vector datasets have been thoroughly documented. In the case of cell-based operations, a null value is returned where any of the terms in a map algebra expression correspond to a cell with a null value for an attribute. Null values are therefore substituted with an identity element (identity), i.e. a numeric value which does not change the value of the evaluated expression: 0 for operations based on addition or subtraction, and 1 for operations based on multiplication and division. In the case of point-based operations, features with no data are treated as missing values and excluded from analysis. Again, as with cell-based operations, features can be included in analysis by substituting the missing values with the appropriate identity. Unlike cells with null values or features with no data, cells or features where the value of an attribute is zero are included in analysis unless they are specifically excluded.

2.2.1 The implications of zero values

It has already been observed that areal units with zero values do not signify the absence of artefacts. The aggregated values of the frequency of artefacts for the Wharram-le-Street case study are based on 20% coverage of the survey area. Two questions arise: 1) are the aggregated values representative of the entire areal unit, i.e. were the artefacts distributed uniformly within the areal unit? and 2) if no artefacts were recovered from an areal unit would artefacts have been recovered from the adjacent parts of the survey area? In the first instance, the stray finds and lithic scatters identified within the parishes corresponding to the study area were not uniformly distributed within each of the parishes. In the second instance, none of the parishes with no stray finds or lithic scatters recorded in the Historic England National Record of the Historic Environment have been systematically surveyed and the zero values reflect the lack of previous research rather than the absence of past human activity.

Furthermore, it has been estimated that between 5% and 6% of the artefacts incorporated to the plough zone are exposed on the surface at any one time. These estimates raise a third question: if no artefacts were recovered from an areal unit would artefacts have been recovered from the corresponding area through excavation? If a single artefact had been incorporated into the plough zone there would be only a 1 in 19 or 1 in 20 chance that the artefact would be visible on the surface of the site. Even if 100% coverage was attained through the use of a quadrat-based sampling strategy, the probability that the artefact would be recovered during the course of surface survey is low. The way in which zero values are handled has profound implications for the analysis of the spatial distribution of artefacts from

surface contexts, particularly in regions where raw materials are scarce or where evidence for past human activity is characterised by low densities of artefacts.

Little or no consideration has been given to the methodological issues posed by the inclusion of areal units where the value of a non-spatial attribute is zero. Where zeros are included, any terms in an expression which contain zero values are reduced to 0, the identity for addition and subtraction, and have no impact on the results of those operations. Similarly, any terms in an expression where the exponent is reduced to 0 are evaluated as 1, the identity for multiplication and division, and have no impact on the results of those operations. In the case of the resel-based data structure adopted here, the inclusion of vertices corresponding to areal units with zero values has implications for convolution or spatial filtering, preserving numeric values for the focal sum and smoothing values for the focal mean. The inclusion of zero values lowers the mean of the aggregated data and decreases the value of the threshold used to differentiate between ‘sites’ and the background scatter.

Any change in the threshold between areal units which correspond to part of a site and those which correspond to part of the background scatter, no matter how small, can have a dramatic impact. In the case of the Wharram-le-Street case study, where zeros are excluded the threshold between 'sites' and the background scatter defined using natural breaks (Jenks) is 3 artefacts. The number of areal units which are classified as part of a site is comparatively low (n=45), with less than half of the artefacts recovered during the course of the survey derived from those areal units. Where zeros are included the threshold used to differentiate between 'sites' and the background scatter is 2 artefacts, a decrease of just 1 artefact. The number of areal units which are classified as part of a site increases significantly (n=78), with over two thirds of the total number of artefacts derived from those areal units.

Definition of the threshold between 'sites' and the background scatter based on natural breaks (Jenks) is perhaps overly simplistic. Alternative methods of classification have therefore been suggested based on quantiles or standard deviations. One such method was adopted for the *Ager Tarraconensis Survey*, where Abnormal Densities Above Background Scatter (ADABS) were defined using quantiles (Millett 1991). Ranked values were classified into eight bins or classes corresponding to octiles, with each bin or class containing approximately 12.5% of the areal units and the upper octile corresponding to areal units with an abnormal density of artefacts. The survey data from the Wharram-le-Street case study can

only be classified using the Ager Tarraconensis approach where areal units with zero values are included. A total of 431 areal units were included in the survey, with a maximum of 7 artefacts recovered from each areal unit. The data can be classified into octiles where zeros are included since there are eight unique values (0 to 7 inclusive).

In theory, each bin or class should contain c.54 areal units (i.e. an eighth of the total number of areal units), with the threshold between 'sites' and the background scatter defined by the areal unit with the 378th highest ranked value (i.e. the minimum value for the upper octile). Each bin or class, however, must contain a unique range of values. Consequently, in practice, each bin or class contains between 1 and 242 areal units, with the upper octile corresponding to a single areal unit which yielded 7 artefacts (Table 7). Quantitatively there is little to distinguish areal units with ADABS from those which correspond to part of a site. Arguably, the greatest contribution of this approach is the recognition that it is not possible to define an absolute threshold between 'sites' and the background scatter and that the value of the threshold is adaptive, i.e. the number of artefacts which constitutes part of a site is unique to each dataset.

An alternative approach based on standard deviations was adopted as part of the *Sangro Valley Project* (Lock and Daly 1999). Normalised values were classified into bins or classes based on standard deviations, with each class or bin corresponding to a multiple of the standard deviation and areal units with values greater than 1 standard deviation above the mean corresponding to part of a site. This approach is grounded in probability theory, rejecting the null hypothesis that the artefacts recovered during the course of the survey are distributed randomly between the areal units. The probability that each of the areal units which form part of a site would have randomly been allocated that number of artefacts is low. Whilst the approach adopted for the *Sangro Valley Project* is fundamentally different to that adopted for the *Ager Tarraconensis Survey*, there is little difference in the percentages of areal units classified as part of a site using these approaches (15.83% and 12.5% respectively).

In contrast to the Ager Tarraconensis approach, the Sangro Valley approach can be applied to the survey data from Wharram-le-Street irrespective of whether areal units with zero values are included or excluded. The threshold between 'sites' and the background scatter (rounded to the nearest artefact) is 3 artefacts where zeros are excluded and 2 artefacts where zeros are included (Table 8). If this threshold is taken as the upper limit of the background scatter,

areal units with 4 or more artefacts and 3 or more artefacts respectively would be classified as part of a site. Conversely, if this threshold is taken as the lower limits of 'sites', areal units with 3 or more artefacts and 2 or more artefacts respectively would be classified as part of a site. Whilst the differences between the thresholds used to differentiate between 'sites' and the background scatter is minimal, there is a significant difference in the total number of artefacts recovered from the areal units with 2 or more artefacts and the total number of artefacts recovered from those with 4 or more artefacts.

Regardless of the method of classification used, the low number of unique values and the high frequency of collection units with zero values introduces problems when trying to define the threshold between 'sites' and the background scatter. These problems are typical in regions where raw materials are scarce or where evidence for past human activity is characterised by low-density artefact scatters. Artefact frequency can be measured as either a categorical variable measured at an ordinal level or as a continuous variable measured at a scale level. Statistical packages such as SPSS typically treat variables with less than 24 unique values as categorical variables rather than continuous variables. Since the artefact frequency for the survey data from the Wharram-le-Street case study has a maximum of 8 unique values it should be treated as a categorical variable. In order to be treated as a continuous variable, the number of unique values must be increased.

2.2.2 Spatial filtering of polygon features

The number of unqiue values can be increased by applying a focal function or spatial filter (convolution) to the survey data, i.e. by standardising the values of the artefact frequencies for each of the areal units based on the values of the adjacent areal units. Convolution is routinely used in image processing to reduce or enhance local variability or 'noise' for the purposes of edge matching and smoothing (Burrough and McDonnell 1998, 186–89). Focal functions or spatial filters can also be used to increase the number of unique values for data from surface survey. The focal sum and focal mean can be calculated for the vertices corresponding to each of the areal units in a resel-based dataset using the following expressions:

$$\sum x_i = x_0 + \sum_{n=1}^{n=k} x_n$$

and:

$$\overline{x_i} = \frac{\sum x_i}{k+1}$$

where:

x_0 = value of areal unit

x_n = value of adjacent areal units

k = degree of vertex

It is appropriate to calculate focal sums for data collected using systematic sampling strategies, such as the survey data from the Wharram-le-Street case study, since each areal unit should theoretically have an identical number of neighbours. Where incomplete areal units are included, the neighbours which lie beyond the limits of the survey area can be treated as vertices with null values. Consequently, calculation of the focal sum will minimise the potential impact of 'edge' effects, i.e. statistical artefacts introduced by the inclusion of areal units along the edges of the survey area.

Furthermore, focal means can be calculated for any dataset regardless of whether it was collected using a systematic or unsystematic sampling strategy since it accounts for differences in the number of neighbours for each of the areal units. A low-pass filter, for example, can be applied to the parish data from the study area by calculating the focal mean for the vertices corresponding to each of the parishes. The filtered data clearly shows the concentration of stray finds and lithic scatters in the north-east of the study area where Greenwell was particularly active (Figure 24). This approach is a logical extension of the use of the degree of a vertex to provide a measure of confidence that areal units with single artefacts correspond to part of a low-density artefact scatter rather than stray finds. It also provides a mechanism for the inclusion of zero values, addressing the potential implications of ecology fallacy and the Modifiable Areal Unit Problem.

Returning to the survey data from the Wharram-le-Street case study, calculation of the focal mean increases the number of unique values from 8 to 52 (including zeros). The convoluted data is consequently better suited to more complex methods of classification than the raw data. Where the convoluted values are classified into 8 bins or classes using quantiles, there is a major reduction in the variability in the number of areal units corresponding to each bin or class, with the number of areal units ranging between 24 for the bin or class corresponding

to the 1st octile and 88 for the bin or class corresponding to the 2nd octile. A total of 45 areal units were included in the bin or class corresponding the upper octile and would be classified as part of a site using the approach adopted for the *Ager Tarraconensis Survey*. Together, these areal units yielded approximately a third of the total number of artefacts recovered during the course of the survey.

Where the convoluted values are classified using standard deviations, the value of the threshold used to differentiate between 'sites' and the backgrounds scatter corresponds to a focal mean of 1.711 artefacts. A total of 77 areal units had convoluted values greater than one standard deviation above the mean and would be classified as part of a site using the approach adopted for the *Sangro Valley Project*. Together, these areal units yielded approximately half of the artefacts which were recovered during the course of the survey. Whilst the direct link between the non-spatial attributes of the collection units has been broken by transforming the artefact frequencies, the convoluted values still correspond to the collection units from which the artefacts were derived. Regardless of the method used to differentiate between areal units which correspond to part of a site and those which correspond to part of the background scatter, two main concentrations of artefacts can be seen in the survey data: one to the east of the former source of the Gypsey Race and one to the west of the former source of the Gypsey Race (Figure 25, left).

The spatial patterning in the distribution of artefacts can also be enhanced by resampling the survey data to a finer resolution or, in this instance, by resampling the data so that the spacing between transects and collection intervals is equal (Figure 25, right). This can be achieved by interpolation or by splitting each collection unit into two areal units and by reallocating the artefacts between the areal units corresponding to the left and right sides of the collection unit. The resampling of the survey data for the Wharram-le-Street case study is simplified by the regular configuration of the collection units and a simple rule set can be created to split each of the collection units into two areal units. Artefacts can be reallocated based on the sum of the values of the adjacent collection units, assigning greater weighting to the values of the collection units in the same transect (the first neighbours defined using the Rook's case) than those of the collection units in adjacent transects (the first neighbours defined using the Queen's case). Both spatial filtering and resampling enhance the patterns visible in the point provenance plot for the lithic artefacts from the surface scatter (Figure 6).

2.2.3 Spatial statistics and exploratory data analysis

Until this point, emphasis has been placed on the analysis of the non-spatial attributes of data from surface survey at the expense of the analysis of the spatial attributes of that data. Reclassification of the values of the non-spatial attributes of a dataset can allow the intuitive identification of spatial patterning through the production of thematic maps or cartograms. In conjunction with thresholding or similar methods of classification, these patterns can be made explicit by merging adjacent areal units with identical values to form contiguous areas which correspond respectively to 'sites' and the background scatter. Clumping, for example, can be used to identify cells with identical values in a raster dataset by comparing the value of each cell with those of the cells above and to the left of the cell (Shapiro 2008). Cell-based operations like clumping, however, are typically less versatile than their point-based counterparts used in exploratory data analysis which take into account variation in the spatial associations between the features in a vector dataset (Anselin 1995).

The term spatial statistics refers to a range of inferential techniques, grounded in probability theory, which test the null hypothesis that the distribution of features in a spatial dataset is part of a larger population (Ebdon 1985). Each of the statistical techniques outlined below tests the null hypothesis that the features in a spatial dataset are randomly distributed. Where the value of the test statistic is significantly higher or lower than that expected for a random distribution, the spatial distribution of features can be characterised as either clustered or dispersed. The critical values and confidence levels for the test statistic can be defined by calculating the z score and p value respectively. A z score of +1.96 standard deviations or higher and p value less than 0.05 indicates a clustered distribution with a less than 5% chance that the clustering was the result of random chance. Conversely, a z score of -1.96 standard deviations or lower and p value less than 0.05 indicates a dispersed distribution with a less than 5% chance that the dispersion was the result of random chance[9].

A common variant of the null hypothesis used in spatial statistics is the randomization null hypothesis, i.e. that the distribution of features in a spatial dataset is one version of a random distribution (Bailey and Gatrell 1995, 96–105). This hypothesis assumes that the observed

[9] The critical values for the z score at the 1% confidence level are +2.68 standard deviations for a clustered distribution and -2.68 standard deviations for a dispersed distribution, with a p value less than 0.01 in both instances.

spatial distribution of features is one of *n* possible distributions and that, since the data values are fixed, only the spatial distribution of the features could vary. It assumes Complete Spatial Randomness (CSR), i.e. the assumption that the distribution of features is an example of a homogeneous Poisson distribution. A test statistic that corresponds to the centre of the Poisson distribution is consistent with the expected outcome, indicating that the null hypothesis is correct and that the spatial distribution of the features is an example of a random distribution. In contrast, a test statistic which corresponds to the tails of the Poisson distribution indicates that the null hypothesis should be rejected and that the distribution of the features must be either clustered or dispersed.

One of the most common and simplest techniques used to test the distribution of the features in a spatial dataset is nearest neighbour analysis (Whallon 1974). The spatial distribution of features can be tested by calculating the average nearest neighbour ratio for the dataset, i.e. the ratio of the values of the observed mean distance between each feature and its nearest neighbour and the expected mean distance for features with a random distribution. The test statistic is sensitive to the size of the survey area. Consequently, where the size of the survey area is known its value should be specified in the parameters for the test to eliminate potential bias and enable meaningful comparison of the test statistics for different datasets. Values for the test statistic >1 indicate that the distribution of features in a spatial dataset is clustered, while those <1 indicate that the spatial distribution of the features is dispersed. In both instances, the confidence level in the characterisation of the spatial distribution is low where the value of the test statistic for a dataset is close to 1.

Although nearest neighbour analysis is well-suited to point data, it is poorly suited to data which has been aggregated by areal unit. For instance, the values of the average nearest neighbour ratio for the survey data from the Wharram-le-Street case study where zeros are included (frequency ≥ 0 artefacts) and where zeros are excluded (frequency ≥ 1 artefact) indicate a dispersed distribution with a less than 1% likelihood that the dispersion was the result of random chance (Table 9). Unless the survey data is reduced to include only collection units which yielded 3 or more artefacts (frequency ≥ 3+ artefacts), the threshold between areal units which corresponded to part of 'sites' and those which corresponded to part of the background scatter based on the Sangro Valley approach, the test statistic relates to the configuration of the areal units rather than the distribution of the artefacts.

Since the collection units are represented as polygons, the value of the average nearest neighbour ratio is calculated for the points corresponding to the centroids of the polygons. Due to the regular configuration of the collection units, the distribution of the centroids of the polygons is characterised by a uniform distribution of points spaced at intervals of 20m along the x axis and 10m along the y axis. Consequently, it is not surprising that the value of the test statistic indicates a dispersed distribution when all of the collection units are included in the nearest neighbour analysis. It is only when the number of collection units is dramatically reduced that the value of the test statistic begins to correspond to the distribution of artefacts. As the number of collection units decreases, however, so does the confidence level in the value of the test statistic. Similarly, in the case of the parish data for the study area, nearest neighbour analysis would tell us more about the configuration of the civil parishes than the spatial distribution of stray finds and lithic scatters.

One potential solution would be to create multiple polygons for each collection unit or parish, with one polygon per artefact, stray find or lithic scatter. Where multiple polygons are created for each collection unit or parish, the centroids of those polygons are coincident with one another. Since a feature cannot be its own neighbour, distances are still calculated to the closest adjacent polygon. Greater weighting, however, is given to the distances between collection units or parishes with multiple artefacts and their nearest neighbours. This principle is used in geostatistical techniques such as kriging where weights are used to apply moments to each of the features within a spatial dataset based on the values of a non-spatial attribute (Burrough 1986). Kriging assumes that a dataset exhibits positive spatial autocorrelation, i.e. the values for features which are close together are similar to one another, while those for features which are far apart are dissimilar to one another.

Spatial autocorrelation underpins many of the statistical techniques which are used in spatial analysis (Cliff and Ord 1973). The focal functions used to apply spatial filters to the values of the artefact frequencies for the Wharram-le-Street case study and the counts of the stray finds and lithic scatters for the study area, for instance, are based on the assumption that the values for neighbouring collection units or parishes are closely related to one another – an assumption that is taken one step further by the method used to resample the survey data from Wharram-le-Street so that the spacing between transects and collection units is equal in order to enhance the spatial patterning in the distribution of artefacts. Spatial autocorrelation can be tested by calculating the Moran's I statistic, a statistic which tests the null hypothesis

that there is no spatial patterning in the distribution of the values of a non-spatial attribute for each of the features in the dataset.

The Moran's I statistic can be used to identify the range of distances where spatial autocorrelation is strongest and to test the suitability of a dataset for techniques which require independent values (Goodchild 1988). Values of the test statistic range between -1 and 1, with negative values indicating that the spatial distribution of the values of an attribute are dispersed (i.e. the values exhibit negative spatial autocorrelation) and positive values indicating that the values of an attribute are clustered (i.e. the values exhibit positive spatial autocorrelation). Where the value of the test statistic is close to zero the confidence level in the characterisation of the spatial distribution is low, indicating that the null hypothesis is correct and that there is no spatial patterning in the distribution of the values of a non-spatial attribute for each of the features in the dataset (i.e. the values do not exhibit spatial autocorrelation) and that the values for the features are randomly distributed.

In the case of the survey data for the Wharram-le-Street case study, the Moran's I statistic for the artefact frequencies has a value of 0.32 where collection units with zeros values are excluded and 0.21 where collection units with zeros values are included, with z scores of 6.47 and 6.28 respectively indicating that the values of the artefact frequencies are clustered with a less than 1% likelihood that the clustering was the result of random chance. The spatial patterning persists regardless of whether zero values were included or excluded and is enhanced when a focal function is applied to the survey data, with a test statistic of 0.90 and z score of 18.31 indicating that the values of the focal mean are clustered at the 1% confidence level. Whilst calculation of the focal mean does not introduce spurious spatial patterning, it is likely to mask localised trends in the distribution of artefacts.

Both of the tests of the distribution of the features in a spatial dataset outlined above calculated a single test statistic, z score and p value for the entire dataset. The characterisation of a spatial distribution based on all of the features in a spatial dataset is likely to mask local variation between features in different parts of the dataset. Fortunately, test statistics based on local indicators of spatial association, such as the Anselin's Local Moran's I test statistic, have been developed to identify this type of variation (Anselin 1995). The Anselin's Local Moran's I test statistic is an implementation of the Moran's I test statistic which identifies local trends in the spatial patterning of features and the values of their attributes

(Anselin 1995). Test statistics, z scores and p values are calculated for each of the features in a spatial dataset and localised patterning can consequently be identified in the distribution of the values of the attributes for the features. The values of the test statistics can be used to identify both clusters of features with similar values and spatial outliers, i.e. features with a value which is significantly different to the values of its immediate neighbours. In addition to the test statistics, each of the features is classified at the 5% confidence level as either: 1) part of a cluster of high values; 2) part of a cluster of low values; 3) a spatial outlier with a high value; or, 4) a spatial outlier with a low value.

A high frequency of spatial outliers can be identified within the raw survey data from the Wharram-le-Street case study due to the low number of unique values. Distinct spatial patterning, however, can be seen in the values of the Local Moran's I test statistics for the focal mean of the artefact frequencies (Figure 26). The distribution of the values of the focal mean is dominated by two discrete clusters of collection units with high values in the central and eastern parts of the survey area. Localised clusters of collection units with low values can also be seen along the margins of the survey area. In each instance, the collection units which correspond to these clusters have high z scores and low p values indicating a high degree of confidence that the clustering is not simply the product of random chance. Variability in the values of the test statistics for the focal mean in the western part of the survey area is not reflected in the classified values for the collection units. In order to interpret the significance of the clusters of high values it is also necessary to understand the nature of the activity represented by the unclassified collection units.

Classes of artefacts characteristic of Mesolithic, Neolithic and Bronze Age industries were recovered from both the collection units which formed part of the clusters of high values and the collection units from the western part of the survey area. These classes of artefacts represent several millennia of past human activity and it would be naïve to assume that the spatial distribution of artefacts represents a single pattern of discard and deposition. At best, spatial patterning identified on the basis of the analysis of the composite distribution of artefacts will be indicative of the dominant phase of activity, i.e. the phase of activity which yielded the highest frequency of artefacts or which resulted in the highest degree of clustering. While, at worst, the spatial patterning will be the cumulative product of multiple patterns of discard and deposition and thus may not be indicative of any of the phases of activity. Meaningful interpretation of the spatial patterning in the distribution of lithic

artefacts from surface contexts is only possible when groups of stone tools and lithic debitage which are broadly contemporary with one another have been identified.

The distribution of chronologically diagnostic artefacts would appear to suggest that the spatial patterning identified within the values of the focal mean was the product of at least two distinct patterns of discard and deposition. These patterns of discard and deposition are characterised by the clustering of artefacts from Mesolithic and Early Neolithic activity close to the former source of the Gypsey Race and the dispersion of artefacts from Late Neolithic and Bronze Age activity over the entire survey area. By isolating groups of artefacts which were characteristic of each of these phases of activity it may be possible to refine the spatial patterning identified on the basis of the values of the focal mean of the artefact frequency. However, less than a fifth of the assemblage of stone tools and lithic debitage recovered from the Wharram-le-Street case study was chronologically diagnostic and a maximum of two diagnostic artefacts was recovered from any given collection unit.

2.3 Time and relative dimensions in space

The approach to the analysis of stray finds and lithic scatters developed in this chapter treats the areal unit rather than the artefact as the basic unit of analysis and focuses on the relationships between artefacts found in adjacent areal units. It acknowledges the methodological and theoretical implications of ecological fallacy and addresses the problems posed by low frequencies or densities of artefacts. The network data structure used to implement Tobler's proposal for a resel-based GIS provides a mechanism for handing areal units with zero values and allows identification of spatial patterning amongst datasets with a low number of unique values. Whilst the analytical potential of this approach has been highlighted using the case studies introduced in the previous chapter, calibration of the spatial distribution of lithic artefacts from surface contexts is required using comparative assemblages of worked flint from excavated contexts before meaningful analysis can be undertaken. Technological analysis of the stone tools and unmodified cores from the Neolithic burial mounds in the next chapter is intended to identify methods and techniques which are characteristic of different stone working traditions and can ultimately be used to isolate groups of artefacts associated with individual phases of activity.

Neolithic stone working traditions on the Yorkshire Wolds

This chapter seeks to characterise the nature of the Neolithic stone working traditions on the Yorkshire Wolds through the technological analysis of the stone tools and unmodified cores from the Neolithic burial mounds. The first part of the chapter identifies recurrent patterns in the raw materials, methods and techniques employed in Early Neolithic and Late Neolithic stone working traditions, through the reconstruction and comparison of the 'life histories' of the stone tools. This approach is intended to standardise the way in which the process of making stone tools is described, identify the knapping operations employed at different stages of that process, and predict the attributes of the resultant lithic debitage. The second part of the chapter identifies the methods of core working that were represented amongst the lithic assemblages from Early Neolithic and Late Neolithic contexts, differentiating between both systematic and expedient methods of core working, and organised and opportunistic stone working. Technological analysis of the stone tools and unmodified cores would appear to indicate that local industries were reliant on 'small rocks' and that the removal of cortex did not play a significant role in the initial stages of stone working.

3.1 Stone working in context

Analysis of lithic assemblages from both excavated contexts and surface scatters has been dominated by the typological classification of stone tools and cores for the purposes of relative dating. Criteria used to establish artefact typologies are primarily based on the morphological characteristics of the final form of the stone tool (c.f. Evans 1897; Clark, Higgs, and Longworth 1960; Green 1980). In the case of the Neolithic, the artefact typologies used for the purposes of the analysis of lithic assemblages are largely reliant upon the system of recording established for a single site, the site at Hurst Fen, near Mildenhall in Suffolk (Clark, Higgs, and Longworth 1960). The classes of scrapers, burins and cores defined in this system of recording, however, were essentially modified versions of those employed in the typology for the Mesolithic site at Star Carr, in the Vale of Pickering, North Yorkshire (Clark 1954).

The variability in the criteria used for typologies for different classes of artefacts is reflected in the complexity of the recording system developed for the Southern Hebrides Mesolithic Project (Finlayson, Finlay, and Mithen 2000). This system was an adaptation of the recording system used in the analysis of the lithic assemblages from the excavations at Kinloch, Rhum (Wickham-Jones 1990), which was based on the terminological lexicon set out in *Technology and Terminology of Knapped Stone* (Tixier, Inizan, and Roche 1980)[10]. Despite the use of the same standardised vocabulary, these recording systems are not interoperable and perpetuate an all too familiar fragmented approach to the analysis of lithic technology, permitting little or no comparison of different classes of artefacts from the same lithic assemblage, let alone those from other lithic assemblages.

A comparatively simple typology was used for the purposes of the description of the lithic assemblages from the surface scatter at Wharram-le-Street and the Neolithic burial mounds. This typology comprised eight generic classes of stone tools and lithic debitage (e.g. arrowheads and flakes), each of which was in turn subdivided into a series of sub-classes (e.g. leaf-shaped arrowheads and cortical flakes). Each artefact was assigned a unique identifier, using a single sequence of numbers for the lithic assemblages from all of the burial mounds[11]. Artefacts which were on display at the Hull and East Riding Museum but which had been illustrated in *Forty Years' Researches* (Mortimer 1905) were also included in this analysis and are denoted by the letters A to V. In the absence of a one size fits all recording system, an approach based on the reconstruction of 'life-histories' was adopted (after Inizan et al. 1999). This approach is grounded in the basic principles of fracture mechanics.

The sequence of knapping operations can be inferred from the flake scars on the worked surface of a stone tool, working from the centre of the stone tool outwards and identifying flake scars from later removals which truncate the ridges formed by the flake scars from earlier removals. Flake scars from knapping operations associated with the preparation of the debitage surface on a core or the initial stages of tool manufacture will be truncated by flake scars from knapping operations associated with the modification of blanks or the final stages

[10] Updated with a multilingual vocabulary (Inizan et al. 1999).
[11] ID numbers 54 to 65 inclusive corresponded to the artefacts from Towthorpe 292, one of the burial mounds (Towthorpe 291, 292 and 293) immediately to the east of the circular enclosure at Duggleby Howe (Towthorpe 273). The lithic assemblage from this barrow was initially included in the sample of Neolithic round barrows due to its proximity to the lithic artefact scatter at Wharram-le-Street, however, could not be dated independently and in consequence was ultimately excluded.

of tool manufacture. The resultant 'life histories' (Appendix G) can be compared across the different types of stone tools represented amongst the lithic assemblages from the Neolithic burial mounds (Table 10) to identify recurrent patterns that can be used to characterise the methods and techniques employed in different stone working traditions. They can also be compared directly with the 'life histories' for the stone tools represented amongst the lithic assemblage from the surface scatter at Wharram-le-Street (Appendix I). This approach is a fusion of the American and French traditions which have dominated the analysis of lithic technology (Grimaldi 1998). In contrast to conventional 'vertical' approaches which have dominated both the American and French traditions and focus on the individual sequences of knapping operations associated with the manufacture of particular classes of stone tools, this 'horizontal' approach seeks to identify the elements of stone working that are common to the manufacture of different classes of stone tools.

In the case of stone tools which were manufactured from blades or flakes, the distribution of flake scars was recorded in relation to the dorsal surface and ventral surface of the blank. The terms Face I and Face II, however, were used for stone tools which were manufactured from other types of blank or those which had been worked bifacially and the dorsal and ventral surfaces could no longer be identified. Both surfaces were divided into three zones: upper/proximal, middle/medial and lower/distal. The relative position on each of the surfaces was noted in relation to the left edge or right edge of the implement. Left and right were defined in relation to the long axis of the stone tool, with either the bulb of percussion/striking platform or point at the top, and the base or haft at the bottom. The size and depth of flake scars or type of edge-retouching were also recorded.

Basic dimensions, i.e. length (parallel to the long axis), breadth (perpendicular to the length) and thickness, were included in all of the life histories. These dimensions were supplemented by additional measurements for classes of stone tools, such as transverse arrowheads, where metric properties have been used to establish or reinforce artefact typologies (c.f. Green 1984). Measurements were taken using a pair of *Mitutoyo Absolute Digimatic* digital callipers, with a tolerance of ±0.02mm. Although the stone tools on display in the Hull and East Riding Museum were illustrated in *Forty Years' Researches* (Mortimer 1905), only one face of each of the stone tools was typically illustrated. The 'life histories' for these artefacts relate only to the illustrated surface(s) – the sequence of knapping operations are incomplete and variables extracted from the 'life histories' have missing values.

The 'life histories' for the stone tools from the Neolithic burial mounds were combined in order to eliminate variability due to individual responses to knapping errors or flaws in the material, and to identify recurrent sequences of knapping operations indicative of the use of particular methods and techniques. Whilst it is not possible to define a universal sequence of knapping operations, a series of general patterns emerge when the combined 'life histories' for each of the classes of stone tools are compared. Underlying trends in the raw materials, types of blanks, and methods and techniques used in the manufacture of stone tools from different phases of activity can potentially be used to discriminate between Early Neolithic and Late Neolithic stone working traditions.

3.1.1 Sourcing the stone

The lithic assemblages from the Neolithic burial mounds were overwhelmingly dominated by worked flint. With the exception of the hammerstones from the non-megalithic chamber at Towthorpe 18 and the fragment of the stone pounder or hammerstone recovered from the fabric of the burial mound at Aldro C75, only one piece of worked stone was identified within the lithic assemblages. This implement, a blunted-back edge-retouched flake knife from the fabric of the burial mound at Aldro 116, was manufactured from a piece of epidotised intermediate tuff (Figure 27). Epidotised intermediate tuff is not represented in the solid geology of Eastern Yorkshire and instead outcrops only at a handful of locations in the Cumbria High Fells (Fell and Davis 1988, 73). It was typically used for the manufacture of stone axes, specifically Group VI axes from the axe factories at Great Langdale.

Two possibilities arise: either, the raw material used for the edge-retouched flake knife was a glacial erratic obtained from the exposures of boulder clay along the Holderness coastline or, the knife was manufactured from a flake from the roughing out of a Langdale axe and was brought to the region by human agency. The deposits of boulder clay in Holderness comprise three units, namely: the Skipsea Till (Drab Clay) and the Withernsea Till (Purple Clay) both deposited during the Dimlington Stadial (c.18,000 BP) (Penny, Coope, and Catt 1969); and, the Basement Till, deposited during the Wolstonian glaciation (c.140,000 BP) (Catt and Penny 1966) or the Late Devensian (c.20,000BP) (Eyles, McCabe, and Bowen 1994). All three units comprise glacially reworked marine deposits transported from the North Sea bed and, as such, are unlikely to be the source of the epidotised intermediate tuff.

Large numbers of Group VI axes have been found in Eastern Yorkshire (Bradley and Edmonds 1993). Complete Group VI axes and fragments of Group VI axes have been found in the immediate vicinity of the burial mounds that form part of the Towthorpe and Aldro barrow groups (Clough and Cummins 1988, 209–18). The methods and techniques used in the manufacture of Langdale axes are well documented (Edmonds 1989). A suitable piece of stone was selected as a blank for the axe. Flakes were removed from the edges of the piece of stone to create an edged blank, which in turn was shaped and thinned by the removal of further flakes to create a preform. The 'roughed out' axe was then finished by pecking and grinding. Flaking was carried out at axe factories close to the source of the epidotised intermediate tuff at Great Langdale and Scafell (Bradley and Edmonds 1993).

Although it is likely that the flake used as a blank for the blunted-back edge-retouched flake knife from Aldro 116 was derived from the axe factories in the Cumbria High Fells, it is impossible to determine whether the flake was brought to Eastern Yorkshire as an unmodified blank or as a finished implement. Regardless, the edge-retouched flake knife illustrates two key points. First, raw materials, blanks or stone tools were transported over large distances. Individual lithic assemblages cannot be understood in isolation and must instead be placed into a much broader spatial and temporal framework. Secondly, more than one class of artefact may be produced as part of a single knapping episode. Care must be taken to differentiate between the intended product of a reduction strategy and the expedient manufacture of stone tools from suitable blanks.

The remaining stone tools from the Neolithic burial mounds were manufactured from flint. Two principal sources of flint have been identified within Eastern Yorkshire (Figure 28), namely the flint marker horizons in the chalk formations of the Yorkshire Wolds and secondary deposits (glacial erratics) from the boulder clay along the Holderness coastline (Henson 1985). A distinction can be made between the nodular flint of the Welton formation and the tabular flint of the overlying Burnham formation. Both occur in a limited range of colours, varying from white to bluish grey. Surface exposures of the chalk on the High Wolds were subject to intense periglacial weathering. The associated horizons of nodular and tabular flint are often frost shattered. They fracture in an unpredictable manner and are consequently poorly suited to controlled flint knapping.

Nodules of flint, varying in colour from dark grey to reddish brown, can also be found in the deposits of boulder clay in Holderness. These nodules typically comprise higher quality dark coloured flint and have been compared to the flint found in the chalk of Southern Britain (Henson 1985, 7). They fracture in a more predictable manner and are therefore better suited to controlled flint knapping. The littoral zone, however, is a high energy environment. Many of the nodules of flint exposed on the beach have been rolled and battered by breaking waves. Flint which has been exposed for a prolonged period of time will typically have a waxy or lustrous surface, with a crushed or blocky texture which belies numerous hair-line or sub-surface fractures. Suitable nodules of flint are most likely to be found when fresh material is exposed from the boulder clay.

In contrast to southern Britain, no Neolithic flint mines have been identified in Eastern Yorkshire (Barber, Field, and Topping 1999). Instead, the procurement of raw materials is likely to have been largely reliant upon quarrying of the cliff edge (Figure 29). The coastline of Eastern Yorkshire, however, has shifted dramatically with the loss of numerous settlements since the mediaeval period (Sheppard 1912). It has been estimated that the position of the coastline during the Neolithic was at least 6km further to the east than the present day coastline (Manby 1988, 39). The absence of evidence for mining or quarrying is thus not surprising. Antler picks and bone shovels, however, are commonly found in Neolithic contexts. Quarrying of the cliff face would have been aided by collapses caused by storm seas during winter months, possibly suggesting a degree of seasonality.

Potential sources of raw materials can be identified through consideration of both the character of the traces of cortex or unmodified external surface of a piece of worked flint, and the colour of the flint used in the manufacture of stone tools. Over half of the stone tools, excluding those that were on display at the Hull and East Riding Museum, were partially corticated or retained partial traces of the outer surface of the raw material. In the majority of instances, the nature of the cortex or outer surface of the piece of flint was inconclusive. Several of the stone tools, however, had clearly been manufactured from nodules of high-quality flint obtained from the exposures of boulder clay along the coastline of Eastern Yorkshire or from pieces of rolled flint, presumably derived from the river gravels of Holderness, the Vale of York or the Vale of Pickering.

The dorsal surface of the flake or blade used as a blank for the edge-retouched flake knife found in the cache of worked flint from Burial 1 at Aldro C75 was fully corticated (Figure 30). This flake or blade was struck from the edge of a kidney-shaped nodule of high quality mid grey flint. Several refitting blades and flakes from the cache of worked flint had similar cortex and were thought to have been struck from the same nodule. The texture of the cortex on the dorsal surface of the edge-retouched flake knife and the refitting blades and flakes was characteristic of the flint nodules found in the exposures of boulder clay along the Holderness coastline. A direct link between the procurement of raw materials on the coast and stone working further inland can therefore be surmised during the Neolithic.

In contrast, the dorsal surface of the chunky flake or piece of angular shatter used as a blank for the fabricator from the outer mound at Towthorpe 273 was only partially corticated. One of the edges of the fabricator, however, was heavily rolled. This edge had a waxy or lustrous texture characteristic of the flint derived from the fluvio-glacial gravel deposited during the Dimlington Stadial (c.18,000 BP) (Penny, Coope, and Catt 1969). An unworked piece of flint gravel was also recovered from the fabric of the burial mound at Towthorpe 291. Small quantities of flint could have been obtained from the linear spreads and isolated patches of gravel deposited in Holderness, the Vale of York and the Vale of Pickering by glacial melt water. This potential source of raw materials is often overlooked.

Two of the stone tools from the Neolithic burial mounds were manufactured from flakes with a distinctive flat abraded or corticated surface characteristic of the tabular flint found either in the Burnham formation of the Yorkshire chalk or on the beaches of the Holderness coastline. Both of these implements, a short end scraper and a retouched flake, were recovered from the interim mound at Calais Wold 275. Over 200 sherds of AOC and AOTC Beaker pottery were found on the surface of this mound when the site was re-excavated between 1974 and 1975 (Coombs 1976a, 1976b). The lithic assemblage from which these implements were derived was dated to the Late Neolithic (Phase 6).

No definitive evidence for the use of tabular flint was identified amongst the stone tools recovered from Early Neolithic contexts. Tabular flint, however, could potentially have been used to manufacture leaf-shaped arrowheads. It has been suggested that leaf points may have been used as blanks for leaf-shaped arrowheads (Green 1980, 63). Indeed, the morphological characteristics of leaf points, their comparatively crude manufacture,

asymmetry and absence of a well-defined point (Clark, Higgs, and Longworth 1960, 223), are consistent with the later stages of bifacial reduction (Andrefsky 1998, 180). Traces of cortex were identified on both surfaces of the leaf point from Towthorpe 291 (Figure 31). This leaf point had a maximum thickness of 12.79mm and, as such, was thought to have been manufactured from a piece of tabular flint or a flat flint nodule.

The leaf point from Towthorpe 291 could not be dated independently and evidence for the use of tabular flint is consequently restricted to the lithic assemblages from Late Neolithic contexts. The use of tabular flint, typically flat pieces of flint less than 25mm in thickness, is broadly consistent with the decline in emphasis on the production of elongated flakes or blades for use as blanks for tools during the Late Neolithic and Early Bronze Age. Changes in core technology, with decreased emphasis on the careful creation and maintenance of striking platforms and debitage surfaces, associated with this decline have been documented in other parts of Britain (Edmonds 1987) and can be sustained on the basis of the analysis of the lithic debitage from the Neolithic burial mounds. These changes are also accompanied by the increasing use of a wider range of raw materials.

Whilst there is little overall variation in the percentages of stone tools manufactured from different coloured flint, two distinct underlying trends emerge: a decline in the use of high-quality black flint and an increase in the use of low-quality white flint (Table 11). The significance of any variability between the two extremes of the colour spectrum is debatable since systematic appraisal of the flint from Eastern Yorkshire has demonstrated that both colour and translucency may vary greatly within the same nodule (Henson 1985, 7). It is notable that the only stone tool manufactured from opaque white flint characteristic of the low-quality nodular flint from the Welton formation, a disc scraper recovered from the interim mound at Calais Wold 275, was derived from the same lithic assemblage as the end scraper and retouched flake manufactured from pieces of tabular flint.

The apparent trend towards the increased use of both tabular and nodular flint from the chalk formations of the Yorkshire Wolds for the purposes of manufacturing stone tools is confirmed by the analysis of the lithic debitage from the Neolithic burial mounds. Changes in the procurement of raw materials, reflected by the diversification of lithic resources, can potentially be used to discriminate between assemblages of worked flint associated with different phases of activity. These changes may have been precipitated by either increased

pressure on or restricted access to established sources of flint, i.e. the exposures of boulder clay along the Holderness coastline. Alternatively, they may simply reflect a decline in the demand for high quality raw materials associated with the wider changes in core technologies and reduction strategies which took place during the Late Neolithic.

3.1.2 Production of blanks

A wide variety of blanks was used in the manufacture of the stone tools from the Neolithic burial mounds. Two of the stone tools, the polished Duggleby type flint adze found with one of the simple burials (Burial G) at Towthorpe 273 and the leaf point from the old land surface beneath the burial mound at Towthorpe 291, could be classed as core tools. Both were manufactured from nodules of flint, or in the case of the leaf point from Towthorpe 291 possibly a piece of tabular flint, which were worked bifacially with the removals of a series of flakes from both surfaces of the blank. The vast majority of the stone tools, however, could be classified as flake tools and were manufactured from blades or flakes, which were subsequently worked either bifacially or on one surface only.

Whilst no evidence for differential patination indicative of the re-use of earlier pieces of worked flint was identified, the broken scraper from Wharram Percy 46 was thought possibly to have been re-used as an awl. Six of the stone tools were also manufactured from complete cores or core fragments, including four scrapers and a burin. These tools were derived from lithic assemblages that could be dated to both the Early Neolithic (Phase 2) and the Late Neolithic (Phases 4 and 6). Whilst there would appear to be little or no chronological pattern, all of the stone tools which were manufactured from cores could be classed as utilitarian and could have been made from any piece of flint, without the need for a specific type of blank.

The high frequency of stone tools which retained traces of cortex or the unmodified external surface of the piece of flint from which it was manufactured has already been noted. In the majority of instances, traces of cortex were confined to either the midpoint or the margins of the implement. Two of the stone tools, however, were manufactured from flakes where the entire dorsal surface was covered with cortex, i.e. the first flakes struck from a new core or striking platform. Both of these stone tools were derived from the lithic assemblages recovered from Aldro C75: the first, an edge-retouched flake knife found in the cache of worked flint from Burial 1; and, the second, an end scraper recovered from the fabric of the burial mound.

Persistent selection of cortical flakes as blanks for stone tools would appear to indicate either a lack of concern with the removal of cortex or reliance upon the use of smaller nodules of flint. The removal of cortex can take place during the course of the initial stages of the preparation of a core/debitage surface or the modification of a blank. It may be carried out for cosmetic or practical reasons, either reflecting aesthetic preferences or indicating a concern with precision and control. Although the removal of cortex will increase the likelihood that a piece of flint will fracture in a predicable manner, it is not necessarily a pre-requisite for the manufacture of stone tools. This is particularly true of the expedient pebble-based industries in areas like the Outer Hebrides where access to larger nodules of flint is limited (c.f. Wickham-Jones and Pouncett 2000).

Stone working, by its very nature, is a reductive process. The possibility that the external surface of a piece of worked flint may retain cortex is likely to decrease with every stage in the manufacturing process. Cortex is likely to have been removed either during the course of the modification of a blank or as part of the subsequent thinning and shaping of a stone tool. The frequency of stone tools manufactured from cortical flakes is therefore likely to have been higher than that suggested on the basis of the examination of the surfaces of finished implements. Use of cortical flakes was not confined solely to classes of stone tool that could be considered to be expedient. The oblique arrowhead from the outer mound at Towthorpe 273 was manufactured from a cortical flake.

The reductive nature of stone working also presents difficulties for the assessment of the metric properties of the blanks selected for the purposes of the manufacture of stone tools during the Neolithic. Artefacts such as leaf-shaped arrowheads which had been worked bifacially had typically been thinned and shaped extensively. In these instances, successive removals from both the edges and surfaces of the implement were likely to have resulted in a considerable change in the overall dimensions of the piece of flint initially selected as a blank. Not all classes of artefacts, however, were subject to extensive modification. With the exception of the removal of flakes to reduce or remove the bulb of percussion and/or striking platform, none of the scrapers from the Neolithic burial mounds had been significantly modified prior to edge-retouching.

In the case of end scrapers, the most abundant type of scraper found in the lithic assemblages from the Neolithic burial mounds, edge-retouching was confined to the distal end of the

implement. Whilst edge-retouching would have resulted in the truncation of the end of the scraper, it is likely to have had a consistent impact on the metric properties of the scraper and therefore the flake used as a blank. There would appear to be a change in both the overall size and the relative proportions of the flakes used as blanks for end scrapers during the Neolithic (Table 12). A decrease can be seen in the mean values of both the product (overall size) and the ratio (relative proportions) of the lengths and breadths of the end scrapers derived from lithic assemblages dated to the Early Neolithic (Phase 2) and those dated to the Late Neolithic (Phases 4 and 6).

The decline in the emphasis on the production of larger elongated flakes for use as blanks is not limited to end scrapers and instead would appear to be representative of broader changes in stone working traditions during the Neolithic. If the metric properties of a stone tool are used as proxies for those of the blank from which it was manufactured, a general trend towards the use of smaller broader flakes can be seen through time (Table 13). The mean values for the overall size and relative proportions of the stone tools typically decrease from one phase to the next. One of the phases of activity (Phase 3), however, is anomalous and does not respect this trend on either count. Five of the stone tools from this phase of activity were derived from the cache of worked flint associated with Burial 1 at Aldro C75.

Elongated flakes which are at least twice as long as they are wide (L:B ≥ 2.00) are commonly referred to as blades. The high mean values for the relative proportions of the stone tools from Phases 1 to 3 are consistent with blade manufacture. Several refitting blades and flakes were identified within the cache of worked flint from Burial 1 at Aldro C75. One of the blades thought to have been struck from the same core was used as a blank for an edge-retouched flake knife also found with Burial 1. Evidence for blade manufacture would appear to suggest that the stone tools derived from lithic assemblages dated to Phase 3 had a strong affinity with Early Neolithic stone working traditions, emphasising the transitional nature of this phase of activity.

The high mean value for the overall size of the stone tools from Phase 3 can be attributed to a single implement, the rectangular polished discoidal knife found with Burial 2 at Aldro C75, which had an overall size of 3,605mm^2. Only two of the stone tools from the Neolithic burial mounds, the leaf point found on the old land surface beneath Towthorpe 291 and the blunted-back edge-retouched flake knife from the fabric of the burial mound at Aldro 116, were larger,

with overall sizes of 5,128mm² and 3,792mm². These two implements should be treated as outliers. They were manufactured from a piece of tabular flint and a flake from the roughing-out of a Group VI stone axe respectively and are not typical of the types of blank selected for the purposes of manufacturing stone tools.

Four additional outliers can be identified in the scatter plot for the length and breadth of the stone tools from the Neolithic burial mounds (Figure 32). These outliers correspond to two of the leaf-shaped arrowheads found in the non-megalithic chamber at Towthorpe 18, the edge-retouched flake knife from Burial 1 at Aldro C75 and the polished-edge knife recovered from the linear zone at Aldro 94. Each of these stone tools was manufactured from a flake with a length greater than 80mm. The majority of the stone tools, however, were manufactured from flakes which did not exceed 60mm in length or breadth, adding weight to the suggestion that Neolithic stone working traditions on the Yorkshire Wolds were reliant upon the use of smaller nodules of flint (c.f. Makey 1996).

The rectangular polished discoidal knife from Aldro C75 had a length of 103mm and should therefore also be treated as an outlier. Analysis of the stone tools from the Neolithic burial mounds would appear to suggest that access to larger nodules of flint was limited. A flake of suitable size and shape, however, could have been obtained from a smaller nodule of flint using the Levallois method. Evidence for the use of this method in Eastern Yorkshire during the Neolithic, including distinctive Levallois-like or 'tortoise shell' cores, has been identified at the specialist workshops at North Dale and South Landing (Durden 1994, 1995, 1996). The dihedral burin recovered from the fabric of the burial mound at Aldro C75 was also thought to have been manufactured from a broken Levallois-like or 'tortoise shell' core.

High mean values for both the overall size and the relative proportions of the stone tools in Phase 3 would appear to be related to the use of pre-determined debitage methods, in the form of either blade manufacture or the Levallois method. The apparent increase in the mean value for the relative proportions of the stone tools between Phases 5 and 6 (Table 13) can also be attributed to blade manufacture. Four of the stone tools dated to Phase 6 were manufactured from blades. All of these stone tools were derived from the interim mound at Calais Wold 275. The assemblage of worked flint from the interim mound contains residual material associated with the Early Neolithic mortuary enclosure beneath the mound, which may account for the apparent increase in Phase 6.

Although a general pattern emerges in the mean values for the overall size and relative proportions of the stone tools from the Neolithic burial mounds, it is not possible to define a meaningful threshold which marks the boundary between the metric properties of the flakes used as blanks for Early Neolithic and Late Neolithic stone tools. In both instances, there is a considerable degree of overlap between the minimum and maximum values for the phases of activity corresponding to the Early Neolithic (Phases 1 and 2) and those corresponding to the Late Neolithic (Phases 4 to 6). With the exception of Phase 5, the relative proportions of at least one of the stone tools from the aggregated assemblages for each of the phases of activity had a value above the threshold for blade manufacture (≥2.00) and another below this threshold (<2.00).

Furthermore, the mean values of the flakes used as blanks for end scrapers from both Early Neolithic (Phase 2) and Late Neolithic (Phases 4 and 6) contexts were considerably below the threshold for blade manufacture (Table 12). In contrast to the use of tabular flint which is exclusive to the lithic assemblages from Late Neolithic contexts, a more nuanced method of differentiating between the metric properties of stone tools associated with Early Neolithic and Late Neolithic stone working traditions is required. Stone tools with higher values for the overall size and relative proportions are more likely to be associated with Early Neolithic stone working traditions whilst those with lower values are more likely to be associated with Late Neolithic traditions and should therefore be weighted accordingly.

The methods used in the production of blanks can be inferred from the patterns of any flake scars from previous removals on the dorsal surface of a stone tool. Blades are characterised by parallel ridges formed by the flake scars from two or more previous ridges. Several of the flakes used as blanks for the stone tools from the Neolithic burial mounds had the metric properties of blades but lacked the regularity and parallel ridges of 'true' blades. These flakes, sometimes referred to as 'blade-like' flakes, can be more properly described as irregular blades (Bordes 1988, 6). Stone tools manufactured from 'true' blades were predominately found in lithic assemblages dated to the Early Neolithic (Phases 2 and 3) (Table 14), while those manufactured from irregular blades were more commonly found in lithic assemblages dated to the Late Neolithic (Phases 4 and 6).

In contrast, flakes struck from Levallois-like or 'tortoise shell' cores are characterised by a series of centripetal flake scars, truncated by either a single removal or recurrent removals

from the proximal end and/or distal end of the flake (Mellars 1996, 61). Flakes with a similar scar pattern could also have been created by *ad hoc* removals from polyhedral flake cores characteristic of the middle to late Bronze Age. One of the chisel-shaped arrowheads from Grave A at Towthorpe 273 and an awl recovered from the interim mound at Calais Wold 275 were tentatively thought to have been manufactured from flakes struck from Levallois-like or 'tortoise shell' cores. Both of these stone tools were derived from lithic assemblages dated to the Late Neolithic (Phases 5 and 6 respectively).

A degree of overlap between the two methods of producing pre-determined debitage is suggested by the lithic assemblages associated with the simple burials (Burials 1 and 2) at Aldro C75. Whilst evidence for blade manufacture was identified within the cache of worked flint from Burial 1, the rectangular polished discoidal knife found with Burial 2 was manufactured from a flake struck from a Levallois-like or 'tortoise shell' core. The distinction between the methods associated with Early Neolithic and Late Neolithic stone working traditions is also blurred by the type of flakes used as blanks for plano-convex knives. Plano-convex knives are generally considered to be Late Neolithic or Early Bronze Age in date and were thought to have been manufactured from broad flakes with a trapezoidal cross-section (Pierpoint 1980). A suitable flake was found beneath one of the plano-convex knives from Grave C at Painsthorpe Wold 98.

Blanks for plano-convex knives or barbed and tanged arrowheads could have been produced using a method similar to that employed in blade manufacture. This method was characterised by the preparation of a debitage surface with a series of parallel ridges. Two ridges would have been needed to produce a flake with a trapezoidal cross-section. These ridges could have been created by the removal of three flakes, the third of which would have resulted in the production of a blade or an elongated flake with parallel edges and a single ridge formed by the intersection of the flake scars from the two previous removals. Further removals can subsequently be controlled by adjusting the point of the impact, relative to the position of the ridges on the debitage surface and the edge of the striking platform. It is at this stage in the sequence of knapping operations where differences can potentially occur.

Two scenarios can be envisaged: either, two narrow blades or flakes could have been struck by two separate blows with points of impact close to the edge of the striking platform and directly in line with each of the ridges on the debitage surface; or, a single blade or flake could

have been produced by a blow with a point of impact further away from the edge of the striking platform and midway between the two ridges. Whilst both scenarios could potentially relate to blade manufacture, only the second scenario would result in the production of a flake suitable for use as a blank for a plano-convex knife. In this instance, the length and breadth of the removal respectively will be determined by a combination of the depth of the striking platform, the mode of percussion or the amount of force that was applied, and the distance between the ridges on the debitage surface.

Two of the plano-convex knives from Grave C at Painsthorpe Wold 98 and the plano-convex knife from the grave at Acklam Wold 211 had length to breadth ratios which were consistent with blade manufacture (Figure 33). The flakes used as blanks for these plano-convex knives would have had the same morphological characteristics as blades. Consequently, the methods used in the manufacture of stone tools cannot be inferred solely on the basis of a single variable or pair of variables, such as the pattern of flake scars on the dorsal surface of a flake or the length and breadth of a stone tool. In the majority of instances, the methods and techniques associated with different stone working traditions can only be identified through the analysis of a series of different metrical properties and/or physical attributes.

A higher frequency of debitage with the morphological characteristics of blades was likely to have been produced as a result of blade manufacture than during the course of the production of a blank for a plano-convex knife. Blade manufacture is a very efficient method of stone working and a large number of blades could potentially have been struck from a single debitage surface on a blade core. Only four elongated flakes or blades, however, would have been struck from the debitage surface of a core associated with the manufacture of plano-convex knives: the three narrow blades or flakes removed during the course of the preparation of the debitage surface and the flake used as a blank for the plano-convex knife. Blades are therefore still more likely to be associated with Early Neolithic stone working traditions and should be weighted accordingly.

3.1.3 Modification of blanks

The initial stages in the reduction sequence for an individual stone tool are determined by both the type of blank selected for the tool and the methods that were used in its manufacture. In the case of a stone tool which was manufactured from either a core or flake that was worked bifacially, an edged blank must be first created by the removal of a series of

flakes from both surfaces of the piece of worked flint. These removals would have served two purposes, namely the creation of a continuous striking platform around the circumference of the blank and the preparation of two debitage surfaces from which subsequent flakes could be removed in a controlled manner. The removal of cortex or pronounced ridges and reduction of striking platforms or bulbs of percussion is likely to have taken place at this stage in the sequence of knapping operations.

Once an edged blank has been created, a series of flakes would be removed from the debitage surfaces in order to reduce the thickness of the blank and create a pre-form or rough-out for the finished biface (c.f. Callahan 1979; Whittaker 1994). Flake scars from thinning typically extend across the centre of the debitage surfaces, while those from roughing-out or the creation of a pre-form are shorter or less invasive. The extent of the flaking associated with the thinning and roughing-out or shaping of the blank is typically such that the flake scars from the preparation of the edged blank are either no longer visible or have been truncated and are only partly visible. This is particularly true at the proximal and distal ends of the blank where multiple flakes are likely to have been removed in order to shape the base or the point of the stone tool.

Debitage from different methods of stone working is likely to have different morphological characteristics. The exterior platform angles of flakes from bifacial flaking, for instance, are likely to be more acute than those associated with other methods of stone working. A degree of overlap, however, is inevitable. Use of bifacial flaking was not confined solely to the production of particular types of stone tools, such as flaked axes or leaf-shaped arrowheads. The same method could have been employed to create a flaked crest during the early stages of blade manufacture or as part of the preparation of the debitage surface and striking platform on a Levallois-like or 'tortoise shell' core. In both instances, it would be difficult to differentiate the debitage morphologically from that associated with the production of a flaked axe or leaf-shaped arrowhead.

Evidence for the use of bifacial flaking, however, would appear to be largely confined to the lithic assemblages dated to the Early Neolithic. Ten of the stone tools which had been worked bifacially, the leaf-shaped arrowheads from the non-megalithic chambers at Towthorpe 18 and Aldro 88 and the linear zone at Calais Wold 275, were derived from lithic assemblages dated to the Early Neolithic (Phase 2). Two of the other stone tools which had been worked

bifacially, the kite-shaped arrowhead and polished Duggleby-type flint adze found with Burial G at Towthorpe 273, could be dated to the Early Neolithic (Phase 3). The stone tools from lithic assemblages associated with this phase of activity are known to have an affinity to Early Neolithic stone working traditions.

With the exception of the polished Duggleby type flint adze from Towthorpe 273 and the leaf point found on the old land surface beneath Towthorpe 291, all of the stone tools which had been worked bifacially were thought to have been manufactured from flakes. The angle between the two debitage surfaces was typically very acute. Abrasion or trimming of the edges of the blank was consequently likely to have been required in order to strengthen the edge of the striking platform in preparation for the removal of a flake. The flake scars associated with the thinning and shaping of the flakes used as blanks were shallow and diffuse, spreading out from the point of impact. This type of flake scar is consistent with the use of soft hammer percussion (Cotterell and Kamminga 1987).

Removal of flakes from both the dorsal and ventral surfaces of the flake used as a blank was not unique to the stone tools which had been worked bifacially. The bulb of percussion on the ventral surface of the flake used a blank for one of the leaf-shaped arrowheads from the non-megalithic chamber at Towthorpe 18 had been reduced by the removal of at least two flakes from the proximal end of the flake. Flake scars associated with the reduction of the bulb of percussion, however, were also identified on the ventral surfaces of the flakes used as blanks for the plano-convex knife from the old land surface beneath Aldro 49, one of the end scrapers recovered from the interim mound at Calais Wold 275 and the disc scraper found with Burial K in Grave B at Towthorpe 273.

Similar flake scars were identified at the distal end of the ventral surface of the flakes used as a blank for the plano-convex knife from the fabric of the burial mound at Aldro 116. These flake scars were thought to be associated with the reduction or removal of a pronounced hinge or step fracture. Hinge or step fractures are likely to occur as a result of either individual knapping errors or flaws in the piece of flint or stone being worked (Cotterell and Kamminga 1987). Pronounced bulbs of percussion, however, are one of the morphological characteristics of flakes produced by the technique of hard hammer percussion (Cotterell and Kamminga 1987). The flakes used as blanks for plano-convex knives typically had an overall

size in excess of 1,200mm², with a maximum thickness greater than 6mm, and were likely to have been struck using a hard hammer.

Modes of percussion are seldom specific to individual stone working traditions and a variety of techniques may be employed at different stages in the same reduction sequence. Whilst specific techniques may not be chronologically diagnostic *per se*, the identification of debitage characteristic of particular modes of percussion can potentially indicate the range of knapping operations represented within an individual lithic assemblage. Different modes of percussion, however, could have been selected for the same knapping operation, a problem compounded by the degree of overlap between the morphological characteristics of the associated debitage. Flakes struck using a softer blow with a hard hammer, for instance, may have similar characteristics to those produced by a more forceful blow from a soft hammer.

Whilst the flakes used as blanks for the plano-convex knives from the Neolithic burial mounds were thought to have been struck using a hard hammer, the thinning of the blank and preliminary shaping of the knife would most likely have been carried out using a soft hammer. Diffuse flake scars from the reduction or removal of the striking platform were identified at the proximal end of the dorsal surfaces of the flakes used as blanks for four of the plano-convex knives. Likewise, a series of shallow flake scars, extending across the surface of the knife, had been removed from one or both edges of each of the plano-convex knives, to reduce the volume of the blanks. Flake scars from subsequent thinning and shaping were typically confined to the distal and proximal ends of one edge of the blank. Evidence for the reduction or the removal of striking platforms was also identified on the dorsal surfaces of the flakes used as blanks for ten scrapers from the Neolithic burial mounds. These scrapers were predominantly derived from lithic assemblages dated to the Late Neolithic (Phases 4 to 6).

The methods used in the preparation of these blanks and the thinning/preliminary shaping of the plano-convex knives, however, were comparable to those employed in the initial stages of the manufacture of the Early Neolithic stone tools which had been worked bifacially. Debitage associated with each of these methods, however, is likely to have different morphological characteristics. It has already been noted that the angles between the debitage surfaces of the stone tools which had been worked bifacially were typically very acute. The exterior platform angles (the angle between a striking platform and the adjacent debitage surface) of debitage from bifacial flaking are likely to be shallow. Exterior platform angles,

however, can be adjusted through platform preparation and can be increased by trimming the edge of the striking platform (Whittaker 1994, 101–2). Conversely, stone tools which have been worked primarily on one surface will typically have steeper exterior platform angles and are therefore less likely to have trimmed striking platforms.

Evidence for platform preparation, in this instance, can potentially be misleading. The angle between a striking platform and an adjacent debitage surface can be increased by faceting. Debitage associated with the later stages of bifacial flaking may have striking platforms with vestigial facets (Andrefsky 1998, 89–90). These facets are the result of multiple removals from two opposed debitage surfaces and are not related to platform preparation. Faceting would typically be associated with steeper exterior platform angles. Inferences based on the evidence for platform preparation can therefore only be made in conjunction with the other characteristics of the striking platform. The discrimination of different methods on the basis of the associated debitage is often reliant upon the analysis of a series of inter-related morphological characteristics.

In the majority of instances, the methods used in the preparation of blanks are related to the removal of knapping artefacts and are consequently poor chronological indicators. Whilst certain knapping artefacts are more likely to be associated with particular methods and techniques, the use of these methods and techniques is typically related to specific knapping operations or stages in the reduction sequence. One of the techniques used in the preparation of blanks for the stone tools from the Neolithic burial mounds, however, would appear to be more chronologically diagnostic. Three of the stone tools, a double microburin from the burial mound at Towthorpe 291, a serrated blade found with Burial K in Grave B at Towthorpe 273, and a dihedral burin from the interim mound at Calais Wold 275, were manufactured from medial blade segments. The blade segments used as blanks for these tools could have been produced using the microburin technique.

The microburin technique can be used to split a blade or flake into a series of triangular or trapezoidal segments. It is commonly associated with the production of blanks for geometric microliths during the Mesolithic (Inizan et al. 1999, 82–84). The double microburin from Towthorpe 291 was manufactured from a trapezoidal blade segment. Two opposed notches, characteristic of the use of the microburin technique, were identified at the proximal and distal ends of the blade segment. The lithic assemblage from which the double microburin

was found could be dated to the Early Neolithic (Phase 2), possibly suggesting a degree of continuity between Mesolithic and Early Neolithic stone working traditions. Blade segments, however, could simply have been produced by snapping or breaking a blade.

3.1.4 The finished article

The size of the flake scars (with the length and/or breadth exceeding 10mm) associated with both the production or preparation of blanks and the early stages of bifacial flaking is such that debitage from these knapping operations is likely to be recovered during the course of surface artefact survey. In contrast, debitage from the methods and techniques used in the latter stages of stone working or bifacial flaking is typically smaller and is consequently less likely to be found in lithic artefact scatters. A wide variety of techniques was employed in the modification or finishing of the edges and/or surfaces of the stone tools from the Neolithic burial mounds, including edge-retouching, pressure flaking and grinding or polishing.

Considerable variation was noted in the distribution of edge-retouching and pressure flaking. Both techniques would appear to have been used variously to shape, strengthen and blunt the edges of stone tools. Edge-retouching was carried out by direct percussion, using either a soft hammer or a small hard hammer. Three quartzite hammerstones of a suitable size and shape were found with the burials from the non-megalithic chamber at Towthorpe 18. The steepness and length of edge-retouching can be varied by changing the angle and the force of the blow. Pressure flaking involved the direct application of force to the edge of a blank or stone tool. A fabricator with an abraded distal end, characteristic of use as a pressure flaker, was recovered from the outer mound at Towthorpe 273.

Pressure flaking is often equated with the removal of a series of fine flakes, with uniform size and spacing, from the margins of a stone tool. The length of a removal, however, can be controlled by adjusting the amount of force and direction of the pressure applied to the edge of the tool (Whittaker 1994, 133). Longer removals, extending across the surface of a stone tool, can also be produced using the same technique. The distinctive finish on the surface of the ripple-flaked transverse arrowheads produced in the specialist workshops at North Dale and South Landing would have been applied by pressure flaking. Whilst none of the transverse arrowheads from the Neolithic burial mounds were ripple-flaked, a similar technique had been employed in the manufacture of several of the leaf-shaped arrowheads (Figure 34).

The left edge of one of the leaf-shaped arrowheads from the non-megalithic chamber at Towthorpe 18, for instance, had been shaped by the removal of a continuous series of regular flakes. Both lower edges of another leaf-shaped arrowhead from the non-megalithic chamber had been shaped in the same way. Short sequences of regular flake scars were also noted along the edges of the kite-shaped arrowhead found with Burial G at Towthorpe 273 and two of the leaf-shaped arrowheads recovered from the linear zone at Calais Wold 275. In each instance, the flake scars extended part way across the surface of the arrowheads and could have been produced by either pressure flaking or invasive edge-retouching.

Although debitage from pressure flaking and edge-retouching can potentially be differentiated morphologically, it is not routinely recovered during the course of surface survey. The criteria used for the purposes of discrimination between the two techniques are consequently not relevant here. It is sufficient to highlight that either of the two techniques could have been used for the purposes of shaping the edges of stone tools. The use of a particular technique may represent a deliberate choice. Both techniques, however, could have been used during the course of the manufacture of a single stone tool. The right edge of the plano-convex knives from the grave at Acklam Wold 211, for example, would appear to have been shaped by both edge-retouching and pressure flaking.

Edge-retouching and/or pressure flaking were common to all phases of activity. One variant of these techniques, however, was more chronologically diagnostic. Six serrated blades and flakes, with fine denticulations created by abrupt edge-retouching or pressure flaking, were found in the non-megalithic chamber at Towthorpe 18. The lithic assemblages from the non-megalithic chamber could be dated to the Early Neolithic (Phase 2). Serrated blades and flakes were also found with Burial K in Grave B at Towthorpe 273 and the cache of worked flint found with one of the simple burials on the old land surface at Aldro C75 (Burial 1). Both of these lithic assemblages could be dated to the Early Neolithic (Phase 3).

All of the stone tools which had been ground or polished were also derived from lithic assemblages dated independently to the Early Neolithic (Phase 3). The techniques of grinding and polishing, however, are more commonly associated with later Neolithic stone working traditions. Polishing or grinding was confined to just one edge of the polished-edge knives found with Burial 1 at Aldro C75 and could feasibly have been the product of use wear, i.e. sickle gloss (Figure 35, left). Both edges of the polished-edge knife from the linear zone at

Aldro 94, in contrast, had been ground and polished to create two well-defined facets (Figure 35, right). The proximal and distal ends of the blade used as a blank for this knife had been edge-retouched, before grinding and polishing, in order to remove the striking platform and to carefully shape the corners of the knife.

A force will always follow the path of least resistance and when pressure is applied to the edge of a stone tool it will be dissipated along any ridges formed by the intersection of flake scars from previous removals. Potential points of weakness can be eliminated by removing pronounced flake scars from the surfaces of a stone tool by grinding or polishing. The rectangular polished discoidal knives found with Burial D at Towthorpe 273 and Burial 2 at Aldro C75 (Figure 36), however, had been ground to a thickness of less than 2mm. In both instances, the edges of the knives were carefully bevelled and both surfaces had been polished beyond the point of functional necessity. This degree of elaboration has been linked with the display of status and creation of identity during the Late Neolithic (Pierpoint 1980; Edmonds 1995; Loveday 2011).

Unlike the rectangular polished discoidal knives, the polished Duggleby-type adze found with Burial G at Towthorpe 273 was only partly ground or polished (Figure 37). Grinding or polishing was confined to the area of the cutting edge and the remainder of the surface of the adze was covered by flake scars from the bifacial flaking. The flaked edges of the butt of the adze had been blunted by semi-invasive or abrupt edge-retouching in preparation for hafting. Similarly, the abrupt retouch along the right edge of the blunted-back edge-retouched flake knife from Aldro 116 would appear to be related to the way in which the knife was used. Regardless of whether the edge-retouched flake knife was hafted or simply held in the hand, pressure could be applied to the retouched edge without biting or cutting.

The techniques of edge-retouching and pressure flaking also often served a practical purpose. The tips of two of the leaf-shaped arrowheads, for example, had been abruptly edge-retouched or pressure flaked to create a well-defined angular point. In both instances, edge-retouching and pressure flaking would have strengthened the tip of the arrowhead and also improved its ability to penetrate a target. Likewise, the notches at the base of the complete barbed and tanged arrowhead recovered from the upper levels of the burial mound at Calais Wold 275 had been created by pressure flaking (Figure 38). The tang defined by these notches

enabled the arrowhead to be securely attached to the shaft of the arrow, while the barbs prevented it from being easily withdrawn from a target.

The significance of hafting has often been neglected in accounts of the manufacture of stone tools during the British Neolithic (Saville 2002, 92). Hafted stone tools have only been found in rare instances where the organic remains have been preserved. Part of the tip of a wooden arrow shaft, for instance, was found with the broken leaf-shaped arrowhead from the non-megalithic chamber at Aldro 88. The base of the arrowhead was embedded in a notch or split in the tip of the shaft and was presumably held in place by resin and/or secured by a piece of thread bound tightly around the spine of the shaft. Similar methods would have been used to attach the flights to the shaft and strengthen the nock.

Flights would have been made from feathers, split in half and secured using the spine of the quick. The range of materials used in hafting arrowheads highlights the need to place stone working within a much broader technological context. Accounts of the procurement of raw materials based solely on lithic resources are incomplete and also need to consider the materials implicit in stone working. The 'tool-kit' which can be inferred from the methods and techniques represented by the tools from the Neolithic burial mounds alone, would have included: quartzite pebbles (hard hammers); wooden batons or antler billets (soft hammers); and, antler tines, bone points or fabricators (pressure flakers). Pieces of animal hide were also likely to have been used to improve grip and to prevent cuts or nicks.

Adzes and arrowheads were not the only classes of stone tools which would have been hafted. Two notches had been created on either side of the serrated blade recovered from the cache of worked flint found with Burial 1 at Aldro C75 by abrupt edge-retouching. Denticulation or serration was confined to the distal end of the blade, below the notches, and the proximal end would presumably have been hafted. The notches would have enabled the serrated blade to be hafted in or bound securely to a wood, bone or antler handle. Similar notches, created by abrupt edge-retouching or pressure flaking, were also identified on the edges of one of the edge-polished knives, two of the scrapers, one of the awls, two of the burins and one of the retouched flakes from the Neolithic burial mounds.

The distribution of edge-retouching and pressure flaking would appear to suggest that both techniques were routinely associated with the hafting of stone tools. In the case of end scrapers, abrupt or semi-invasive edge-retouching associated with the creation of a blunt

scraping edge was typically confined to the distal end of the scraper. Where edge-retouching also extended part way along one of side of the scraper, the distribution of edge-retouching could perhaps be explained in terms of left handedness or right handedness. Whilst edge-retouching or pressure flaking on the opposite edge of the scraper at the proximal end of the blade or flake used as a blank cannot be explained in this way, an obvious parallel can be drawn with the distribution of edge-retouching on the blunted back edge-retouched flake knife recovered from the fabric of the burial mound at Aldro 116.

3.2 Constraints of raw materials

Technological analysis of the stone tools from the sample of Neolithic round barrows has identified a series of underlying trends which can potentially be used to differentiate between Early Neolithic and Late Neolithic stone working traditions. A general scheme of knapping operations has been identified through the reconstruction and comparison of 'life histories' for individual stone tools, based on empirical observations of contemporary lithic industries rather than analogies with the lithic industries of the French Palaeolithic or parallels with North American industries. In contrast to more conventional typological analysis, this approach is not reliant upon the identification of stone tools with distinctive morphological characteristics which are chronologically diagnostic and is based instead on the identification of recurrent patterns between different classes of stone tools. Recurrent patterns emerge in the procurement of raw materials, the preferred types of blanks and the methods and techniques employed in the manufacture of stone tools.

A trend towards the increased use of poorer quality flint from the chalk formations of the Yorkshire Wolds can be seen during the Neolithic. This trend was accompanied by a decline in the emphasis on the manufacture of blades for use as blanks for stone tools. Two key points emerge. First, both of these observations are inter-related; the flint from the chalk formations of the Yorkshire Wolds is poorly suited to blade manufacture. Secondly, neither observation is chronologically diagnostic *per se*; chalk flint was used for ad hoc stone tool manufacture during the earlier Neolithic and irregular blades were used as blanks for stone tools during the later Neolithic. The high frequency of stone tools which retained traces of cortex was thought to indicate a lack of concern with the removal of cortex and the overall size of stone tools was considered to be consistent with an industry reliant upon smaller pieces of flint.

3.2.1 Methods of core working

Where raw materials are at a premium, constraints are inevitably imposed on the methods and techniques employed in stone working. Constraints imposed by raw materials have profound implications for the analysis and interpretation of lithic debitage. Both prepared core-technologies and more expedient methods of core working can be considered to maximise the potential return from a piece of flint. The amount of waste will be minimised and the intended goal of a sequence of knapping operations is likely to become evident at an early stage. Consequently, the morphometric properties of the resultant debitage are likely to be sensitive technological indicators. The term debitage (*sensu* Andrefsky 2001) is used to describe the by-products of stone working, including cores (discussed below) and blades, flakes and debris (discussed in the next chapter).

Cores are a form of lithic debitage which is particularly technologically diagnostic. In its simplest form, a core can be considered to be a piece of flint or stone from which a series of flakes, blades or bladelets have been removed. Whilst simple cores from which only a few flakes have been removed are often difficult to recognise, those associated with the systematic production of pre-determined debitage are more distinctive. Analysis of striking platforms and debitage surfaces on cores can indicate the reduction strategies employed. The morphology of a core is indicative of the final stage of a reduction sequence (Inizan et al. 1999). Several different strategies, however, may have been employed during the course of the reduction sequence and may not be reflected in the final form of the core.

A distinction can be drawn between systematic (pre-determined) methods of core working and expedient (simple) methods of core working. During the Mesolithic emphasis was placed on the systematic production of bladelets for use as blanks for microliths (Butler 2005, 83–87). Striking platforms and debitage surfaces were carefully prepared and maintained. Once a striking platform had been exhausted it was either rejuvenated by the removal of a core tablet or the core was rotated through 180° with reduction continuing from an opposed platform. Similarly, knapping errors were corrected by the removal of a plunging blade or rejuvenation of the active area of the debitage surface. Expedient methods of core working were also employed during the Mesolithic and flakes were used as blanks for a wide variety of tools, including knives, scrapers and tranchet axes.

Methods of core working began to change from the Early Neolithic onwards with the manufacture of blades, as opposed to bladelets, and increasing emphasis on the production of flakes (Butler 2005, 119–22). Early Neolithic blade manufacture was also accompanied by a change in rejuvenation techniques. Once a striking platform had been exhausted, the core was rotated and another striking platform selected. The edge of the old platform was commonly used as a crest to control the removal of the first blade from the new platform. Unlike the single or opposed platform cores of the Mesolithic, Early Neolithic blade cores typically had at least two striking platforms, either at an oblique angle or perpendicular to one another. Preparation of striking platforms continued into the Early Neolithic. Trimmed cores are commonly mistaken for scrapers.

Expedient methods of core working became increasingly common during the later Neolithic and Bronze Age (Butler 2005, 155–58). Flakes were typically struck from polyhedral cores with multiple striking platforms. Once a platform had been exhausted, the core was rotated until a new platform was found. Debitage surfaces were frequently re-used as striking platforms. The demise of blade technologies did not herald the end of systematic methods of core working. Late Neolithic industries used 'tortoise shell' cores, similar to the Levallois cores of the Middle Palaeolithic, to produce flakes of a pre-determined size and shape. These flakes were used as blanks for a limited range of artefacts, including the ripple-flaked transverse arrowheads and polished discoidal knives manufactured in specialist workshops at North Dale and South Landing (Durden 1994, 1995, 1996).

Any piece of flint could be selected as a core providing that an exterior platform angle less than 90° could be found between two of the surfaces. Flakes or broken implements may also have been used as cores. Whilst systematic methods of core working required the preparation of striking platforms and/or debitage surfaces, different sequences of knapping operations could have been employed in the preparation of the same type of core (Figure 39). Blades, for instance, were typically manufactured from single or opposed platform cores. Striking platforms were created either by splitting a nodule or by the removal of a series of flakes. A debitage surface was then established using a natural ridge or bifacial crest to control the removal of a long thin 'flake'. The ridges formed by the edges of the resultant flake scar were used to control subsequent removals from the core. Both methods of initiation were represented amongst the Neolithic round barrows.

A total of eighteen cores was identified within the lithic assemblages from the Neolithic round barrows. These cores were classified using a modified version of the typology established for the Neolithic site at Hurst Fen, near Mildenhall, in Suffolk (Clark, Higgs, and Longworth 1960). A simple distinction was made between single platform, opposed platform and polyhedral cores. Crude cores from which only a handful of flakes had been removed were classified separately (other cores). The 'Hurst Fen' typology, however, only considers the final form of a core and neither reflects dominant production sequences nor accounts for the dynamic nature of reduction strategies (Finlayson, Finlay, and Mithen 2000). Evidence for different methods of core working or multiple episodes of flaking was consequently noted for each of the cores in order to counteract perceived deficiencies relating to the use of this typology.

Over two thirds of the cores were polyhedral cores with multiple striking platforms and only two single platform cores and one opposed platform core were identified amongst the lithic assemblages from the Neolithic round barrows (Table 15). Whilst platform cores would appear to be under-represented, evidence for the re-use of cores was identified within the assemblages of worked flint. Five of the polyhedral cores had one well-defined striking platform and were consequently thought to have been re-used single platform cores. Four of these cores were derived from the interim mound at Calais Wold 275. Re-use of worked flint (opportunistic procurement) became increasingly common from the Late Neolithic onwards. Discarded flakes and cores, for instance, were procured from the spoil heaps associated with the Neolithic flint mines at Grimes Graves during the Bronze Age (Longworth et al. 1991). The cores from Calais Wold 275 are likely to have been procured from the Early Neolithic mortuary enclosure beneath the interim mound.

A limited range of methods of core working was represented amongst the cores from the sample of Neolithic round barrows. Examination of the debitage surfaces of the cores would appear to suggest that emphasis was placed on the manufacture of flakes rather than blades during the final stage of core working, a simple method of core working which is consistent with the relative abundance of polyhedral and re-used cores. Evidence for the systematic methods of core working identified through the reconstruction of the life histories for the concomitant stone tools was limited. Whilst two of the cores had debitage surfaces with parallel ridges consistent with blade manufacture, none of the cores exhibited evidence for centripetal flaking characteristic of use of the Levallois method. One of the 'blade' cores, a single platform core, was derived from the cache of worked flint found with one of the simple

burials at Aldro C75 (Burial 1). This cache of worked flint contained a series of refitting blades and flakes and was dated to the Early Neolithic (Phase 3).

Over half of the 'flake' cores were derived from lithic assemblages dated to the Late Neolithic (Phases 4 and 6), including an opposed platform core, two polyhedral cores and four re-used cores from the interim mound at Calais Wold 275. The types of core associated with the production of flakes were consistent with simple methods of core working, lacking distinctive patterns of flake scars and exhibiting greater variability in general morphology, and as such are poor chronological indicators. Whilst polyhedral 'flake' cores are generally considered to have been associated with later Neolithic stone working traditions, five of the polyhedral cores were derived from lithic assemblages dated to the Early Neolithic (Phase 2). The cores from the fabric of the burial mounds at Towthorpe 291 and Wharram Percy 46 are potentially incongruous with the date suggested on the basis of ceramic phasing and structural associations, and a degree of caution should therefore be exercised in the analysis of the debitage from these lithic assemblages.

A limited range of continuous and categorical variables was recorded for each of the cores in order to identify any underlying differences between the methods of core working represented amongst the cores from earlier Neolithic and later Neolithic contexts (Table 16). These variables can be divided into two categories: those relating to the surface character of the cores; and those relating to the metric properties of the cores. In both instances, it is important to recognise that the variables typically relate to either the final episode of core working or the dominant striking platform and debitage surface. Whilst the low frequency of cores does not permit detailed analysis, a series of general observations can be made about the procurement strategies and methods of core working employed in earlier Neolithic and later Neolithic stone working traditions.

3.2.2 Platform preparation

Analysis of the stone tools from the sample of Neolithic round barrows indicated a change in the nature of the procurement of raw materials, with increased use of low-quality flint from the chalk formations of the Yorkshire Wolds during the Late Neolithic. This change can be explained in terms of either increased pressure or restricted access to the lithic resources of the Holderness coastline or broader changes in the nature of stone working and a decline in the emphasis on controlled flint knapping. Whilst explanations grounded in demography or

the notion of tenure should not be discounted, there is a fundamental link between the quality of raw materials and the methods of core working represented by different types of core. High-quality raw materials would appear to have been preferred for methods of core working associated with the reduction of single and opposed platform cores.

All of the single platform, opposed platform and re-used cores, including the single platform 'blade' core from the cache of worked flint found with Burial 1 at Aldro C75, were manufactured from mid grey or light grey flint. Likewise, the Levallois-like or tortoise shell core which was used as a blank for the burin from the fabric of the burial mound at Aldro C75 was manufactured from a piece of mid grey flint. These types of core were typically associated with systematic methods of core working which would have required homogeneous raw materials that fractured in a predictable manner. In contrast, a wider variety of raw materials would appear to have been used for the types of cores associated with simple methods of core working, including low-quality flint from the chalk formations of the Yorkshire Wolds.

At the extremes of the colour spectrum the colour of a piece of flint can be used as an indicator of the quality of raw materials. One of the cores from Wharram Percy 46, a crude 'flake' core, was manufactured from a piece of white 'chalk' flint. This colour of flint is characteristic of the nodular flint found in the Welton formation and the tabular flint Burnham formations of the chalk on the Yorkshire Wolds. The flint from the Welton and Burnham formations is calcareous, i.e. contains a large number of impurities in the form of calcium carbonate. It does not fracture in a predictable manner and, as such, is poorly suited to controlled flint knapping. Indeed, the core from Wharram Percy 46 had not been extensively worked and was abandoned after only six flakes had been detached.

The type of raw materials used in stone working can also be inferred from the character of the unmodified surface of a piece of flint. Inspection of the surfaces of the stone tools from the sample of Neolithic round barrows indicated the exploitation of a wide range of lithic resources, including 'rolled' flint from gravel deposits in the low-lying areas adjacent to the Yorkshire Wolds and high-quality nodular flint from the boulder clay of the Holderness coastline. The majority of the cores found in conjunction with the stone tools were partially corticated and only one of the cores, the single platform 'blade' core from Burial 1 at Aldro C75, had been completely decorticated. Three of the cores had distinctive flat corticated surfaces characteristic of tabular flint.

Evidence for the use of tabular flint would appear to have been largely confined to the lithic assemblages dated to the Late Neolithic. All three of the cores manufactured from pieces of tabular flint were derived from the lithic assemblage recovered from the surface of the interim mound at Calais Wold 275. This lithic assemblage was associated with over two hundred sherds of AOC and AOTC Beaker pottery and could be dated to the Late Neolithic (Phase 6). Both of the stone tools manufactured from pieces of worked flint which could be dated independently were also derived from the surface of the interim mound at Calais Wold 275. The flat surfaces of pieces of tabular flint were well-suited to core working and could have been used as striking platforms with little or no modification.

The preparation of striking platforms and debitage surfaces plays a significant role in systematic methods of core working. Evidence for platform preparation was noted on five of the cores from the Neolithic round barrows. In each instance, one or more of the striking platforms had been trimmed to remove overhangs and strengthen the edge of the platform. Trimming was noted on platform cores and polyhedral cores alike, with no evidence of a correlation between platform preparation and core morphology. Overhangs occur as a result of the detachment of a flake with a pronounced bulb of percussion characteristic of direct percussion with a hard hammer and, as such, trimmed striking platforms are indicative of the mode of percussion rather than the method of core working.

Preparation of debitage surfaces can be inferred by the identification of distinctive patterns of flake scars on one or more surfaces of a core. The high frequency of cores which retained traces of cortex would appear to suggest that the removal of cortex did not play a significant role in the preparation of either debitage surfaces or striking platforms. Approximately 50% of the single platform core from Aldro 94, for instance was corticated suggesting only partial removal of cortex before commencement of systematic core reduction. Additional cortical flakes or blades could subsequently have been removed to expand the active area of the debitage surface during the course of the reduction sequence. This method of core reduction is consistent with the refitting blades and flakes from Aldro C75.

The apparent lack of emphasis on the preparation of striking platforms and debitage surface is not surprising as the majority of the cores were polyhedral 'flake' cores with multiple striking platforms characteristic of simple methods of core working. These methods of core working, which could only be inferred from the analysis of the stone tools, operated on a different

principle to blade manufacture and the Levallois method, i.e. polyhedral shaping (Inizan et al. 1999, 49). Polyhedral shaping is dependent on the centre of gravity of the core. Flakes can be removed from a polyhedral core so long as an angle less than 90° can be found between two of the surfaces of the core. These surfaces do not necessarily have to be contiguous and the angle between the striking platform and the adjoining debitage surface may exceed 90°.

3.2.3 Polyhedral flaking

In contrast to systematic methods of core working which are concerned with control of the size and shape of the flakes detached from a core, polyhedral shaping is concerned with control of the core with little or no regard for the morphological characteristics of the detached flakes. Each removal created a new facet that could potentially be used as a striking platform or debitage surface at a later stage in the sequence of knapping operations, thereby keeping the core 'alive'. Several of the polyhedral cores from the sample of Neolithic round barrows, including two of the cores from the interim mound at Calais Wold 275, were described as 'slingstones' in the accounts of the excavations published in *Forty Years' Researches* (Mortimer 1905, 163), a description that would appear to suggest that these cores were almost spherical in shape.

Flakes could continue to have been detached from a polyhedral core until it became either too small in size or too regular in shape, characteristics which can both be evaluated through the analysis of the metric properties of a core. Basic dimensions, i.e. length (perpendicular to the midpoint of the final striking platform), breadth (parallel to the edge of the final striking platform) and thickness (perpendicular to the midpoint of the final debitage surface), were recorded for each of the cores. All measurements were taken using a pair of *Mitutoyo Absolute Digimatic* digital callipers, with a tolerance of ±0.02mm, and were recorded in millimetres to two decimal places. The length and width of each of the cores can be used to estimate the maximum size of the final debitage surface and the metric properties of the last flake detached from that surface.

The majority of the cores were relatively small and over half of the cores were less than 40mm in both length and breadth (Figure 40). In contrast, the simple core from the upper levels of the burial mound at Towthorpe 273 was considerably larger with a breadth greater than 110mm. This core was treated as an outlier. The lengths and widths of the cores were strongly correlated with a best-fit line defined by the equation L=B. Two key points can be highlighted

with regard to the metric properties of the cores. First, both of the single platform 'blade' cores lay above the best-fit line, i.e. the lengths of the cores were greater than the breadths (L>B). Secondly, the polyhedral 'flake' cores were clustered along the best-fit line, i.e. the lengths of the cores were approximately equal to the breadths (L≈B).

Two thirds of the cores had a volume less than 30,000mm³ and were consequently thought to have been abandoned because they had been reduced to a point where they could no longer produce a flake of suitable size and shape (Figure 41). The mean length and mean breadth of these cores, 32.87mm and 30.12mm respectively, would equate to a debitage surface with an approximate area of 990.04mm². Even without shaping or retouching, the maximum size of the flakes which could have been struck from these cores was considerably lower than the average size of the stone tools from the sample of Neolithic round. Once that striking platform had been exhausted, the mean thickness (20.00mm) of these cores would have prevented the continuation of flaking from a new debitage surface or striking platform.

Potentially, several of the cores could also have been abandoned at a point where a striking platform had been exhausted and the core could not be rejuvenated or rotated to establish a new striking platform. Whilst none of the cores would appear to have been formally rejuvenated, four rejuvenation flakes were identified amongst the lithic assemblages from the sample of Neolithic round barrows. The majority of the cores, however, were polyhedral cores or re-used platforms cores with multiple striking platforms. Once a striking platform had been exhausted the core was simply rotated and a new striking platform selected from the surface of the core from which further flakes could be removed. Through careful control of the shape of the core, this process could have been repeated until the core became too regular.

The regularity or sphericity of polyhedral and re-used platform cores can be assessed through comparison of the basic dimensions of each of the cores and the magnitude of the differences between their lengths, breadths and thicknesses (Table 17). First, little difference can be seen between the length and breadth of the cores, with a mean difference equivalent to less than a fifth of the average length or breadth and a small standard deviation. Secondly, whilst the mean differences between the length/breadth and thickness are much greater relative to the size of the cores, the maximum difference is small in absolute terms. Once the final debitage surface had been exhausted there was limited scope for further removals from the core.

However, not all of the polyhedral and re-used platform cores had been exhausted before they were abandoned.

Two of the polyhedral cores from Wharram Percy 46 which could be dated to the Early Neolithic (Phase 2) had been abandoned after only a handful of flakes had been removed. Both of these cores had approximate volumes (156,939mm³ and 80,995mm³ respectively) which were considerably larger than the majority of the cores and were thought to have been the products of *ad hoc* core working where the core was abandoned as soon as a suitable flake had been produced, rather than sustained core working associated with the systematic production of blanks. It is notable that all of the polyhedral cores derived from lithic assemblages dated to the Early Neolithic had flake scars from no more than eight previous removals and were abandoned before they had been exhausted.

The methods of core working represented by the unmodified cores from the sample of Neolithic round barrows were broadly consistent with those inferred on the basis of the analysis of the stone tools. Although the distribution of polyhedral cores typologically characteristic of Late Neolithic stone working traditions would appear to suggest that two of the lithic assemblages contained anomalous or intrusive material, underlying differences were noted in the methods of core working represented by the polyhedral cores from earlier Neolithic and later Neolithic contexts. It is important to differentiate between organised and opportunistic stone working and, as such, the concerns about the integrity of these lithic assemblages would perhaps appear to be unwarranted.

Technological analysis of the unmodified cores supports the assertion that local industries were reliant upon the use of smaller pieces of stone advanced on the basis of the technological analysis of the stone tools. Despite intensive reduction, with the removal of an average of at least 10 flakes per core and a mean volume of less than 40,000mm³, a high frequency of the cores from the Neolithic round barrows retained traces of cortex. Together, the reduced state of the cores and the frequency of cores which were partially corticated would appear to suggest that the removal of cortex did not play a significant role in the preparation or maintenance of cores and the production of blanks, and that the pieces of flint selected for the purposes of core working were comparatively small in the first instance.

The methods of core working represented by the unmodified cores were well-suited to industries based on 'small rocks', maximising the number of flakes which could be removed

through either the preparation of debitage surfaces and striking platforms in the case of blade manufacture or simply by keeping the core alive in the case of polyhedral shaping. Similarly, the frequent re-use of cores for the purposes of flaking and shaping reflects a concern with minimising wastage and, in doing so, maximising the return from a piece of stone. Cores constituted less than a tenth of the debitage from the Neolithic round barrows, however, and the assemblages of worked flint were dominated by other types of lithic debitage, specifically blades, flakes and angular shatter.

3.3 Moving beyond diagnostic artefacts

Technological analysis of the stone tools and unmodified cores from the Neolithic burial mounds has enabled the identification of a series of recurrent patterns which can potentially be used to discriminate between Early Neolithic and Late Neolithic stone working traditions. These patterns can be mapped onto a generalised sequence of knapping operations which is characterised by the progression from the procurement of raw materials, through the production, thinning and shaping of blanks, to the hafting, maintenance and use of finished stone tools. This sequence of knapping operations, in turn, provides a robust framework within which to identify statistical patterns in the metric properties and morphological attributes of the corresponding assemblages of lithic debitage which are chronologically or technologically diagnostic. Morphometric analysis of the complete blades and flakes from the Neolithic burial mounds in the next chapter seeks to define debitage signatures characteristic of the methods and techniques employed in Neolithic stone working traditions.

Morphometric analysis and the definition of debitage signatures

This chapter aims to define debitage signatures characteristic of the stone working traditions identified in the previous chapter through the morphometric analysis of the complete blades and flakes from the Neolithic burial mounds. The first part of the chapter introduces the approach used to analyse the lithic debitage and summarises the variables which describe the morphological attributes and metric properties of the complete blades and flakes. The second part of the chapter identifies recurrent patterns in the values of the variables which can be explained in terms of the principles of fracture mechanics. Emphasis is placed on variables which can be controlled by the person working stone and are consequently thought to have been chronologically or technologically diagnostic. Analysis of the lithic debitage is based on either: 1) the aggregated assemblages of worked flint dated to the Early Neolithic and Late Neolithic on the basis of ceramic phasing or artefact associations, or; 2) the assemblages of worked flint from Burial 1 at Aldro C75, the burial mound at Riggs 20 and the interim mound at Calais Wolds 275 which represent different methods of core working.

4.1 Classification of lithic debitage

Analysis of lithic debitage has been dominated by a tripartite system of classification based on the analysis of a single attribute – the amount of cortex on the dorsal surface of a flake. This system recognises three classes of debitage, namely primary flakes, secondary flakes and tertiary flakes. The relative frequency of these classes of debitage is often used to identify flakes associated with different stages of a sequence of knapping operations. A distinction is often made between primary flakes associated with initial stages of the reduction sequence, and tertiary flakes associated with later stages. The thresholds used to differentiate between primary, second and tertiary flakes, however, vary from site to site. Tertiary flakes may be regarded as either cortical or non-cortical flakes depending on the threshold employed. This system of classification has been criticised, understandably, for a lack of consistency (Sullivan and Rozen 1985). The validity of this criticism has been widely accepted and has resulted in recognition of the need both to define the criteria used in the classification of debitage and to develop more robust systems of classification (Andrefsky 1998, 111–13).

Although 'declaration of terms' improves consistency in the recording of lithic debitage from one assemblage of worked flint to the next it does not address flaws in the assumptions inherent in the system of classification. The degree of cortication is dependent on a wide variety of factors, such as the availability of raw materials and the intensity of reduction. Alternative systems of classification have been proposed. Debitage from the Stonehenge Environs Project, for example, was classified on the basis of position and supposed function on the core (Harding 1990, 218–20). This system of classification and others like it is highly subjective and makes assumptions about both the general methods employed in the reduction of cores or the production of stone tools and the specific methods represented within an assemblage of worked flint. In contrast, the system proposed by Sullivan and Rozen is not technologically diagnostic (Sullivan and Rozen 1985, 758–60). Debitage is classified on the basis of the identification of a single interior surface (ventral surface), the presence or absence of a point of applied force (a pressure or striking platform) and whether or not the margins (distal end or left/right edges) of a flake remain intact (Figure 42).

A modified version of the Sullivan and Rosen typology was used to classify the debitage from the Neolithic burial mounds (Table 18). The debitage was initially divided into three classes, namely blades, flakes and debris. Blades and flakes were subdivided into complete blades/flakes, broken blades/flakes and blade/flake fragments. Complete blades/flakes were subsequently further subdivided into cortical blades/flakes and non-cortical blades/flakes. The distinction between blades and flakes ensures consistency with other systems of classification and allows preliminary estimation of the significance of blade manufacture. Evidence for systematic blade manufacture is routinely used to differentiate between Early Neolithic and Late Neolithic stone working traditions. Blades are ostensibly flakes with distinctive metric properties and both classes of debitage were therefore ultimately grouped together. Similarly, the distinction between cortical and non-cortical blades/flakes was solely used for the purposes of the initial characterisation of the debitage, allowing rapid quantification of the frequency of debitage which retained traces of cortex.

Blades are elongated flakes with a length to breadth ratio greater than 2:1 (L>2B). A distinction is often made between regular blades with straight parallel sides and less regular 'blade-like' flakes. The validity of this distinction has been disputed (Bordes 1988, 16). It has been suggested that the term 'blade-like' flakes should only be used to refer to broken pieces (Inizan et al. 1999, 130–31). The term irregular blades is consequently used to describe less

regular 'blade-like' flakes. Several variants of blades have been identified on the basis of their maximum length or breadth. These include bladelets (L<30mm) and narrow blades (B<8mm). The frequency of blades in a lithic assemblage is not directly correlated with the prevalence of blade manufacture. Shorter flakes may be removed from a blade core at any point in a sequence of knapping operations, including during the course of the preparation and maintenance of striking platforms and debitage surfaces. Conversely, long thin flakes may be produced by methods of core working that are not associated with the systematic production of blades or bladelets.

The lamellar index can be used to provide an estimate of the prevalence of blade manufacture (Bordes and Gaussen 1970). This estimate may be obtained by dividing the number of blades by the total number of blades and flakes. A lamellar index greater than or equal to 20% is considered to be indicative of blade manufacture. This figure may be lower where raw materials are scarce. Lamellar indices were calculated for the aggregated assemblages of worked flint from the Neolithic burial mounds (Table 19). Whilst the lamellar indices for the lithic assemblages dated to the Early Neolithic (Phases 1 to 3) were higher than those dated to the Late Neolithic (Phases 4 to 6), only the lithic assemblages dated to Phase 3 had a lamellar index consistent with blade manufacture. Six of the blades from the lithic assemblages dated to Phase 3 were derived from the cache of worked flint found with one of the simple burials at Aldro C75 (Burial 1). Seventeen of the flakes from this cache of worked flint could also be classified as irregular blades.

Four of the irregular blades and one of the blade fragments from the cache of worked flint refitted (Figure 43). Two irregular blades were removed from an initial striking platform, the second of which terminated in a step fracture. A third blade was struck from this platform. This blade was broken either as a result of a knapping error or a flaw in the raw material. The core was subsequently rotated and two irregular blades were removed from an opposed striking platform. Two further refitting 'blades' were identified amongst the cache of worked flint. The texture of the cortex on the dorsal surface of the refitting blades and irregular blades is identical to that on the dorsal surface of the edge retouched knife found behind the shoulders of the burial. As such, the cache of worked flint would appear to be related to the manufacture of this knife and is possibly the product of a single knapping episode. An abandoned or exhausted single platform core, with a debitage surface consistent with blade manufacture, was also identified amongst the cache of worked flint.

The decrease in evidence for systematic blade manufacture during the Neolithic suggested by the lamellar indices for the aggregated assemblages of worked flint is indicative of broader changes in the nature of stone working. These changes are also reflected in the relative frequencies of debris from Early Neolithic and Late Neolithic contexts: a sixth of the debris was derived from lithic assemblages dated to the Early Neolithic (Phases 1 to 3); conversely, two thirds of the debris was derived from lithic assemblages dated to the Late Neolithic (Phases 4 to 6). Debris is technologically undiagnostic and is generally considered to be indicative of a lack of emphasis on controlled stone working. Whilst it is sometimes difficult to distinguish between debris and simple flake cores (Andrefsky 1998, 147), the mean number of flake scars from previous removals for the debris from the Neolithic burial mounds was considerably lower than that for the unmodified cores. Together, the low frequency of blades and high frequency of debris from Late Neolithic contexts reflect a decline in the emphasis on controlled flint knapping.

Although chronological patterning can be seen in the relative frequencies of blades and debris from Early Neolithic and Late Neolithic contexts, both classes of debitage combined make up less than a quarter of the debitage from the Neolithic burial mounds. The remainder of the debitage was comprised of flakes – a class of debitage which was strongly represented amongst each of the aggregated assemblages of worked flint. Little or no chronological patterning could be seen in the relative frequencies of complete flakes, broken flakes and flake fragments from the lithic assemblages dated to the Early Neolithic (Phases 1 to 3) and those dated to the Late Neolithic (Phases 4 to 6). The majority of the broken flakes (i.e. flakes where the left edge, right edge or distal end was broken) and flake fragments (i.e. flakes where the striking platform or proximal end was missing) were recovered from the fabric of the burial mounds and could have been broken or snapped during the course of barrow building which may account for the apparent lack of chronological patterning.

Two discrete patterns emerge, however, when the relative frequencies of complete flakes, broken flakes and flake fragments are compared with the relative frequencies of complete blades, broken blades and blade fragments. First, no broken blades were identified amongst the debitage from the Neolithic burial mounds. Broken blades are likely to be under-represented within an assemblage of worked flint. Proximal blade segments (broken blades) will typically be thicker, wider and more regular than distal blade segments (blade fragments) and, as such, are more likely to have been used as blanks for stone tools. Secondly, the ratio

of blade fragments to complete blades (3:5) was considerably higher than the ratio of flake fragments to complete flakes (c.1:9). The high frequency of blade fragments is consistent with the deliberate snapping of blades using the microburin technique. Six of the blade fragments were distal blade segments and were likely to have been discarded because they were not suitable for use as blanks for stone tools. The remainder of the blade fragments were medial blade segments which could have been used as stone tools without additional modification.

The debitage from the Neolithic burial mounds was dominated by complete blades and flakes, over half of which retained traces of cortex. Technological analysis of the stone tools and unmodified cores in the previous chapter would appear to suggest that trimming cortex did not play a significant role in the preparation of cores or the production of blanks. Marked differences, however, can be seen in the relative frequencies of complete blades and complete flakes which retained traces of cortex. The ratio of cortical blades to non-cortical blades (1:2) was significantly lower than the ratio of cortical flakes to non-cortical flakes (5:3). Even at this superficial level patterns emerge which can be explained technologically and can potentially be used to discriminate between debitage characteristic of the methods and techniques employed in different stone working traditions. Detailed analysis of the metric properties and physical attributes of the debitage is required in order to identify debitage 'signatures' characteristic of Early Neolithic and Late Neolithic stone working traditions. Only complete blades and flakes were included in this analysis.

A series of categorical variables was recorded for each of the complete blades and flakes[12] from the Neolithic burial mounds (Table 20). These variables can be divided into four categories, namely: 1) those relating to the surface character (colour and approximate degree of cortication); 2) those relating to the possible mode of percussion (type of blade/flake termination); 3) those relating to the striking platform (type of striking platform and exterior platform angle), and; 4) those relating to the debitage surface (number of flake scars from previous removals, number of directions from which blades/flakes had previously been removed and pattern of flake scars). For the purposes of the analysis below, the colour of a piece of flint was treated as an ordinal variable, with ranked values ranging from high quality black or dark grey/brown flint, through mid grey/brown flint, to poor quality light grey/brown

[12] Complete blades and flakes are hereafter referred to collectively as complete removals.

or white flint. The number of flakes scars from previous removals and the number of directions from which flakes had previously been removed were also treated as ordinal variables, with maximum values of 8 and 5 respectively.

Basic measurements were also recorded for the complete removals using a pair of *Mitutoyo Absolute Digimatic* digital callipers with a tolerance of ±0.02mm:

1. Length (L ≡ maximum length) was measured along a line perpendicular to the striking platform and corresponded to the maximum distance between the proximal and distal ends of the blade or flake (c.f. Andrefsky 1998, Figure 5.8 a/c). The line along which the length was measured may extend beyond the margins of the blade or flake;

2. Breadth was measured at three points: at the proximal end (B_p), at the midpoint (B_m) and at the distal end (B_d). Each measurement was taken parallel to the edge of the striking platform, perpendicular to the line along which the length was measured, and corresponded to the distance between the left and right margins of the blade or flake;

3. Thickness was measured at three points: at the proximal end (T_p ≡ depth of the striking platform), at the thickest point of the bulb of percussion (T_b) and at the midpoint (T_m). Where the bulb of percussion could not be discerned, a measurement was taken at the point halfway between the proximal end and the midpoint of the blade or flake.

These measurements were used to calculate a series of continuous variables which describe the metric properties of the blades and flakes (Table 21).

The resultant variables can be divided into three categories, namely: those relating to the general metric properties (maximum length, maximum breadth, maximum thickness, overall size/approximate surface area, relative proportions and maximum variation in breadth); those relating to the possible mode of percussion (relative thickness of the bulb of percussion), and; those relating to the striking platform (depth and area of the striking platform). These variables were reclassified as categorical variables for ease of interpretation with nominal or ordinal values defined using data reduction techniques. The metric properties of the lithic debitage from the Neolithic burial mounds are shown in Appendix H, with comparative data

from the surface scatter at Wharram-le-Street shown in Appendix J. Three general observations can be made with regard to the variables which describe the morphological attributes and metric properties of the lithic debitage.

First, the dataset was screened for outliers and extreme values that may have an undue influence on any statistical patterns that are identified either within or between variables. Eleven of the complete removals had values for one or more continuous variables which corresponded to outliers. A further twenty-four removals corresponded to extreme values, i.e. complete blades or flakes with unusually high or low values. Approximately one third of the outliers and extreme values had high or low values in at least two inter-related variables, typically the overall size/approximate surface area, maximum thickness, depth of the striking platform and area of the striking platform. All but one of the recurrent outliers or extreme values were derived from lithic assemblages dated to the Late Neolithic (Phases 4 to 6). The frequency of complete removals with unusually high or low values from the Late Neolithic assemblages is consistent with the decline in the emphasis on the standardised production of blanks identified on the basis of the technological analysis of the stone tools and unmodified cores in the previous chapter.

Secondly, the values of the ordinal variables and continuous variables were examined for skewed distributions and tests of normality were carried out where appropriate. With the exception of the approximate degree of cortication and number of directions from which flakes had previously been removed, the values of the ordinal variables approximated a normal distribution. In contrast, the values of only two of the continuous variables, the maximum length and relative thickness of the bulb of percussion, approximated a normal distribution. Whilst the application of a natural log (ln) transformation provided a better approximation to a normal distribution and eliminated the majority of the extreme values and outliers, logged values are harder to interpret and it is more difficult to identify patterns or thresholds that can easily be applied to other datasets. Unless stated otherwise, the statistical techniques used as part of the analysis below were either “distribution free”, i.e. made no assumptions about the distribution of the values of the variables that were being analysed, or the values of the variables provided a close enough approximation to a normal distribution, i.e. did not require the application of a natural log (ln) transformation.

Thirdly, the dataset was inspected for significant relationships between pairs of variables and correlation coefficients were calculated where possible. There is a direct relationship between the overall size/approximate surface area or maximum thickness of a blade or flake and the depth of the striking platform or area of the striking platform. The successful detachment of a large blade or flake is dependent on a number of factors, including the amount of force applied and the ability of the raw material to withstand that force (Cotterell, Kamminga, and Dickson 1985). Large flakes are likely to have a high maximum thickness, allowing the force to dissipate gradually, and a striking platform with a large contact area enabling the application of a forceful blow via direct percussion. There is also a direct relationship between the overall size/approximate surface area or maximum length of a blade or flake and the approximate degree of cortication of the dorsal surface and the number of flake scars from previous removals. Under optimal conditions, the outcome of a knapping operation can be controlled by creating a system of ridges formed by the intersections of flake scars from previous removals on the debitage surface of a core or stone tool.

4.2 Morphometric properties

Analysis of the variables which describe the morphological attributes and metric properties of the complete removals (n=140) from the Neolithic burial mounds is intended to identify recurrent patterns which are either chronologically diagnostic or technologically diagnostic. Recurrent patterns are defined in relation to either the aggregated assemblages of worked flint dated to the Early Neolithic (Phases 1 to 3) and those dated to the Late Neolithic (Phases 4 to 6), or the individual assemblages of worked flint from Aldro C75 (Burial 1), Riggs 20 (Burial Mound) and Calais Wold 275 (Interim Mound). These assemblages of worked flint represent not just different phases of activity but different methods of core working. The unmodified cores and lithic debitage from the assemblages of worked flint dated to the Early Neolithic and the cache of worked flint found with Burial 1 at Aldro C75 are consistent with blade manufacture. Conversely, the unmodified cores and debitage from the assemblages of worked flint dated to the Late Neolithic and the residual occupational debris incorporated into the fabric of the burial mound at Riggs 20 are consistent with polyhedral flaking.

The values of variables which are chronologically or technologically diagnostic typically correspond to outliers/extreme values or the tails of the distribution, i.e. unusual values which reflect deviations from the norm. Differences between the Early Neolithic and Late Neolithic are either defined in terms of presence/absence or are characterised by low frequencies of

artefacts (n << 10). Significance tests have consequently been avoided. The scoring systems proposed in the next chapter account for the uncertainty in the significance of the values of individual variables by placing greater weighting on artefacts which have multiple traits that are characteristic of either Early Neolithic or Late Neolithic stone working traditions. Although spurious values could in principle have a confounding effect, this does not appear to be the case based on the validation of the scoring systems using the chronologically diagnostic artefacts from the lithic scatter at Wharram-le-Street (Section 5.2).

4.2.1 Surface character

Technological analysis of the stone tools and unmodified cores from the Neolithic burial mounds would appear to suggest that a change in the procurement of raw materials took place during the Neolithic. This change is characterised by the diversification of the resource base of contemporary lithic industries, with increased evidence for the use of poor-quality white flint and tabular flint amongst the lithic assemblages dated to the Late Neolithic. The range and relative frequency of the raw materials represented amongst the complete removals from the Neolithic burial mounds are broadly comparable to those represented amongst the stone tools and unmodified cores. If the blades and flakes manufactured from light grey and light brown flint are combined the frequency diagram approximates a normal distribution, with the frequencies of dark grey and light grey/brown flint distributed equally around the mode – mid grey flint. It is only the tails of the frequency diagram, at the two extremes of the colour spectrum, that exhibit chronological patterning (Table 22).

At one extreme, all three of the removals manufactured from high quality black flint from the Holderness coastline were derived from lithic assemblages dated to the Early Neolithic (Phases 1 to 3). At the other extreme, two of the removals manufactured from poor quality white flint from the chalk formations of the Yorkshire Wolds were derived from lithic assemblages dated to the Late Neolithic (Phases 4 to 6). Although chalk flint is poorly suited to controlled flint knapping, it nonetheless possesses the property of conchoidal fracture and could potentially have been worked. The definition of normative processes is critical to the identification of debitage signatures which are characteristic of individual stone working traditions. Care must be taken to differentiate between the systematic procurement of raw materials and the opportunistic use of pieces of flint which are suitable for a particular task. Whilst the opportunistic use of chalk flint from the quarry ditches of Early Neolithic long

barrows has been documented on the Lincolnshire Wolds (Phillips 1989), such flint would have constituted only a small proportion of the resource base of contemporary industries.

Despite the low frequency of complete removals manufactured from white flint derived from the Welton and Burnham chalk formations, two general observations can be made with regard to the procurement of raw materials. First, high quality raw materials are a pre-requisite for controlled flint knapping and none of the complete blades or unmodified cores with debitage surfaces characteristic of blade manufacture from the Neolithic burial mounds were manufactured from chalk flint. Secondly, the cumulative frequency of stone tools, unmodified cores and complete removals manufactured from chalk flint was higher for the lithic assemblages dated to the Late Neolithic (Phases 4 to 6) than those dated to the Early Neolithic (Phases 1 to 3). These observations are consistent with the broader changes in the nature of stone working which took place from the Late Neolithic onwards, with a decline in the emphasis on controlled flint knapping and the standardised production of blanks (Ford et al. 1984). However, the relationship between production and procurement is not determined solely by the quality of the raw materials upon which stone working was based.

With the exception of pebble-based industries, little attention has been paid to the quantity and size of the pieces of flint which were available for stone working and the implications for industries that were based on those resources. In contrast to the flint bearing counties of Southern and Eastern England, flint was not widely used in the construction of buildings in Eastern Yorkshire during the Mediaeval and Post Mediaeval periods. Although suitable flint could have been obtained from the exposures of boulder clay along the Holderness coastline, the quantity of flint which could have been obtained from the boulder clay was not sufficient for use as a building material. Similarly, the quantity of flint which was suitable for the purposes of the manufacture of stone tools is likely to have been limited and will have imposed constraints on prehistoric industries. Few usable pieces of flint as large as the simple core from the upper levels of the burial mound at Duggleby Howe can be found along the beach or cliff face of the Holderness coastline today. The limited availability of usable flint would account for the nature of both the lithic scatters and the stone working traditions which are characteristic of the Neolithic of Eastern Yorkshire.

4.2.2 Degree of cortication

The frequency of unmodified cores and stone tools from the Neolithic burial mounds which retained traces of cortex is consistent with an industry based on limited resources, with the minimisation of waste going hand in hand with the maximisation of the return from a piece of stone. Trimming of cortex does not appear to have played a major role in either the reduction of cores or the manufacture of tools. The intended outcome of an episode of flaking or shaping is therefore likely to become evident at an early stage in the sequence of knapping operations and the rate at which cortex is removed can potentially be used to discriminate between different methods of stone working. It can be assumed that the amount of cortex on the surface of a core or piece of flint will decrease during the course of a sequence of knapping operations. Equally, the probability of the dorsal surface of a removal bearing traces of cortex will decrease as the sequence progresses. The rate at which the amount of cortex decreases and therefore the probability that a removal will be corticated, however, will be dependent upon the reduction strategy employed.

Whilst the traditional distinction between primary, secondary and tertiary blades or flakes allows crude differentiation between the earlier and later stages of a reduction sequence, discrimination between specific reduction strategies requires a system of classification which provides a more accurate estimate of the amount of cortex on the dorsal surface of a removal. Approaches which record the absolute percentage of cortex using a transparent overlay with a regular mesh of dots are time consuming (c.f. Andrefsky 1998, 102–4). A method was sought which allowed the approximate percentage of cortex to be recorded rapidly with a reasonable degree of precision and accuracy, i.e. a method which would both minimise the margin of error and yield the same results if repeated. An initial distinction was made between cortical removals where the entire dorsal surface was covered with cortex (Stage 1: t_0=100%) and non-cortical removals where all of the cortex had been removed (Stage 7: t_6=0%), with five subsequent classes of cortical removals (Stages 2 to 6) based on the estimated or projected amount of cortex on the dorsal surface after equal increments of time (t_1 to t_5).

The rate at which cortex is removed is not constant and will vary from one sequence of knapping operations to the next. More cortex is removed during the initial stages of a reduction sequence and the rate of decay will consequently decrease with each successive knapping operation. The amount of cortex can be estimated using the cumulative distribution function:

$$1 - e^{-\lambda t}$$

where:

e = base of the natural logarithm

λ = decay constant

t = time elapsed

and the probability that a removal would be corticated can be obtained using the expression:

$$1 - (1 - e^{-\lambda t})$$

or:

$$e^{-\lambda t}$$

A decay constant (λ=0.40) was chosen to allow greater differentiation between removals with less than 50% of the dorsal surface covered with cortex (Figure 44). The resultant probabilities were converted into percentages, simplified for ease of classification and mapped onto a standardized chart for estimating percentages to enable rapid estimation of the approximate degree of cortication (Figure 45).

The relative frequencies of complete cortical removals were plotted for the individual assemblages of worked flint from Aldro C75, Riggs 20 and Calais Wold 275, and compared against those for the aggregated assemblage of worked flint from the Neolithic burial mounds. Z-scores were calculated in order to standardise the frequencies for each of the assemblages of lithic debitage and allow meaningful comparison of the corresponding debitage signatures (Figure 46). The frequency of complete removals for the aggregated assemblage of lithic debitage is inversely proportional to the approximate degree of cortication. It increases exponentially, mirroring the decay curve used to define the classes of intermediate cortical flakes. This frequency diagram can be used as a baseline to interpret the relative frequencies of complete removals with different degrees of cortication for the individual assemblages of debitage. As with changes in the procurement of raw materials, the definition of normative processes is pivotal to the identification of debitage signatures which are characteristic of individual stone working traditions. Deviation from the norm established on the basis of the aggregated assemblage of worked flint from the Neolithic burial mounds is potentially indicative of the use of different methods of core working.

This principle can be illustrated with reference to the methods used to initiate blade manufacture. Where a natural ridge is used to control the first removal from a striking platform or debitage surface, 100% of the dorsal surface of the flake or blade will be corticated (Figure 47). The ridges formed by the edges of the resultant flake scar can be used to control further removals. In each instance, approximately 50% of the dorsal surface of the flake or blade will be covered with cortex. As further flakes or blades are removed from the core the degree of cortication will continue to decrease. Once a system of parallel ridges has been established on the debitage surface, subsequent removals are likely to have traces of cortex at the distal end or along one margin only (typically either 20% or <10%). Expansion of the active area of the debitage surface may result in removals with a higher degree of cortication. Approximately 35% or 50% of the dorsal surface may be covered with cortex, depending on whether one or two ridges are used to control the removal of the blade or flake.

Where an artificial crest is used to control the first removal from a striking platform or debitage surface, cortex will have been removed as part of the preparation of the crest and blades struck from the striking platform or debitage surface are unlikely to retain traces of cortex. Two opposed debitage surfaces are created along the line of the crest which acts as striking platform during the course of the preparation of the core. The dorsal surface of the first flake struck from each of debitage surface will be fully corticated. Where the ridges formed by the edges of the resultant flake scar are used to control subsequent removals from the debitage surfaces, approximately 50% of the dorsal surface of those removals will be covered with cortex. A higher frequency of removals with between 50% and 100% of the dorsal surface covered with cortex will be produced where an artificial crest is used to control the first removal from a blade core. Conversely, a higher frequency of removals with either 20% or <10% of the dorsal surface covered with cortex will be produced where a natural crest is used to control the first removal from a blade core. Distinctions between different methods of core working are likely to be even more pronounced.

Three distinct patterns emerge when the frequency diagrams for the complete removals from the individual assemblages of worked flint from Aldro C75, Riggs 20 and Calais Wold 275 are compared against the aggregated assemblage of worked flint from the Neolithic burial mounds. First, the frequency diagram for the cache of worked flint from Aldro C75 is characterised by a pronounced peak with an increase in the number of Stage 5 removals (20%) consistent with the systematic reduction of a single or opposed platform core, once a system

of parallel ridges had been established on the debitage surface. Secondly, the frequency diagram for the residual occupational debris from Riggs 20 is characterised by a sinuous curve with a greater frequency of removals from Stages 2 and 3 (70% and 50%) than the assemblage from Aldro C75 and is consistent with the *ad hoc* reduction of a polyhedral core, initiating a new debitage surface by rotating the core. Thirdly, the frequency diagram for the knapping debris from Calais Wold 275, which contained evidence for both of these methods of core working, mimics the characteristics of the frequency diagrams for the assemblages of worked flint from Aldro C75 and Riggs 20.

4.2.3 Size sorting

The metric properties of blades and flakes are often considered to be chronologically diagnostic. During the Mesolithic, emphasis was placed on the manufacture of short narrow flakes or bladelets (L<30mm and L>2B) for use as blanks for microliths (Butler 2005, 83–88). Increased emphasis on the manufacture of larger blades (L>30mm and L>2B) during the Early Neolithic was accompanied by a gradual shift towards the production of longer flakes (L≈1.5B). This shift is consistent with the type of flake that was used as a blank for the manufacture of Early Neolithic scrapers (Riley 1990, 226). A series of distinctive industries emerged during the Late Neolithic, based on prepared core technologies that utilised variants of the Levallois method to produce flakes of a pre-determined size and shape (Edmonds 1995). These industries were associated with the production of a limited range of stone tools and were contrary to broader changes in contemporary stone working which witnessed a decline in the production of regular flakes (Holgate 1988). Late Neolithic and Bronze Age flakes were typically short and squat (L≈B), with a reliance on hard hammer percussion reflected by both the frequency of removals with hinged or stepped terminations and the number of broken flakes or flake fragments.

Analysis of the stone tools from the Neolithic burial mounds in the previous chapter identified decreases in the mean values of both the overall size and the relative proportions of the blades or flakes used as blanks in successive phases of activity. It might be reasonable to expect that changes in the types of blanks used for stone tools would be correlated directly with changes in the corresponding debitage. At face value, however, this assertion cannot be sustained on the basis of the analysis of the metric properties of the complete blades and flakes (Tables 23 and 24). The mean values for the overall size of the pieces of debitage typically increase, rather than decrease, from one phase of activity to the next. Differences in the mean values

of the overall size and relative proportions of the blades and flakes which were selected for use as blanks for stone tools and those which were discarded can be attributed to the nature of the two classes of artefacts. A fundamental distinction can be drawn between the products of flaking, i.e. usable blanks, and the by-products of flaking, i.e. discarded removals.

The methods of core working represented by the stone tools and unmodified cores are consistent with an industry based on limited resources, seeking to maximise the return from a piece of stone and minimise the amount of waste. Blades or flakes which were suitable for use as blanks for stone tools were therefore likely to have been used for this purpose, regardless of whether they were produced intentionally or by chance. Conversely, the reliance upon smaller pieces of raw material and the efficient nature of the methods of core working would appear to suggest that the blades or flakes which were discarded were typically not suitable for use as blanks for stone tools, a suggestion which is congruent with the differences in the mean sizes of the stone tools and the complete removals from the Neolithic burial mounds. Even without compensating for the reduction in surface area resulting from shaping and edge modification, the blades or flakes used as blanks for the stone tools from each phase of activity were considerably larger than the complete removals which had not been modified.

The headline increase in the overall size of the complete removals masks underlying changes in the nature of stone working. Comparison of the mean values of the metric properties of the complete removals from the assemblages of worked flint from Aldro C75 and Riggs 20 reveals significant differences between the two assemblages, most notably a decrease in the maximum length and an increase in the maximum breadth of the blades and flakes (Table 25). These differences are consistent with the dominant methods of core working with which these assemblages of worked flint were associated, i.e. blade manufacture and polyhedral shaping. As with the approximate degree of cortication, the mean values of the maximum length and maximum breadth of the blades and flakes from the assemblage of worked flint from Calais Wold 275, which contained evidence for both blade manufacture and polyhedral shaping, occupied the middle ground between those for the assemblages of worked flint from Aldro C75 and Riggs 20. Hierarchical cluster analysis (HCA) is used below to classify the complete removals from the Neolithic burial mounds on the basis of their maximum length and maximum breadth.

HCA is an agglomerative technique. Each blade or flake was initially treated as a separate cluster. Individual clusters were subsequently fused, grouping the two clusters with the most similar metric properties, until the removals had been split into the desired number of clusters. The optimal number of clusters is difficult to determine and, consequently, a range of solutions was obtained (Figure 48). When classified into two clusters, the solution provided a simple distinction between large and small removals. Analysis appeared to yield more meaningful solutions when blades and flakes were classified into more than two clusters. As the number of clusters increased, the removals could be sub-divided into a series of discrete clusters on the basis of their length relative to their breadth. The solution for four clusters differentiated between undiagnostic removals (Cluster 1: L<40mm and B<30mm), long thin removals (Cluster 2: L>2B), intermediate removals (Cluster 3: B<L<2B) and short squat removals (Cluster 4: L≈B or L<B). With the exception of Cluster 1, these clusters correspond to groups of blades and flakes which have been identified intuitively in the past and are considered to be chronologically or technologically diagnostic.

Although little or no differentiation can be seen in the relative frequencies of intermediate removals for the assemblages of worked flint from Aldro C75, Riggs 20 and Calais Wold 275, pronounced differentiation can be seen in the relative frequencies of long thin, short squat and undiagnostic removals for the individual assemblages of worked flint (Table 26). First, the cache of worked flint from Aldro C75 contained a higher frequency of long thin removals (Cluster 2) than the assemblages of worked flint from Riggs 20 and Calais Wold 275. Secondly, the residual occupational debris from Riggs 20 contained a higher frequency of short squat removals (Cluster 4) than the assemblages of worked flint from Aldro C75 and Calais Wold 275. Thirdly, the knapping debris recovered from Calais Wold 275 contained a higher frequency of undiagnostic removals (Cluster 1) than the assemblages of worked flint from Aldro C75 and Riggs 20. The differences in the metric properties of the complete removals from these assemblages of worked flint is consistent with the decline in the emphasis on controlled flint knapping and the standardised production of blanks which took place during the course of the Neolithic.

Although the length to breadth ratio (L>2B) for the long thin removals (Cluster 2) falls within the range used to define blades, less than a sixth (13.51%) of the long thin removals were classified as blades. A distinction was consequently made been regular blades and irregular blades for the purposes of the analysis below. The long thin removals which were classified

as blades (regular blades) had a higher length to breadth ratio (L>3B) than those which were classified as flakes. Conversely, the long thin removals which were classified as flakes (irregular blades) exhibited greater maximum variation in breadth than those which were classified as blades (Table 27). Thirty-two irregular blades were identified amongst the lithic assemblages from the Neolithic burial mounds, sixteen of which were derived from the cache of worked flint from Aldro C75. These removals were tentatively thought to have been associated with the early stages of blade manufacture, before a system of parallel ridges had been established on the surface of a core. Only a handful of irregular blades were identified amongst the residual occupational debris from Riggs 20 and the knapping debris from Calais Wold 275.

4.2.4 Mode of percussion

The outcome of a knapping operation and therefore the metric properties of a blade or flake can be determined by the flint knapper through the controlled application of force and the selection of an appropriate technique for the task at hand. Experiments have shown that the overall size of a blade or flake is proportional to the amount of force that was applied, i.e. more force is required to detach a large blade or flake than is required to detach a small blade or flake (Whittaker 1994, 71). A wide variety of techniques was employed in the manufacture of the stone tools from the Neolithic burial mounds. These techniques can be grouped into two categories: those involving the application of force through percussion (e.g. direct percussion, indirect percussion, bipolar flaking and edge retouching); and, those involving the application of force through pressure (e.g. pressure flaking and the microburin technique). Whilst the amount of force that was applied and the angle of a blow cannot be measured, the technique that was used for a particular knapping operation can potentially be inferred from the morphological attributes and metric properties of the proximal and distal ends of the resultant blade or flake.

4.2.4.1 Thickness of the bulb of percussion

A force can be subdivided into two components, a horizontal (outward) component and a vertical (downward) component. The magnitude of the horizontal component of a force will determine the way in which a fracture was initiated:

1. high – the force travels across the surface of the volume of stone before it begins to dissipate and a fracture is initiated away from the point of application, resulting

in the formation of a bending 'flake' with a distinctive 'lipped' striking platform. Bending 'flakes' typically occur as the result of pressure flaking or direct percussion using a soft hammer;

2. moderate – a fracture is initiated at the point of application and the force forms a partial Herzian cone before dissipating as it travels through the volume of stone, resulting in the formation of a conchoidal 'flake' with a bulb of percussion. Conchoidal 'flakes' typically occur as the result of direct percussion using either a hard or a soft hammer;

3. low – a fracture is initiated at the point of application and the force travels into the volume of stone at an angle of approximately 90° without forming a Herzian cone, resulting in the formation of a compression 'flake'. Compression 'flakes' typically occur as a result of either bipolar flaking using a hammer and anvil or 'quartering' a nodule of flint[13].

The morphological characteristics of the proximal end of a blade or flake are determined by the way in which a fracture was initiated and, as such, are potentially indicative of the technique that was used to detach the blade or flake.

No bending or compression 'flakes' were identified amongst the lithic assemblages from the Neolithic burial mounds. All of the complete blades/flakes were conchoidal 'flakes' characteristic of direct percussion using a hard hammer or soft hammer. The thickness of the bulb of percussion at the proximal end of the ventral surface of a conchoidal 'flake' is determined by a combination of the type of hammer that was used, the amount of force that was applied and the direction of the blow. Although a blade or flake struck using a glancing blow with a hard hammer may have a bulb of percussion of the same thickness as one struck using a forceful blow with a soft hammer, blades or flakes struck using a hard hammer will typically have a more pronounced bulb of percussion than those struck using a soft hammer. An estimate of the relative thickness of the bulb of percussion of a blade or flake can be obtained by calculating the ratio of the observed thickness of the bulb of percussion to the expected thickness based on the formation of a hypothetical Herzian cone.

[13] Splitting a nodule by direct percussion using a hard hammer.

For the purposes of the analysis below, the expected thickness of the bulb of percussion was defined as the mean value of the measurements of thickness taken at the proximal end and midpoint of the blade or flake, i.e. the thickness at the point midway along the chord between the point of impact on the striking platform and the midpoint of the ventral surface of the blade or flake. Three groups of blades or flakes can be identified on the basis of the relative thickness of the bulb of percussion: 1) blades or flakes with a diffuse bulb of percussion (≤1.00), where the observed thickness was less than or equal to the expected thickness; 2) blades or flakes with a moderate bulb of percussion (>1.00 and ≤1.17), where the observed thickness was greater than the expected thickness; and, 3) blades or flakes with a pronounced bulb of percussion (>1.17), where the observed thickness was significantly greater than the expected thickness. The mean value of the relative thickness of the bulb of percussion was used to define the threshold between blades or flakes with moderate bulbs of percussion and those with pronounced bulbs of percussion.

Differential patterning can be seen in the relative frequencies of the complete removals which corresponded to each of these groups of blades and flakes for the assemblages of worked flint from Aldro C75, Riggs 20 and Calais Wold 275 (Table 28). First, the cache of worked flint from Aldro C75 contained a higher frequency of removals with diffuse bulbs of percussion and lower frequency of removals with pronounced bulbs of percussion than the aggregated assemblage of worked flint from the Neolithic burial mounds. Secondly, the residual occupational debris from Riggs 20 contained a higher frequency of removals with pronounced bulbs of percussion and lower frequency of removals with diffuse bulbs of percussion than the aggregated assemblage of worked flint from the Neolithic burial mounds. Thirdly, the frequencies of removals with diffuse bulbs of percussion and pronounced bulbs of percussion for the knapping debris from Calais Wold 275 were comparable to those for the aggregated assemblage of worked flint from the Neolithic burial mounds. Little variation was noted in the frequencies of removals with moderate bulbs of percussion.

Blades or flakes with diffuse bulbs of percussion are generally considered to be indicative of soft hammer percussion, a mode of percussion typically associated with knapping operations or methods of core working which required a higher degree of control or precision (e.g. blade manufacture). Conversely, blades or flakes with pronounced bulbs of percussion are generally considered to be indicative of hard hammer percussion, a mode of percussion typically associated with knapping operations or methods of core working which required a lower

degree of control or precision (e.g. polyhedral shaping). The differences identified in the relative frequencies of blades and flakes with diffuse bulbs of percussion and pronounced bulbs of percussion are consistent with the changes in the nature of stone working which took place during the Neolithic, with a decline in the emphasis on the controlled flint knapping and an increase in the reliance upon hard hammer percussion. Yet again, the morphometric characteristics of the complete removals for the knapping debris from Calais Wold 275 mimic those of the complete removals for the cache of worked flint from Aldro C75 and the residual occupational debris from Riggs 20.

4.2.4.2 Type of blade/flake termination

The way in which a force travels through a volume of stone is dependent on the physical properties of the stone and those of the hammer that was used to strike the blow. A soft hammer will compress more than a hard hammer and the force from the blow will be spread out further from the point of impact on the striking platform (Cotterell and Kamminga 1987). If an identical force is applied, a flake struck using a soft hammer will be shorter than one struck using a hard hammer. A force with a greater vertical component must be applied with a soft hammer to produce a flake of the same length as one struck using a hard hammer. The magnitude of the vertical component of a force will determine the way in which a fracture terminates:

1. high – the force will overshoot the debitage surface before it has dissipated fully, removing part of another surface of the volume of stone and resulting in the formation of a blade or flake with an overshot termination;

2. moderate – the force will dissipate gradually as it travels through a volume of stone, exiting cleanly from the debitage surface of a core or blank and resulting in the formation of a blade or flake with a feathered termination;

3. low – the force will peter out and turn sharply to follow the path of least resistance, exiting the volume of stone at right angles to the debitage surface and resulting in the formation of a blade or flake with a hinged or stepped termination.

Blades or flakes with stepped terminations may also occur as a result of flaws in raw materials. The morphological characteristics of the distal end of a blade or flake are determined by the way in which a fracture terminated and, as such, are potentially indicative of the amount of

force that was used to detach the blade or flake. Depending upon the method of flaking or shaping employed, the intended outcome of a particular knapping operation will be the production of a blade or flake with a feathered or overshot termination. A high frequency of blades or flakes with hinged terminations or stepped terminations is consequently considered to be indicative of either a lack of concern with controlled flint knapping or the use of low-quality raw materials.

As with the relative thickness of the bulb of percussion, differential patterning can be seen in the relative frequencies of complete removals with different types of blade/flake termination for the assemblages of worked flint from Aldro C75, Riggs 20 and Calais Wold 275 (Table 29). First, the cache of worked flint from Aldro C75 contained a higher frequency of removals with overshot terminations and a lower frequency of removals with hinged terminations than the aggregated assemblage of worked flint from the Neolithic burial mounds. Secondly, the residual occupational debris from Riggs 20 contained a higher frequency of removals with hinged or stepped terminations and lower frequency of removals with feathered or overshot terminations than the aggregated assemblage of worked flint from the Neolithic burial mounds. Thirdly, the combined frequencies of removals with feathered or overshot terminations and hinged or stepped terminations for the knapping debris from Calais Wold 275 were comparable to those for the aggregated assemblage of worked flint from the Neolithic burial mounds. This patterning would appear to be broadly consistent with the dominant methods of core working represented by these assemblages of worked flint.

The high frequency of removals with overshot terminations for the cache of worked flint from Aldro C75 is consistent with methods of core working, such as blade manufacture, which require a higher degree of control or precision. Overshot terminations will typically occur as the result of the application of a force with a high vertical component and are congruent with the amount of force that would be required to detach a blade using a soft hammer. Although the application of too much force may result in the removal of the base of the core, this is more desirable than the application of too little force which will result in the creation of a 'step' on the debitage surface. Conversely, the high frequency of removals with hinged or stepped terminations for the residual occupational debris from Riggs 20 is consistent with methods of core working, such as polyhedral flaking, which require a lower degree of control or precision. Hinged or stepped terminations will typically occur as the result of the

application of a force with a low vertical component and are widely considered to be indicative of a reliance on hard hammer percussion.

Differential patterning in the morphometric characteristics of the proximal and distal ends of the blades and flakes from Aldro C75, Riggs 20 and Calais Wold 275 would appear to be linked to both the possible mode of percussion and the method of flaking or shaping that was employed. As such, one would anticipate that the values of the relative thickness of the bulb of percussion, the type of blade/flake termination and the metric properties of the blades and flakes were highly inter-related. Correspondence analysis can be used to describe the relationships between a pair of categorical variables recorded as a series of nominal values (Greenacre 2007). The relationships between the values of each pair of variables are represented in a low dimensional space, where the maximum number of dimensions is one less than the number of values of the variable with the smallest range, and the distances between data points representing the similarities or differences between the values of those variables. A maximum of two dimensions was used for the purposes of the correspondence analysis of the categorical variables for the complete removals from the aggregated assemblage of worked flint from the Neolithic burial mounds.

Correspondence analysis of the relative thickness of the bulb of percussion, type of blade/flake termination and metric properties[14] of the complete removals was carried out using pairwise contingency tables (m x n matrices). First, there would initially appear to be little correspondence between the relative thickness of the bulb of percussion and the type of blade/flake termination of the complete removals (Figure 49). Little or no grouping can be seen in the values of the two variables. Secondly, more distinct patterning can be seen when the relative thickness of the bulb of percussion is compared with the metric properties of the complete removals (Figure 50), with: 1) a strong correspondence between long thin removals and diffuse bulbs of percussion, and; 2) a strong correspondence between moderate bulbs of percussion and undiagnostic removals. The correspondence between moderate bulbs of percussion and undiagnostic removals is not considered to be diagnostic. Thirdly, similar patterning can be seen when the type of blade/flake termination is compared with the metric

[14] With classes defined using the groups of blades and flakes identified on the basis of the cluster analysis of the maximum length and maximum breadth of the complete removals.

properties of the complete removals (Figure 51), with a correspondence between long thin removals and stepped or overshot terminations.

Whilst the correspondence between long thin removals and blades or flakes with diffuse bulbs of percussion or overshot terminations is consistent with the methods of core working associated with the systematic production of blades or elongated flakes, the correspondence between long thin removals and blades or flakes with stepped terminations would at first appear to be at odds with the controlled nature of those methods of core working. The incidence of blades or flakes with stepped terminations resulting from flaws in raw materials will be proportionate to the amount of force applied, i.e. the larger the force the greater the chance that a removal will break as a result of a flaw in the volume of stone from which it was struck. A high frequency of blades or flakes with stepped terminations may therefore be produced during the course of systematic blade manufacture where removals are detached by forceful blows using a soft hammer. It is important to differentiate between knapping errors which are caused by flaws in raw materials and those which are the result of a lack of consistency on behalf of the flint knapper.

A weak correspondence can be seen between intermediate removals and complete removals with pronounced bulbs of percussion and hinged blade/flake terminations respectively. High frequencies of blades or flakes with pronounced bulbs of percussion and hinged terminations are consistent with the increased reliance on hard hammer percussion and the decline in the emphasis on controlled flint knapping typical of Late Neolithic and Bronze Age industries (Ford et al. 1984). Despite the high frequency of short squat removals identified amongst the lithic assemblages dated to the Late Neolithic, little or no correspondence could be seen between short squat removals and blades or flakes with pronounced bulbs of percussion or hinged terminations. The variability in the relative thickness of the bulb of percussion and the type of blade/flake termination for the short squat removals, however, is in itself indicative of a lack of consistency in the way in which a force was applied.

4.2.5 Preparation of striking platforms

The metric properties of a blade or flake are also dependent upon the exterior platform angle (the angle between the striking platform and the adjacent debitage surface) and the depth of the striking platform (the distance between the edge of the striking platform and the point of applied force). Experiments have shown that the length of a blade or flake increases as the

exterior platform angle approaches 90° and that the length and thickness of a blade or flake are proportional to the depth of the striking platforms (Whittaker 1994, 71). The methods of flaking and shaping identified on the basis of the technological analysis of the stone tools and unmodified cores from the Neolithic burial mounds can be subdivided into two categories, namely those based on secant planes (e.g. blade manufacture and bifacial shaping), and those based on the centre of gravity of a core or blank (e.g. polyhedral flaking). Evidence for the use of methods of flaking or shaping based on the centre of gravity of a core or blank was largely confined to the lithic assemblages dated to the Late Neolithic (Phases 4 to 6).

A blade or flake can be detached from a volume of stone providing that an angle less than 90° can be found between two surfaces of the volume of stone, either: two adjacent surfaces for a knapping operation based on secant planes, or; any two surfaces for a knapping operation based on the centre of gravity of a core or blank. The values of the exterior platform angle for the complete removals from the Neolithic burial mounds approximate a normal distribution, with the frequency of complete removals distributed equally around the mode of 80°. At the two extremes of the range of values, removals with exterior platform angles which correspond to the tails of the distribution are potentially technologically diagnostic. Blades or flakes struck from a polyhedral core, for example, are likely to have a higher exterior platform angle than those struck from a Levallois-like or tortoise shell core. Conversely, blades or flakes struck during the course of the roughing-out of a flint axe are likely to have a lower exterior platform angle than those struck during the course of the later stages of blade manufacture.

Differential patterning can be seen in the values of the exterior platform angle for the groups of blades and flakes identified on the basis of cluster analysis of the maximum length and maximum breadth of the complete removals (Figure 52). Little variation can be seen in the exterior platform angles of the long thin removals, with the values of the exterior platform angle confined to the central part of the distribution and ranging between 70° and 85°. The limited range of values reflects a high degree of consistency and is congruent with the controlled methods of core working which are typical of systematic blade manufacture[15]. A flint knapper can increase the likelihood of producing a blade or elongated flake by keeping

[15] The range of values for the long thin removals is assumed to correspond to the optimal value for the exterior platform angle of a blade or flake. Values of the exterior platform angle which fall outside this range represent a deviation from the norm and are considered to be indicative of different methods of flaking or shaping.

the angle between the striking platform and adjacent debitage surface close to 90°. In contrast, greater variation can be seen in the exterior platform angles for the other groups of blades and flakes, with the values of the exterior platform angle ranging between: 80° and 100° for the intermediate removals; 65° and 100° for the short squat removals, and; 45° and 100° for the undiagnostic removals.

At the upper end of the range of values, nine of the complete removals from the Neolithic burial mounds had an exterior platform angle of 90° or higher. These removals were consistent with knapping operations based on the centre of gravity of a volume of stone and were thought to be characteristic of polyhedral flaking (i.e. the reduction of a polyhedral core). The exterior platform angle may exceed the critical value below which a blade or flake can be detached from a volume of stone where an angle less than 90° can be found between two non-adjacent surfaces of a core or blank[16]. At the lower end of the range of values, three of the complete removals from the Neolithic burial mounds had an exterior platform angle of 65° or lower. These removals were consistent with knapping operations based on secant planes and were thought to be indicative of either bifacial flaking (e.g. the reduction of a discoidal core) or bifacial shaping (e.g. the preparation of the striking platform and debitage surface on a Levallois-like or tortoise shell core or the thinning and shaping of a blank for a leaf-shaped arrowhead).

Removals associated with different methods of bifacial flaking or shaping can be differentiated both quantitatively and qualitatively. A higher frequency of removals with low exterior platform angles, for example, will typically be produced during the course of the reduction of a discoidal core than during the course of the preparation of the striking platform and debitage surface on a Levallois-like or tortoise shell core. Similarly, flakes struck during the course of the preparation of the debitage surface and striking platform on a Levallois-like or tortoise shell core will typically be larger than those struck during the course of the thinning and shaping of a blank for a leaf-shaped arrowhead. Small fraction debitage, less than 10mm in length and 10mm in breadth, characteristic of the latter stages of a sequence of knapping operations was not represented amongst the lithic assemblages from the Neolithic burial

[16] The definition of the exterior platform angle employed here assumes that the exterior platform angle is the angle between the striking platform and the adjacent debitage surface, an assumption which applies to knapping operations based on secant planes but not those based on different methods of flaking or shaping.

mounds. The majority of the removals with low exterior platform angles from the Neolithic burial mounds were consequently thought to have been the products of bifacial flaking or the initial stages of bifacial shaping, i.e. the preparation of cores and the production of blanks for stone tools.

Methods of core working which employ bifacial flaking or bifacial shaping are generally considered to have been associated with Late Neolithic stone working traditions (Butler 2005, 155–57). Removals with exterior platform angles which correspond to both extremes of the range of values would appear to be consistent with methods of core working which were employed during the Late Neolithic and are potentially considered to be chronologically diagnostic. Over half of the removals with high exterior platform angles (n=9) or low exterior platform angles (n=3) were derived from lithic assemblages dated to the Late Neolithic (Phases 4 to 6). Three of the remaining removals with unusually high or low exterior platform angles were derived from lithic assemblages which contained stone tools or unmodified cores characteristic of Late Neolithic stone working traditions. Outside the optimal range of values for the exterior platform angle, the length of a blade or flake that can be detached from a volume of stone can be controlled through preparation and maintenance of the edge of the striking platform, or by adjusting either the angle of a blow or the depth of the striking platform.

4.2.5.1 Methods of platform preparation

A distinction can be made between less complex methods of platform preparation (e.g. abrasion and trimming) which were simply used to strengthen the edge of the striking platform, and more complex methods of platform preparation (e.g. isolation and faceting) which were used to modify the striking platform itself (Whittaker 1994, 101–4):

1. abrasion – removal of overhangs from previous removals, often carried out using a hard or soft hammer, in order to strengthen the edge of the striking platform;

2. trimming – removal of a series of small flakes from the debitage surface either to remove overhangs from previous removals and strengthen the edge of the striking platform, or to increase the exterior platform angle and maximise the length of subsequent removals;

3. isolation – trimming from two opposing directions, with the removal of a series of small flakes from the debitage surface in order to isolate a point of impact above a ridge formed by the intersection of flake scars from previous removals;

4. façeting – removal of a series of small flakes from the striking platform in order to increase the exterior platform angle and maximise the length of subsequent removals.

Chronological or technological patterning can be seen in both the relative frequencies of complete removals which exhibited evidence for platform preparation, and the complexity of the methods of platform preparation that were represented amongst the lithic assemblages derived from Early Neolithic and Late Neolithic contexts.

Over half of the complete removals from the Neolithic burial mounds exhibited evidence for platform preparation (Table 30). Twenty-seven of the remaining blades and flakes had crushed striking platforms and the method of platform preparation, if any, could not be determined. Crushing may indicate a lack of concern with platform preparation or may occur as a result of a forceful blow from a soft hammer (Whittaker 1994, 187). Five further removals had corticated striking platforms, characteristic of either the rejuvenation of an Early Neolithic platform core by rotation or the initiation of a new debitage surface on a Late Neolithic polyhedral core. Whilst little or no chronological patterning can be seen in the distribution of removals with corticated striking platforms, a higher frequency of blades and flakes with crushed or unprepared striking platforms was identified amongst the lithic assemblages dated to the Late Neolithic (Phases 4 to 6) than those dated to the Early Neolithic (Phases 1 to 3). The decline in the evidence for platform preparation during the Neolithic is accompanied by a change in the methods of platform preparation which were employed.

Differences can be seen in the methods of platform preparation represented amongst the assemblages of worked flint from Aldro C75, Riggs 20 and Calais Wold 275 (Figure 53). Two key patterns emerge. First, a higher frequency of blades and flakes which exhibited evidence for complex platform preparation was identified amongst the cache of worked flint from Aldro C75 than amongst the assemblages of worked flint from Riggs 20 and Calais Wold 275. Whilst abrasion and trimming were the most common methods of platform preparation for each of the assemblages of worked flint, the percentage of removals with isolated striking platforms for the cache of worked flint from Aldro C75 was almost twice that for the residual

occupational from Riggs 20 or the knapping debris from Calais Wold 275. Secondly, a wider range of methods of platform preparation was represented amongst the knapping debris from Calais Wold 275 than amongst the assemblages of worked flint from Aldro C75 and Riggs 20. Although blades and flakes with isolated striking platforms were identified amongst all three assemblages of worked flint, evidence for faceting was confined to the knapping debris from Calais Wold 275.

Both of these patterns can be attributed to the methods of core working which were employed in contemporary industries. The high frequency of removals with isolated striking platforms from Aldro C75 is consistent with the evidence for blade manufacture identified amongst the cache of worked flint. Blade manufacture is reliant upon the establishment of a system of parallel ridges formed by the intersection of flake scars from previous removals on the debitage surface of a core. The likelihood of producing a blade or elongated flake can be increased by isolating a point of impact above one of the ridges on the debitage surface. In contrast, the evidence for faceting from Calais Wold 275 is consistent with Late Neolithic industries which employed the Levallois method. Flakes of a predetermined size and shape could be produced using the Levallois method by creating a continuous striking platform around the circumference of a core and by preparing one of the surfaces of the core as a debitage surface. The size of a flake struck from the core can be maximised by strengthening the edge of the striking platform and increasing the exterior platform angle through faceting.

As with the exterior platform angle, differential patterning can be seen in the methods of platform preparation represented amongst the groups of blades and flakes identified on the basis of cluster analysis of the maximum length and maximum breadth of the complete removals (Figure 54). An increase can be seen in the relative frequency of diagnostic removals which did not exhibit evidence for platform preparation as the ratio of the maximum length to maximum breadth or relative proportions of the blades and flakes decreases. Furthermore, the relative frequency of blades and flakes which exhibited evidence for complex platform preparation was much higher for the intermediate removals than for the other groups of blades and flakes. The mean value of the product of the maximum length and maximum breadth or overall size/approximate surface area of the intermediate removals was considerably higher than for the long thin and short squat removals. A large amount of force is required to detach a large flake from a volume of stone and the likelihood of a knapping error occurring can be minimised through preparation of the striking platform.

4.2.5.2 Point of applied force

Preliminary analysis of the complete removals from the Neolithic burial mounds indicated that the metric properties of a blade or flake are also closely related to the depth of the striking platform and the area of the striking platform. The outcome of a knapping operation can be controlled by adjusting the position of the point of applied force relative to the edge of the striking platform or the ridges formed by the intersection of flake scars from previous removals on the corresponding debitage surface. A point of impact further away from the edge of the striking platform is required to detach a long removal, resulting in the formation of a blade or flake with a deep striking platform and a high maximum thickness. Similarly, a point of impact midway between two or more ridges is required to detach a broad removal, with the width and therefore area of the striking platform and the maximum breadth of the resultant blade or flake determined by the distance between the ridges. The larger the removal, the greater the depth of the striking platform and/or the area of the striking platform.

Differences can be seen in the mean values and standard deviations of the depth/area of the striking platform for the groups of blades and flakes identified through cluster analysis (Tables 31 and 32). First, the mean values of the depth/area of the striking platform for the undiagnostic and long thin removals were lower than those for intermediate and short squat removals. 'Size sorting' is implicit within the definition of the groups of blades and flakes, with a distinction between larger removals which are considered to be technologically diagnostic (i.e. long thin, intermediate and short squat removals) and smaller removals which are not (i.e. undiagnostic removals). The intermediate removals were larger than the undiagnostic removals and the difference between the mean values of the depth/area of the striking platform would appear to have been directly related to the overall size/approximate surface area of the groups of blades and flakes. In contrast, the long thin and short squat removals were similar in size and the difference between the mean values of the depth/area of the striking platform would instead appear to have been related to the mode of percussion or the amount of force that was applied.

Secondly, the standard deviations of the depth/area of the striking platform for the intermediate and short squat removals were higher than those for the undiagnostic and long thin removals. The depth of a striking platform will typically vary between c.3mm, the mean value of the depth of the striking platform for the undiagnostic removals, and c.6mm, the

mean value of the depth of the striking platform for the intermediate removals (Whittaker 1994, 95). Consistency can be achieved by isolating a point of impact on the striking platform (i.e. platform preparations) or through the use of a punch (i.e. indirect percussion). The low mean value and standard deviation of the depth/area of the striking platform for the long thin removals is consistent with the controlled methods of stone working associated with the systematic production of blades or elongated flakes. Conversely, the high mean value and standard deviation of the depth/area of the striking platform for the short squat removals is consistent with a lack of concern with controlled stone working and a reliance upon hard hammer percussion. Both patterns are consistent with the broader changes in the nature of stone working which took place during the course of the Neolithic.

The values of the depth/area of the striking platform approximate a log normal distribution and removals with unusually high values which correspond to outliers or extreme values are considered to be chronologically diagnostic. An outlier or extreme value is defined as a value greater than 1.5 times the interquartile range above the upper quartile, i.e. >8.66mm for the depth of the striking platform and >95.58mm² for the area of the striking platform. All of the outliers or extreme values for the depth of the striking platform (n=7) were derived from lithic assemblages dated to the Late Neolithic (Phases 4 to 6) or which contained stone tools or unmodified cores characteristic of Late Neolithic industries. Furthermore, although the area of the striking platform would appear to be a less sensitive chronological indicator than the depth of the striking platform, a higher frequency of outliers or extreme values for the area of the striking platform was identified amongst the lithic assemblages dated to the Late Neolithic (Phases 4 to 6, n=9) than those dated to the Early Neolithic (Phases 1 to 3, n=7).

4.2.6 Preparation of debitage surfaces

The metric properties of a blade or flake are also determined by the pattern of flake scars from previous removals on the debitage surface of a core or stone tool. Ridges formed by the edges or intersections of flake scars from previous removals can be used to channel a force and dictate the outcome of a knapping operation. In the same way that the methods employed in the reduction of a core or the manufacture of a stone tool can be inferred from the flake scars on the surfaces of the core or stone tool, the methods that were employed in the production of a blade or flake can be inferred from the flake scars on the dorsal surface of the blade or flake. Evidence for previous knapping operations was recorded for each of the complete removals from the Neolithic burial mounds using a series of categorical variables,

with the number of flake scars from previous removals on the dorsal surface of a blade or flake and the number of directions from which blades/flakes had previously been removed recorded as ordinal values, and the pattern of flake scars from previous removals recorded as a nominal value.

4.2.6.1 Previous removals

Methods of flaking and shaping which were either employed in individual sequences of knapping operations or were characteristic of particular stone working traditions can potentially be inferred from the number of flake scars from previous removals on the dorsal surface of a blade or flake. The first blade struck from a blade core, for example, will have a higher number of flake scars from previous removals if blade manufacture was initiated using an artificial crest rather than if blade manufacture was initiated using a natural ridge. Similarly, a flake struck from the debitage surface on a Levallois-like or 'tortoise shell' core will have a higher number of flake scars from previous removals than one struck from a discoidal core. In both instances, however, the significance of the number of flake scars from previous removals is context specific. Removals struck during the course of the preparation of an artificial crest on a blade core or the debitage surface on a Levallois-like or 'tortoise shell' core (i.e. shaping) may have the same number of flake scars from previous removals as those struck during the course of the initiation of blade manufacture using a natural ridge or the reduction of a discoidal core (i.e. flaking).

The number of flake scars from previous removals on the dorsal surface of a blade or flake for the complete removals from the Neolithic burial mounds approximates a normal distribution, centred on the modal value of three flake scars from previous removals. Over three quarters (n=109) of the complete removals had between two and four flake scars from previous removals (i.e. within one flake scar of the modal value), typically forming between one and three parallel ridges which could have been used to control the detachment of the blade or flake. Little or no chronological patterning can be seen in the values of the number of flake scars from previous removals for the complete removals from the aggregated assemblages of worked flint dated to the Early Neolithic (Phases 1 to 3) and those dated to the Late Neolithic (Phases 4 to 6). Differences, however, can be seen in the frequency diagrams for the values of the number of flake scars from previous removals for the groups of blades and flakes identified through cluster analysis of the maximum length and maximum breadth of the complete removals (Figure 55).

Two distinct patterns emerge when the frequency diagrams for the values of the number of flake scars from previous removals for the groups of blades and flakes which were considered to be technologically diagnostic are compared. First, the frequency diagrams for the long thin and intermediate removals provide a closer approximation to a normal distribution than that for the short squat removals. Secondly, the frequency diagram for the short squat removals exhibits a greater degree of variation than those for the long thin and intermediate removals. Both of these patterns can be explained in terms of the differences between the methods of core working which are associated with the respective groups of blades and flakes. The high degree of consistency represented by the frequency diagram for the long thin and intermediate removals is consistent with the controlled nature of the methods of core working characteristic of the systematic production of blades or elongated flakes. Conversely, the high degree of variability represented by the frequency diagram for the short squat removals is consistent with the expedient nature of the methods of core working characteristic of the reduction of polyhedral cores.

The number of flake scars from previous removals represents the minimum number of knapping operations that could have resulted in those flake scars, rather than the total number of blades or flakes that had previously been detached from the volume of stone from which it was struck. Stone working is a reductive process and flake scars would have been truncated or removed as a sequence of knapping operations progressed. In consequence, the number of flake scars from previous removals will not necessarily reflect the position of a blade or flake in the corresponding sequence of knapping operations. A temporal component, however, is explicit in the system of classification that was developed to record the approximate degree of cortication for the complete removals from the Neolithic burial mounds. For the purposes of the analysis below, it is assumed that complete removals where ≥50% of the dorsal surface retained traces of cortex were associated with the early stages of a sequence of knapping operations (Stages 1 to 3) and those where <50% of the dorsal surface retained traces of cortex were associated with the latter stages of a sequence of knapping operations (Stages 4 to 6).

An increase can be seen in the frequency of complete removals from the Neolithic burial mounds as the amount of cortex on the dorsal surface of a blade or flake decreases, reflecting the progress of a hypothetical sequence of knapping operations (Figure 56). Patterning can also be seen in the mean values of the overall size and relative thickness of the bulb of

percussion of the complete removals (Figure 57 and Figure 58 respectively). The maximum size of a blade or flake is determined by the size of the volume of stone from which it was struck and will decrease as the size of the volume of stone is reduced after each knapping operation. Although the mean values of the overall size of the blades and flakes associated with the latter stages of a sequence of knapping operations decrease as expected, the mean values of the overall size of the blades and flakes associated with the early stages of a sequence of knapping operations increase. The initial increase in the mean values of the overall size of the complete removals is consistent with the expansion of the active area of a debitage surface prior to the commencement of intensive reduction.

More than one technique may be applied in the sequence of knapping operations associated with the reduction of a core or the manufacture of a stone tool. In the case of the plano-convex knife from the old land surface beneath Aldro 49, the initial act of flaking was carried out using a hard hammer while subsequent shaping was carried out using a soft hammer. The high mean values of the relative thickness of the bulb of percussion or the removals associated with the earlier stages of a sequence of knapping operations were consistent with direct percussion using a hard hammer. Conversely, the low mean values for the removals which were associated with the latter stages of a sequence of knapping operations were indicative of either direct percussion using a soft hammer or indirect percussion using a punch. These patterns are consistent with a change in the mode of percussion as a sequence of knapping operations progresses and are accompanied by an increase in both the mode and the range of the number of flake scars from previous removals (Table 33).

Where two or more flake scars from previous removals can be identified on the dorsal surface of a blade or flake, the number of directions from which blades/flakes had previously been removed can be inferred from the orientations of the flake scars. Chronological patterning can be seen in the values of the number of directions from which blades/flakes had previously been removed for the complete removals from the aggregated assemblages of worked flint from the Neolithic burial mounds (Table 34). Little variation can be seen in the number of directions from which blades/flakes had previously been removed for the complete removals from the lithic assemblages dated to the Early Neolithic (Phases 1 to 3). Conversely, greater variation can be seen in the number of directions from which blades/flakes had previously been removed for the complete removals from the lithic assemblages dated to the Late Neolithic (Phases 4 to 6). This increase in the range of values of the number of directions from

which blades/flakes had previously been removed is consistent with the changes in methods of core working which took place during the Neolithic.

Flake scars on the dorsal surface of blades or flakes struck from blade cores characteristic of Early Neolithic industries are likely to have been struck from either one or two directions, depending on whether the core had a single striking platform or two opposed striking platforms. Even where blade manufacture was initiated using an artificial crest or a core was rejuvenated by rotation to commence reduction from a new striking platform, it is unlikely that the flake scars on the dorsal surface of a blade or flake will have been struck from more than two directions. In contrast, flake scars on the dorsal surface of blades or flakes struck from Levallois-like or 'tortoise shell' cores, discoidal cores or polyhedral cores characteristic of Late Neolithic industries are likely to have been struck from multiple directions. This is particularly true in the case of the first flake struck from the debitage surface of a Levallois-like or 'tortoise shell' core, where a series of flakes would typically have been struck from a continuous striking platform around the circumference of the core to create a ridge along the centre-line of the debitage surface.

4.2.6.2 Pattern of flake scars

The flake scars on the dorsal surface of a blade or flake represent a snapshot of part of the debitage surface of the volume of stone from which it was struck and, as such, are potentially indicative of the method of flaking or shaping employed at a specific point in a sequence of knapping operations. As with the reconstruction of the 'life histories' of the stone tools from the Neolithic burial mounds in the previous chapter, the method employed at the time the blade or flake was struck can be inferred from the pattern of the flake scars from previous removals. Four patterns of flake scars were recognised for the purposes of the analysis below:

1. Parallel – two or more parallel ridges[17] formed by the intersections of flake scars from previous removals struck from one direction only;

2. Opposed – two or more parallel ridges formed by the intersections of flake scars from previous removals struck from two opposite directions;

[17] Blades or flakes with a single ridge formed by the flake scars from two previous removals were not considered to be technologically diagnostic; equally, no pattern can exist where fewer than two flake scars from previous removals can be identified on the dorsal surface of a blade or flake.

3. Irregular – two or more random ridges formed by the intersections of flake scars from previous removals struck from multiple directions;

4. Centripetal – two or more radial ridges formed by the intersections of flake scars from previous removals struck from multiple directions.

Correspondence analysis was used to identify relationships between the pattern of flake scars from previous removals and the groups of blades and flakes identified on the basis of the cluster analysis of the maximum length and maximum breadth of the complete removals from the Neolithic burial mounds (Figure 59). Three key relationships were identified: 1) a correspondence between long thin removals and parallel or opposed flake scars[18]; 2) a strong correspondence between intermediate removals and centripetal flake scars, and; 3) a strong correspondence between short squat removals and irregular flake scars. These relationships can be explained technologically and are potentially considered to be chronologically diagnostic.

Parallel or opposed flake scars are consistent with the systematic methods of core working associated with the reduction of single or opposed platform cores characteristic of Early Neolithic stone working traditions. Blades or flakes with parallel flake scars may be produced by a wide range of knapping operations, including those associated with blade manufacture or the production of a blank for a plano-convex knife. A higher frequency of blades or flakes with parallel flake scars, however, will be produced during the course of blade manufacture than during the course of the production of a blank for a plano-convex knife. The probability that a blade or flake with parallel flake scars is the product of blade manufacture is reflected by the relationship between long thin removals and parallel flake scars. Blades or flakes with opposed flake scars can be differentiated from those with parallel flake scars only by virtue of the number of directions from which blades/flakes had previously been removed; opposed flake scars are the result of a series of removals from two opposed striking platforms, while parallel flake scars are the result of a series of removals from a single striking platform.

In contrast, irregular or centripetal flake scars are consistent with the methods of core working associated with the reduction of discoidal, Levallois-like or 'tortoise shell' or polyhedral cores

[18] The correspondence between undiagnostic removals and parallel flake scars or opposed flake scars is not considered to be technologically or chronologically diagnostic.

characteristic of Late Neolithic stone working traditions. Blades or flakes with irregular flake scars may be produced by knapping operations based on polyhedral flaking. Emphasis was placed on keeping a core alive by rotating the core to commence reduction from a new striking platform, rather than maximising the length of the removals from a core by creating and maintaining a system of parallel ridges on the debitage surface of the core. Blades or flakes with centripetal flake scars may be produced by knapping operations based on bifacial flaking or shaping. Centripetal flake scars exhibit coherent patterning, with a series of contiguous flake scars along one of the margins of the blade or flake typical of either the preparation of a Levallois-like or 'tortoise shell' core or the reduction of a discoidal core. The relationship between centripetal flake scars and intermediate removals is consistent with the use of the Levallois method to maximise the overall size/approximate surface area of a blade or flake struck from a volume of stone.

Two underlying trends can be identified in the relative frequencies of the pattern of flake scars from previous removals for the aggregated assemblages of worked flint from the Neolithic burial mounds (Table 35). First, a higher frequency of blades and flakes with parallel or opposed flake scars was identified amongst the lithic assemblages dated to the Early Neolithic (Phases 1 to 3) than amongst those dated to the Late Neolithic (Phases 4 to 6). Secondly, a higher frequency of blades and flakes with irregular or centripetal flakes scars was identified amongst the lithic assemblages dated to the Late Neolithic (Phases 4 to 6) than amongst those dated to the Early Neolithic (Phases 1 to 3). The decrease in the frequency of blades and flakes with parallel or opposed flake scars and increase in the frequency of blades and flakes with irregular or centripetal flake scars are consistent with the changes in methods of core working and the decline in the emphasis upon controlled flint knapping which took place during the Late Neolithic and Early Bronze Age.

4.3 From debitage signatures to diagnostic traits

Morphometric analysis of the complete blades and flakes from the Neolithic burial mounds has enabled the definition of a series of debitage signatures which can potentially be used to discriminate between Early Neolithic and Late Neolithic stone working traditions. Recurrent patterns were identified within the metric properties and morphological attributes of the complete removals which were consistent with the changes in the nature of stone working which took place during the Neolithic and had been identified on the basis of the technological analysis of the stone tools and unmodified cores from the Neolithic burial mounds in the

previous chapter. The diagnostic traits implicit in these patterns can be used to both isolate groups of blades or flakes which are broadly contemporary with one another and identify the methods of flaking or shaping represented within an assemblage of worked flint. In doing so, these traits can be used to introduce a greater degree of temporal depth into the analysis of the distribution of lithic artefacts from surface contexts, enabling meaningful interpretation of the evidence for past human activity represented by stray finds and lithic scatters.

A probabilistic approach to the calibration of surface scatters

This chapter identifies a series of diagnostic traits based on the reconstruction of the 'life histories' and debitage signatures for the lithic artefacts from the Neolithic burial mounds that can be used to discriminate between stone tools and lithic debitage characteristic of Early Neolithic and Late Neolithic stone working traditions. The first part of the chapter tests three methods for dating lithic artefacts based on the calculation of artefacts scores from the diagnostic traits. All three methods successfully discriminate between the lithic assemblages from Early Neolithic contexts and those from Late Neolithic contexts. One of the methods (the method based on binary scores) was better suited to the dating of individual tools from the Neolithic burial mounds. The second part of the chapter applied the binary method to the stone tools and lithic debitage from the surface scatter at Wharram-le-Street. Differential patterning can be seen in the resultant distributions of Early Neolithic and Late Neolithic stone tools and lithic debitage. Both periods, however, are associated with expedient stone tools characteristic of routine occupation and cortical blades/flakes consistent with the early stages of core working and tool manufacture.

5.1 Diagnostic traits

A series of diagnostic traits can be distilled from the life histories and debitage signatures reconstructed for the Neolithic burial mounds (Table 36). These traits can be divided into six groups which broadly reflect a sequence of tool manufacture, from the initial selection of a volume of stone, through intermediate stages of flaking and/or shaping, to the final form of the stone tool. The groups of traits are described below, highlighting recurring patterns from the corresponding elements of the life histories and debitage signatures that can potentially be used to discriminate between stone tools and lithic debitage characteristic of the methods and techniques employed in Early Neolithic stone working traditions and stone tools and lithic debitage characteristic of the methods and techniques employed in Late Neolithic stone working traditions.

5.1.1 Surface character

The first group of traits reflects the procurement strategies that were employed in Early Neolithic and Late Neolithic stone working traditions which can be inferred from the surface character of a stone tool or piece of lithic debitage:

- Trait 1. The character of the unmodified external surface of a piece of worked flint can be used to infer the **source** of raw materials used in stone working. A change in the source of raw materials was identified, with preferential use of nodular flint from the exposures of boulder clay along the Holderness coastline during the Early Neolithic and the use of a wider range of flint, including tabular flint from the chalk formations of the Yorkshire Wolds and flint from the river gravels of Holderness, the Vale of Pickering and the Vale of York, during the Late Neolithic;

- Trait 2. At the extremes of the colour spectrum, the **colour** of a piece of worked flint can be used as an indicator of the quality of raw materials. Differences in the frequencies of high quality and low-quality flint were highlighted amongst the Early Neolithic and Late Neolithic assemblages. High quality black flint is ideally suited to the controlled methods of flaking and shaping characteristic of the Early Neolithic. Conversely, low quality white flint is better suited to the expedient methods of flaking and shaping characteristic of the Late Neolithic;

- Trait 3. Recurrent **re-use** of pieces of worked flint may reflect either limited access to lithic resources or ad hoc procurement of raw materials. The re-use of pieces of worked flint, including abandoned cores and broken tools, became increasingly common during the Late Neolithic. Increased re-use of worked flint is consistent with the diversification of the resource base of contemporary industries. Evidence for the re-use of worked flint in the form of differential patination was also identified amongst the lithic scatter from Wharram-le-Street.

Although these traits apply to all classes of stone tools and lithic debitage, the source of flint (Trait 1) can only be identified where part of the cortex or unmodified external surface of a lithic artefact is still visible.

5.1.2 Striking platform

The second group of traits relates to the methods of flaking and/or shaping employed in Early Neolithic and Late Neolithic stone working traditions which can be inferred from the striking platform(s) of a stone tool or piece of lithic debitage:

- Trait 4. At the two extremes of the range of values, the **exterior platform angle** can be used to infer the method of core working employed. Higher frequencies of blades or flakes with low (≤ 70°) exterior platform angles consistent with knapping operations based on secant planes[19] or high (≥ 95°) exterior platform angles consistent with knapping operations based on the centre of gravity of a core were identified amongst the Late Neolithic assemblages – both of which are typical of the methods of core working employed during the Late Neolithic;

- Trait 5. Routine evidence for **platform preparation** can be regarded as an indicator of systematic stone working. Differences can be seen in the methods of platform preparation employed during the Early Neolithic and Late Neolithic. Isolation and façeting are characteristic of Early Neolithic and Late Neolithic stone working traditions respectively. Both methods sought to maximise the length of the resultant blade or flake – one by isolating a point of impact close to the edge of the striking platform and the other by increasing the exterior platform angle;

- Trait 6. **Rejuvenation** of cores reflects a concern with keeping a core alive and can also be deemed to be an indicator of systematic stone working. Evidence for the rejuvenation of cores was identified amongst both Early Neolithic and Late Neolithic assemblages. Rejuvenation is usually carried out to correct a knapping error and, in doing so, prolong the life of a core. Although more commonly associated with Early Neolithic stone working traditions, rejuvenation of cores is

[19] Whilst knapping operations based on secant planes are also employed in bifacial shaping, the blades/flakes with low exterior platform angles are thought to be the products of bifacial flaking given the low number of stone tools which exhibit evidence of bifacial shaping amongst the lithic assemblages from both excavated and surface contexts. This assertion is also supported by the Late Neolithic or Bronze Age discoidal cores, cores from which flakes had been detached from two opposed and interchangeable debitage surfaces by means of bifacial flaking, identified amongst the lithic scatter at Wharram-le-Street.

likely to be commonplace in regions where the availability of raw materials was limited.

These traits apply to all classes of stone tools and lithic debitage, with the exception of the exterior platform angle (Trait 4) which applies solely to blades or flakes where the point of applied force is present (cortical, non-cortical and broken).

5.1.3 Debitage surface

The third group of traits relates to the methods of flaking and/or shaping employed in Early Neolithic and Late Neolithic stone working traditions which can be inferred from the debitage surfaces of a stone tool or piece of lithic debitage:

- Trait 7. The methods used in the **initiation** of a new debitage surface are diagnostic of the type of core. Differences were identified between the methods of initiation employed in Early Neolithic and Late Neolithic stone working traditions. Early Neolithic blade manufacture was typically initiated using a natural or artificial crest to control the first removal from a new striking platform, resulting in a blade or flake with a distinctive crest. In contrast, a new striking platform on a Late Neolithic polyhedral core could be initiated simply by rotating the core;

- Trait 8. The **pattern of flake scars** can be used to identify the methods used in the manufacture of a stone tool or reduction of a core. Differential patterning was identified in the frequencies of parallel or opposed and irregular or centripetal flake scars. Parallel or opposed flake scars are consistent with the methods of flaking and shaping employed in Early Neolithic stone working traditions, while irregular or centripetal flake scars are consistent with the methods of flaking and shaping employed in Late Neolithic stone working traditions;

- Trait 9. Similarly, the **approximate degree of cortication** can be used to infer the methods employed in the reduction of a core. Higher relative frequencies of Stage 5 removals (20%), consistent with the expansion of the active area of the debitage surface of a single or opposed platform core, were identified amongst the Early Neolithic assemblages and higher relative frequencies of Stage 2 and Stage 3

removals (70% and 50%), consistent with the reduction of a polyhedral or discoidal core, were identified amongst the Late Neolithic assemblages.

With the exception of the pattern of flake scars (Trait 8) which applies to all classes of stone tools and lithic debitage, these traits only apply to stone tools and complete blades or flakes (cortical and non-cortical blades or flakes).

5.1.4 Mode of production

The fourth group of traits reflects the modes of production employed in Early Neolithic and Late Neolithic stone working traditions which can be inferred from the proximal and distal ends of a stone tool or piece of lithic debitage:

- Trait 10. The **relative thickness of a bulb of percussion** is correlated with the metric properties of a blade or flake. Differential patterning was identified in the frequencies of diffuse and pronounced bulbs of percussion. Diffuse bulbs of percussion, consistent with indirect or soft hammer percussion, are correlated with blades or long thin flakes characteristic of the Early Neolithic. Conversely, pronounced bulbs of percussion, consistent with hard hammer percussion, are correlated with short squat flakes characteristic of the Late Neolithic;

- Trait 11. **Reduction of the bulb of percussion** indicates correction of a knapping error resulting from hard hammer percussion. Evidence for the reduction of striking platforms was identified amongst both Early and Late Neolithic assemblages, reflecting a degree of ambiguity – concern with the correction of knapping errors is in keeping with the systematic nature of Early Neolithic industries, while knapping errors that need to be corrected are more likely to occur as a result of the increased reliance upon hard hammer percussion during the Late Neolithic;

- Trait 12. The **type of blade or flake termination** is also correlated with the metric properties of a blade or flake. Higher frequencies of overshot or stepped terminations were identified amongst the Early Neolithic assemblages and higher frequencies of hinged terminations were identified amongst the Late Neolithic assemblages - overshot or stepped terminations are both correlated with blades

or long thin flakes typical of the Early Neolithic, whereas hinged terminations are correlated with short squat flakes typical of the Late Neolithic.

With the exception of the reduction of the bulb of percussion (Trait 11) which applies solely to stone tools, these traits only apply to stone tools and lithic debitage where the proximal and distal ends of the artefact are still present.

5.1.5 Metric properties

The fifth group of traits relates to the methods of flaking/shaping employed in Early Neolithic and Late Neolithic stone working traditions which can be inferred from the metric properties of a stone tool or piece of lithic debitage:

- Trait 13. **Outliers or extreme values** either relate to the use of specific methods or reflect a lack of emphasis on controlled stone working. A high incidence of outliers or extreme values, typically relating to biface manufacture or pre-determined debitage methods, was identified amongst the stone tools from Early Neolithic contexts. In contrast, a high incidence of outliers or extreme values, reflecting a lack of concern with controlling the outcome of a knapping operation, was identified amongst the lithic debitage from Late Neolithic contexts;

- Trait 14. **Size sorting** of blades and flakes can be used to make inferences about the intended product(s) of a sequence of knapping operations. Differences were identified in the quantities of blades or long thin flakes and short squat flakes found in Early Neolithic and Late Neolithic assemblages. Blades or long thin flakes are consistent with debitage struck from single or opposed platform cores typical of the Early Neolithic. Conversely, short squat flakes are consistent with debitage struck from polyhedral, discoidal or simple cores typical of the Late Neolithic;

- Trait 15. The **type of blank** selected to make a stone tool reflects broader changes in the nature of local industries. A change in the types of blanks that were selected for tool manufacture was identified with a limited range of blanks, including blades, represented amongst the Early Neolithic stone tools and a wider range of blanks, including debris and core fragments, represented amongst the Late Neolithic stone tools. This change echoes the diversification of the resource base

of local industries reflected by the re-use of abandoned cores and broken stone tools.

With the exception of the type of blank (Trait 15) which applies solely to stone tools, these traits only apply to stone tools that have had minimal modification (e.g. knives and scrapers) and complete blades or flakes (cortical and non-cortical blades or flakes).

5.1.6 Hallmark techniques

The sixth group of traits relates to the hallmark techniques employed in Early Neolithic and Late Neolithic stone working traditions which can be inferred from the final stages of the manufacture of a stone tool:

- Trait 16. Techniques used in the **preparation of blanks** are often associated with particular stone working traditions. The microburin technique[20] was used to break blades into smaller segments that could be used to create composite tools. Whilst blade segments could be created simply by snapping a blade, creating a notch on the edge of a blade by pressure flaking allowed greater control over the outcome of snapping the blade. Evidence for use of the microburin technique was confined to lithic assemblages which had an affinity to the Early Neolithic;

- Trait 17. Certain types of **edge modification** are peculiar to Early Neolithic stone working traditions. Differential patterning was identified in two types of edge modification: higher frequencies of stone tools with serrated or denticulated edges were found in Early Neolithic contexts than in Late Neolithic contexts, and; stone tools with polished, edge-ground or bevelled edges were only found in assemblages from Early Neolithic contexts[21]. Both of these types of edge modification are characteristic of Early Neolithic stone working traditions;

[20] Although the microburin technique is more commonly associated with Mesolithic stone working traditions, evidence for limited use of the microburin technique was identified amongst the assemblages of worked flint from the Neolithic burial mounds (Section 3.1.3, 83).

[21] All of the edge-polished or polished artefacts were derived from contexts dated to Phase 3 in the relative chronology established for the Neolithic burial mounds. Phase 3 was introduced to isolate the incipient changes in the nature of stone working which took place towards the end of the Early Neolithic – changes which could perhaps more properly be deemed to be characteristic of the Middle Neolithic. The low frequency of artefacts, however, does not permit differentiation between Early Neolithic and Middle Neolithic stone working traditions.

- Trait 18. Similarly, certain types of **surface treatment** are peculiar to Early Neolithic stone working traditions. Ground or polished stone tools were only found in assemblages from Early Neolithic contexts. Only a handful of polished stone tools were identified, all of which were thought to have been manufactured in the specialist workshops at North Dale and South Landing. Although the stone tools from North Dale and South Landing are highly unusual, grinding and polishing were routinely used in the finishing of Early Neolithic stone axes.

These traits only apply to stone tools. Moreover, some types of edge modification (Trait 17) and surface treatment (Trait 18) apply solely to a limited range of stone tools manufactured in the specialist workshops at North Dale and South Landing.

5.2 Artefact scores

Each of the traits distilled from the life histories and debitage signatures can be treated as variables with one or more chronologically diagnostic values. Classification techniques, such as discriminant functions and two-step cluster analysis can be used to group datasets based on the values of multiple variables. These techniques, however, have limited utility in the context of using the lithic assemblages from excavated contexts to date stone tools and lithic debitage from surface contexts: the lack of a meaningful metric between the values of the diagnostic traits precludes the use of discriminant functions; while, the small sample size and the number of diagnostic values reduces the effectiveness of two-step cluster analysis. Instead, a simple scoring system is preferred which reflects the likelihood that an artefact can be dated to a particular chronological period.

Three scoring systems based on different methods of calculating scores and assigning dates to individual lithic artefacts or aggregated assemblages of worked flint are outlined below. All of the methods follow the same basic procedure:

1. Two scores are calculated for every artefact – one reflecting the likelihood that the artefact is Early Neolithic and the other reflecting the likelihood that the artefact is Late Neolithic. The starting values of the scores are set to 0 or 1

indicating that the artefact could be either Early Neolithic or Late Neolithic in date[22];

2. Scores are calculated iteratively with keyword searches or conditional expressions used to test each trait against lists of values which are chronologically diagnostic[23]. For each iteration, the scores are incremented or weighted using the values shown in Table 37 if the value of the trait is chronologically diagnostic.

3. A date can be assigned to each artefact or assemblage based on the values of the resultant scores – the score with the highest value indicates the date of the artefact or assemblage and the difference between the scores reflects the confidence in the date. Dates cannot be determined if the scores are identical.

The efficacy of the different methods can be tested by applying the scoring systems to the stone tools and lithic debitage from the surface scatter at Wharram-le-Street and the lithic assemblages from the Neolithic burial mounds.

Four criteria are used below to assess the relative strengths and weaknesses of each of the proposed scoring systems:

1. Dated artefacts/assemblages – the total number of chronologically diagnostic artefacts or independently dated lithic assemblages that could be dated;

2. Correct scores – the number of chronologically diagnostic artefacts or independently dated lithic assemblages that were correctly dated;

3. False positives – the number of chronologically diagnostic artefacts or independently dated lithic assemblages that were incorrectly dated;

4. False negatives – the number of chronologically diagnostic artefacts or independently dated lithic assemblages that could not be dated.

[22] Different starting values could be used for artefacts that can be dated typologically, reducing the potential for not assigning a date to those artefacts. This would perpetuate the bias towards diagnostic artefacts, however, and is not consistent with the technological approach advocated in previous chapters.
[23] Counters are used to identify the number of outliers and extreme values for the variables corresponding to the metric properties of the stone tools and lithic debitage (Trait 13).

The dates for the binary scores can be used as a baseline against which the other scoring systems can be compared.

5.2.1 Method 1: Binary scores

The simplest scoring system is based on binary scores. Scores for the Early Neolithic and Late Neolithic are initially set to zero then calculated as follows:

$$E = \sum_{n=1}^{n=18} E_{n-1} + e_n$$

and:

$$L = \sum_{n=1}^{n=18} L_{n-1} + l_n$$

Where:

E = score (Early Neolithic)

n = diagnostic trait (iteration)

e = increment (Early Neolithic)

L = score (Late Neolithic)

l = increment (Late Neolithic)

Both increments have two possible values (1 = diagnostic and 0 = not diagnostic). Three conditions exist for each diagnostic trait:

- Condition 1 – if the value of the trait is diagnostic of the Early Neolithic the scores are incremented by:

$$e_n = 1$$
$$l_n = 0$$

- Condition 2 – if the value of the trait is diagnostic of the Late Neolithic the scores are incremented by:

$$e_n = 0$$
$$l_n = 1$$

- Condition 3 – if the value of the trait is not chronologically diagnostic the scores are incremented by:

$$e_n = 0$$
$$l_n = 0$$

The resultant scores can be used to determine the likely date of each artefact: the sum of the scores reflects the total number of diagnostic traits, and; the difference between the scores reflects the dominant chronological period[24]. Four possible dates can be assigned on the basis of the sum and difference of the scores:

- Early Neolithic – the artefact has more Early Neolithic traits than Late Neolithic traits:

$$L + E > 0$$
$$L - E < 0$$

- Late Neolithic – the artefact has more Late Neolithic traits that Early Neolithic traits:

$$L + E > 0$$
$$L - E > 0$$

- Conflict – the artefact has an equal number of Early Neolithic and Late Neolithic traits:

$$L + E > 0$$
$$L - E = 0$$

- Unknown – the artefact does not have any traits which are chronologically diagnostic:

$$L + E = 0$$
$$L - E = 0$$

Scores for individual artefacts can be aggregated and used to determine the likely date of a lithic assemblage: the aggregated scores reflect the magnitudes of the Early Neolithic and Late Neolithic components of the assemblage, and; the difference between the scores again reflects the dominant chronological period.

5.2.1.1 Individual artefacts

Only 15% (n=51) of the lithic artefacts from the surface scatter at Wharram-le-Street were chronologically diagnostic. These artefacts represent a limited number of classes of stone tools and lithic debitage, the majority of which are common to more than one chronological period. There are strong similarities between the methods and techniques employed in Late

[24] The Early Neolithic score is subtracted from the Late Neolithic score to create a single score, with negative values indicating the degree of earliness and positive values indicating the degree of lateness.

Mesolithic and Early Neolithic stone working traditions and those employed in Late Neolithic and Early Bronze Age stone working traditions[25]. Consequently, the Late Mesolithic and Early Neolithic artefacts and Late Neolithic and Early Bronze Age artefacts have been grouped together for the purposes of the analysis below. In contrast, over 75% (n=269) of the lithic artefacts had one or more traits that were chronologically diagnostic and could potentially be dated using one of the proposed scoring systems.

Criterion 1. Dated artefacts

Approximately half (n=24) of the chronologically diagnostic artefacts from the surface scatter at Wharram-le-Street could be dated using the binary scoring system (Figure 60). Twenty-two of the dated artefacts had only Early Neolithic or Late Neolithic traits and could be dated unambiguously. The dates for these artefacts will be the same for all of the proposed scoring systems. Two of the dated artefacts had both Early Neolithic and Late Neolithic traits and could be dated on the basis of the dominant chronological period. The dates for these artefacts are dependent upon the values of the scores and could be different for each of the scoring systems. A further three artefacts had an equal number of Early Neolithic and Late Neolithic traits and could not be dated definitively. Conflicts in the dates of these artefacts could possibly be resolved by using a different scoring system.

Criterion 2. Correct scores

Over 35% (n=19) of the chronologically diagnostic artefacts from the surface scatter at Wharram-le-Street were dated correctly using the binary scoring system. The binary scores for the Early Neolithic artefacts were typically lower than those for the Late Neolithic artefacts (Figure 61). Perhaps more significantly, the median values of the binary scores for the Early Neolithic artefacts are negative and the median values of the binary scores for the Late Neolithic artefacts are positive. Moreover, if the outliers[26] and extreme values[27] are excluded, none of the Early Neolithic artefacts had positive scores and none of the Late Neolithic artefacts had negative scores. These observations are in keeping with the basic principles that

[25] There are also strong similarities in the spatial distributions of the diagnostic artefacts, with Late Mesolithic and Early Neolithic artefacts clustered around the source of the Gypsey Race and Late Neolithic and the Early Bronze Age artefacts dispersed along the line of a possible prehistoric trackway.
[26] Outliers are defined as values greater than 3 times the interquartile range above the upper quartile or values less than 3 times the interquartile range below the lower quartile.
[27] Extreme values are defined as values greater than 1.5 times the interquartile range above the upper quartile or values less than 1.5 time the interquartile range below the lower quartile.

underpin the binary scoring system and suggest that the dates assigned to the other artefacts from the surface scatter can be relied upon.

Criterion 3. False positives

Less than 10% (n=5) of the chronologically diagnostic artefacts from the surface scatter at Wharram-le-Street were dated incorrectly using the binary scoring system. Two Late Neolithic artefacts (an end scraper and a transverse arrowhead) were incorrectly dated to the Early Neolithic (Figure 62). Three Early Neolithic artefacts (a leaf-shaped arrowhead, a single platform core and an end scraper) were incorrectly dated to the Late Neolithic (Figure 63). All of these artefacts had only a single diagnostic trait and, whilst the values of the scores may vary between the proposed scoring systems, the dates will always be incorrect. At the level of an individual artefact, these artefacts will persist as false positives for all of the scoring systems. At the level of an assemblage of worked flint, the impact of the false positives will be different for each of the scoring systems.

Criterion 4. False negatives

The remainder (n=27) of the chronologically diagnostic artefacts from the surface scatter at Wharram-le-Street could not be dated using the binary scoring system. These artefacts can be divided into two groups, namely: 1) those with conflicts in date – one Early Neolithic artefact (an end scraper) and two Late Neolithic artefacts (a horseshoe scraper and a broad-hafted scraper) had an equal number of Early Neolithic and Late Neolithic traits, and; 2) those with unknown dates – eight Early Neolithic artefacts (an awl, three opposed platform cores and four single platform cores) and sixteen Late Neolithic artefacts (including a transverse arrowhead, a barb and tang arrowhead, a horseshoe scraper, a disc scraper, three discoidal cores and three polyhedral cores) had no diagnostic traits. Although conflicts in date might be resolved by using a different scoring system, unknown dates will persist as false negatives for all of the proposed scoring systems.

5.2.1.2 Aggregated assemblages

Less than 65% (n=24) of the lithic assemblages from the Neolithic burial mounds could be dated independently. Thirteen lithic assemblages could be dated independently to the Early Neolithic (Phases 1 to 3). Eleven lithic assemblages could be dated independently to the Late Neolithic (Phase 4 to 6). Whilst Phases 3 and 6 technically correspond to the Middle Neolithic and the Chalcolithic respectively, the low frequencies of artefacts do not permit analysis at a

more refined level of chronological resolution. The phasing of the lithic assemblages is consequently directly comparable with the grouping of the chronologically diagnostic artefacts from the surface scatter at Wharram-le-Street. In contrast, over 90% (n=34) of the lithic assemblages contained one or more artefacts with diagnostic traits and could potentially be dated using one of the proposed scoring systems.

Criterion 1. Dated assemblages

Over 85% (n=21) of the independently dated lithic assemblages from the Neolithic burial mounds could be dated using the binary scoring system (Figure 64). Eight of the dated assemblages were solely comprised of artefacts with only Early Neolithic or Late Neolithic traits and consequently could be dated unambiguously. Thirteen of the dated assemblages were comprised of artefacts with both Early Neolithic and Late Neolithic traits and could be dated on the basis of the dominant chronological period. Two further lithic assemblages were comprised of artefacts which combined had an equal number of Early Neolithic and Late Neolithic traits and could not be dated definitively. A significant number of the lithic assemblages had dates that were dependent upon the values of the scores and could therefore be different for each of the proposed scoring systems.

The key assemblages which underpin the relative chronology established for the Neolithic burial mounds or were used to define the debitage signatures for Early Neolithic and Late Neolithic stone working traditions were dated correctly. The lithic assemblage from the non-megalithic chamber at Towthorpe 18, the type site for Towthorpe Ware, and the cache of worked flint from Burial 1 at Aldro C75, the lithic assemblage with the sequence of refitting blades and flakes used to define the debitage signatures for Early Neolithic stone working traditions, were dated correctly to the Early Neolithic. Conversely, the assemblages of worked flint from the interim mound at Calais Wold 275 and the burial mound at Riggs 20, the main lithic assemblages used to define the debitage signatures for Late Neolithic stone working traditions, were dated correctly to the Late Neolithic.

Criterion 2. Correct scores

Two-thirds (n=16) of the independently dated lithic assemblages from the Neolithic burial mounds were dated correctly using the binary scoring system. The binary scores for the artefacts from the Early Neolithic assemblages were typically lower than those for the artefacts from the Late Neolithic assemblages (Figure 65). Variation can be seen in the median

values of the scores for different types of artefacts, suggesting that that the scoring system works better for some artefacts than others. The scoring system works well where there is a clear distinction between the median values of the scores (e.g. flakes) and works poorly where the median values of the scores are identical (e.g. scrapers, cores and debris). Greater separation of the median values of the binary scores can potentially be obtained by using one of the other proposed scoring systems.

At face value, the median values of the binary scores for several types of artefacts appear to be incorrect, with positive scores for artefacts from Early Neolithic assemblages and negative scores for artefacts from Late Neolithic assemblages. On closer inspection, the median values for these artefacts are correct and reflect the presence of intrusive Late Neolithic artefacts or residual Early Neolithic artefacts. The positive median value for the cores from Early Neolithic assemblages, for example, can be attributed to a polyhedral core and a simple core. Similarly, the negative median value for the other tools from Late Neolithic assemblages can be attributed to two serrated blades and five burins manufactured from blade segments or irregular blades. Despite its apparent simplicity, the binary scoring system has the ability to identify intrusive or residual artefacts within a lithic assemblage.

Criterion 3. False positives

Less than a third (n=5) of the independently dated lithic assemblages from the Neolithic burial mounds were dated incorrectly using the binary scoring system. One Late Neolithic assemblage, namely the lithic assemblage from the burial mound at Aldro 30, was dated incorrectly to the Early Neolithic (Figure 66). Four of the Early Neolithic assemblages, namely the lithic assemblages from Wharram Percy 46, the outer mound at Towthorpe 273 and the burial mounds at Aldro 116 and Towthorpe 291, were also dated incorrectly to the Late Neolithic (Figure 67). All but one of these lithic assemblages was comprised of artefacts with both Early Neolithic and Late Neolithic traits and was dated on the basis of the dominant chronological period. As such, the number of false positives could perhaps be reduced by using one of the other proposed scoring systems.

Criterion 4. False negatives

Only three of the independently dated lithic assemblages from the Neolithic burial mounds could not be dated using the binary scoring system. One of the Early Neolithic assemblages, namely the lithic assemblage from the linear zone at Calais Wold 275, and two of the Late

Neolithic assemblages, namely the lithic assemblages from Grave A at Towthorpe 273 and the circular pit at Acklam Wold 211, could not be dated. The lithic assemblages from Grave A at Towthorpe 273 and the circular pit at Acklam Wold 211 had an equal number of Early Neolithic and Late Neolithic traits and the conflict in date could possibly be resolved using one of the other proposed scoring systems. In contrast, whilst the assemblage of worked flint from the linear zone at Calais Wold 275 was comprised of three leaf-shaped arrowheads, none of the arrowheads had traits that were technologically diagnostic and the lithic assemblage will therefore persist as a false negative for all of the proposed scoring systems.

5.2.2 Method 2: Ranked scores

The second scoring system is based on ranked scores. Scores for the Early Neolithic and Late Neolithic are calculated in the same way as the binary scores (page 148). The only difference between the two scoring systems are the values of the increments used to update the artefact scores. Increments for the ranked scores have four possible values:

3 = diagnostic (unique)
2 = diagnostic (majority)
1 = diagnostic (minority)
0 = not diagnostic

The values of the increments reflect the degree of association between a diagnostic trait and the corresponding chronological period and are based on the frequencies of artefacts found in the Early Neolithic and the Late Neolithic assemblages[28] from the Neolithic burial mounds. Seven conditions exist for each diagnostic trait:

- Condition 1 – if the value of the trait is diagnostic of the Early Neolithic and is only found in Early Neolithic assemblages the scores are incremented by:

$$e_n = 3$$
$$l_n = 0$$

[28] Undated assemblages are included in the totals used to calculate the percentages in order to account for the uncertainty in the dates of the corresponding artefacts.

- Condition 2 – if the value of the trait is diagnostic of the Late Neolithic and is only found in Late Neolithic assemblages the scores are incremented by:

$$e_n = 0$$
$$l_n = 3$$

- Condition 3 – if the value of the trait is diagnostic of the Early Neolithic and is most commonly found in Early Neolithic assemblages the scores are incremented by:

$$e_n = 2$$
$$l_n = 0$$

- Condition 4 – if the value of the trait is diagnostic of the Late Neolithic and is most commonly found in Late Neolithic assemblages the scores are incremented by:

$$e_n = 0$$
$$l_n = 2$$

- Condition 5 – if the value of the trait is diagnostic of the Early Neolithic but is most commonly found in Late Neolithic assemblages the scores are incremented by:

$$e_n = 0$$
$$l_n = 1$$

- Condition 6 – if the value of the trait is diagnostic of the Late Neolithic but is most commonly found in Early Neolithic assemblages the scores are incremented by:

$$e_n = 0$$
$$l_n = 1$$

- Condition 7 – if the value of the trait is not chronologically diagnostic the scores are incremented by:

$$e_n = 0$$
$$l_n = 0$$

Conditions 5 and 6 appear counterintuitive and have been introduced in order to counteract spurious values caused by the small sample size[29]. The resultant ranked scores can be used

[29] The low values of the increments for these conditions reflect the uncertainty associated with the discrepancy between the expected dates of the diagnostic traits and the observed frequencies of the traits.

to determine the likely date of an individual lithic artefact or an aggregated assemblage of worked flint using the same method as the binary scoring system[30].

The ranked scoring system addresses some of the weaknesses of the binary scoring system and seeks to: 1) reduce the number of artefacts or assemblages with conflicts in date, and; 2) increase the differentiation between the Early Neolithic and the Late Neolithic scores. In contrast to the binary scoring system which treats all of the traits equally, the ranked scoring system recognises that a trait can potentially be associated with more than one chronological period and that some traits will therefore be more reliable chronological indicators than others – traits which are unique to a chronological period have higher scores than traits which are associated with more than one chronological period. The strengths and weaknesses of the ranked scoring system can be assessed by comparing the dates based on the ranked scores to those based on the binary scores.

5.2.2.1 Individual artefacts

Criterion 1. Dated artefacts

Over 50% (n=27) of the chronologically diagnostic artefacts from the surface scatter at Wharram-le-Street could be dated using the ranked scoring system (Figure 68). The artefacts dated on the basis of the dominant chronological period were assigned the same dates using both scoring systems. All of the conflicts in date were eliminated using the ranked scoring system, with two artefacts (a broad hafted scraper and a horseshoe scraper) correctly dated to the Late Neolithic and one artefact (an end scraper) incorrectly dated to the Late Neolithic. The incorrect date introduced when eliminating the conflicts in date can perhaps be resolved by using a scoring system based on probabilities (i.e. continuous values) rather than ranked values (i.e. discrete values).

Criterion 2. Correct scores

An increase in the number (n=21) of chronologically diagnostic artefacts from the surface scatter at Wharram-le-Street that were dated correctly was identified as a result of the reduction in the number of artefacts with conflicts in the date. All of the chronologically diagnostic artefacts with an equal number of Early Neolithic and Late Neolithic traits were

[30] The sum of the scores is replaced by a counter which determines the total number of diagnostic traits for each artefact.

dated to the Late Neolithic using the ranked scoring system, namely an end scraper, a horseshoe scraper and a broad hafted scraper. The reduction in the number of conflicts in date is accompanied by increased differentiation between the scores for the Early Neolithic and the Late Neolithic artefacts (Figure 69). As with the binary scores, the median values of the ranked scores for the Early Neolithic artefacts were negative and the median values of the ranked scores for the Late Neolithic artefacts were positive.

Criterion 3. False positives

One additional (n=6) chronologically diagnostic artefact from the surface scatter at Wharram-le-Street was dated incorrectly using the ranked scoring system. The ranked scores for the Early Neolithic artefacts are similar to the binary scores and the two Late Neolithic artefacts dated incorrectly to the Early Neolithic persist as false positives (Figure 70). In contrast, the ranked scores for the Late Neolithic artefacts are different to the binary scores and, in addition to the three Early Neolithic artefacts previously dated incorrectly to the Late Neolithic, a fourth false positive was introduced (Figure 71). The additional false positive (a second end scraper) was introduced as a result of eliminating one of the conflicts in date. Since this artefact had both Early Neolithic and Late Neolithic traits, it could in theory be dated correctly using the third proposed scoring system.

Criterion 4. False negatives

The remainder (n=24) of the chronologically diagnostic artefacts from the surface scatter at Wharram-le-Street could not be dated using the ranked scoring system. The artefacts which could not be dated were all artefacts with unknown dates. All of the conflicts in date were eliminated using the ranked scoring system, with two of the artefacts (a broad hafted scraper and a horseshoe scraper) correctly dated to the Late Neolithic and one of the artefacts (an end scraper) incorrectly dated to the Late Neolithic. Reassuringly, no new conflicts in date were introduced as a result of using the ranked scoring system. The artefacts with unknown dates cannot be dated using any of the proposed scoring systems.

5.2.2.2 Aggregated assemblages

Criterion 1. Dated assemblages

Over 90% (n=22) of the independently dated lithic assemblages from the Neolithic burial mounds could be dated using the ranked scoring system (Figure 72). The lithic assemblages dated on the basis of the dominant chronological period were assigned the same dates using

both the binary and the ranked scoring systems. One of the conflicts in date was eliminated using the ranked scoring system, with the lithic assemblage from Grave A at Towthorpe 273 dated incorrectly to the Early Neolithic. Again, as with the chronologically diagnostic artefacts from Wharram-le-Street, the incorrect date introduced when eliminating the conflict in date can perhaps be resolved by using a scoring system based on probabilities (i.e. continuous values) rather than ranked values (i.e. discrete values).

Criterion 2. Correct scores

No additional lithic assemblages (n=16) from the Neolithic burial mounds were dated correctly using the ranked scoring system. The increase in the number of unique values for the artefact scores resulted in increased separation of the median values of the scores for the knives, other tools, flakes and cores from Early Neolithic and Late Neolithic assemblages (Figure 73). This increase is most evident in the case of the scores for the knives. The number of knives that were dated was consequently higher for the ranked scoring system.

Criterion 3. False positives

One additional lithic assemblage (n=6) from the Neolithic burial mounds was dated incorrectly was using the ranked scoring system. The Late Neolithic assemblage dated incorrectly to the Early Neolithic using the binary scoring system persists as a false positive, namely the lithic assemblage from the burial mound at Aldro 30 (Figure 74). An additional false positive, the lithic assemblage from Grave A at Towthorpe 273 dated incorrectly to the Early Neolithic using the ranked scoring system, was introduced as a result of the elimination of one of the conflicts in date. All four of the Early Neolithic assemblages dated incorrectly to the Late Neolithic using the binary scoring system also persist as false positives (Figure 75).

Criterion 4. False negatives

Only two of the independently dated lithic assemblages from the Neolithic burial mounds could not be dated using the ranked scoring system. Two of the lithic assemblages which could not be dated using the binary scoring system persisted as false negatives, namely the Early Neolithic assemblage from the linear zone at Calais Wold 275 and the Late Neolithic assemblage from the circular pit at Acklam Wold 211. The other lithic assemblage that could not be dated using the binary scoring system, the Late Neolithic assemblage from Grave A at Towthorpe 273, was incorrectly dated to the Early Neolithic using the ranked scoring system.

This assemblage had an equal number of Early Neolithic and Late Neolithic traits and the conflict in date could possibly be resolved using the fuzzy scoring system.

5.2.3 Method 3: Fuzzy scores

The third scoring system is based on fuzzy scores. Scores for the Early Neolithic and Late Neolithic are initially set to one and calculated as follows:

$$E = \sum_{n=1}^{n=18} E_{n-1}\, e_n$$

and:

$$L = \sum_{n=1}^{n=18} L_{n-1}\, l_n$$

Where:

E = score (Early Neolithic)

n = diagnostic trait (iteration)

e = weight (Early Neolithic)

L = score (Late Neolithic)

l = weight (Late Neolithic)

The values of the weights are based on the probabilities that the value of a trait is diagnostic of the Early Neolithic and/or the Late Neolithic. In contrast to the increments for the binary and ranked scoring systems, both weights for the fuzzy scoring system may have non-zero values. Five possible conditions exist for each diagnostic trait:

- Condition 1 – if the value of the trait is diagnostic of the Early Neolithic and is only found in Early Neolithic assemblages the scores are weighted by:

$$e_n = 1$$
$$l_n = 0$$

- Condition 2 – if the value of the trait is diagnostic of the Late Neolithic and is only found in Late Neolithic assemblages the scores are weighted by:

$$e_n = 0$$
$$l_n = 1$$

- Condition 3 – if the value of the trait is diagnostic of the Early Neolithic and is found in both Early Neolithic and Late Neolithic assemblages the scores are weighted by:

$$0 < e_n < 1$$
$$0 < l_n < 1$$

- Condition 4 – if the value of the trait is diagnostic of the Late Neolithic and is found in both Early Neolithic and Late Neolithic assemblages the scores are weighted by:

$$0 < e_n < 1$$
$$0 < l_n < 1$$

- Condition 5 – if the value of the trait is not chronologically diagnostic the scores are weighted by:

$$e_n = 1$$
$$l_n = 1$$

The resultant scores can be used to determine the likely date of each artefact. All of the artefacts dated using the fuzzy scoring system are dated on the basis of the dominant chronological period. Four possible dates can be assigned on the basis of the values of the fuzzy scores and/or the counts of the number of diagnostic traits:

- Early Neolithic – the probability that the artefact is Early Neolithic in date is greater than the probability that the artefact is Late Neolithic in date:

$$L - E < 0$$

- Late Neolithic – the probability that the artefact is Late Neolithic in date is greater than the probability that the artefact is Early Neolithic in date:

$$L - E > 0$$

- Conflict – the probability that the artefact is Early Neolithic in date is the same as the probability that the artefact is Late Neolithic in date:

$$count > 0$$
$$L - E = 0$$

- Unknown – the artefact does not have any traits which are chronologically diagnostic:

$$count = 0$$

Again, as with the binary and ranked scoring systems, scores for individual artefacts can be aggregated and used to determine the likely date of a lithic assemblage.

The fuzzy scoring system addresses some of the weaknesses of the binary and the ranked scoring systems and seeks to: 1) reduce the number of false negatives, i.e. artefacts or assemblages with conflicts in date, and; 2) reduce the number of false positives, i.e. artefacts or assemblages that were dated incorrectly. In contrast to the binary and ranked scoring systems which are based on discrete values, the fuzzy scoring system is based on continuous values and the number of artefacts or assemblages with conflicts in date should be much lower – the fuzzy scores will have a higher number of unique values than the binary or ranked scores, thereby reducing the potential for conflicts in date. The strengths and weaknesses of the fuzzy scoring system can be assessed by comparing the dates based on the fuzzy scores to those based on the binary and ranked scores.

5.2.3.1 Individual artefacts

Criterion 1. Dated artefacts

Over 50% (n=27) of the chronologically diagnostic artefacts from the surface scatter at Wharram-le-Street could be dated using the fuzzy scoring system (Figure 76). Seven of the artefacts dated using the binary scoring system were re-dated – five of which (two non-cortical blades, a retouched blade, a serrated blade and a rejuvenation flake) were re-dated to the Late Neolithic and two of which (a discoidal core and a simple core) were re-dated to the Early Neolithic. All three conflicts in date were also eliminated – two of which (a broad hafted scraper and a horseshoe scraper) were correctly dated to the Late Neolithic and one of which (an end scraper) was incorrectly dated to the Late Neolithic. In both instances, the dates based on the fuzzy scores appear to exhibit a bias towards the Late Neolithic. Sixteen artefacts were dated to the Late Neolithic using the fuzzy scoring system and only eleven artefacts were dated to the Early Neolithic. In comparison, ten artefacts were dated to the Late Neolithic using the binary scoring system and fourteen artefacts were dated to the Early Neolithic.

Criterion 2. Correct scores

Approximately 25% (n=14) of the chronologically diagnostic artefacts from the surface scatter at Wharram-le-Street were dated correctly using the fuzzy scoring system. The decrease in the number of correctly dated artefacts coincides with a decrease in the differentiation between the fuzzy scores for the Early Neolithic and the Late Neolithic artefacts which is

particularly evident in the case of the lithic debitage (Figure 77). Although there is overlap between the ranges of the scores for the stone tools, the median values of the scores for the Early Neolithic and the Late Neolithic are clearly separated. In contrast, there is significant overlap between the ranges of the scores for the lithic debitage and the median values of the scores for the Late Neolithic debitage are lower than those for the Late Neolithic debitage increasing the potential for assigning incorrect dates to artefacts.

Criterion 3. False positives

Approximately 25% (n=13) of the chronologically diagnostic artefacts from the surface scatter at Wharram-le-Street were dated incorrectly using the fuzzy scoring system. Both of the Late Neolithic artefacts dated incorrectly to the Early Neolithic using the binary scoring system persist as false positives and two additional false positives (a discoidal core and a simple core) were introduced (Figure 78). All of the Early Neolithic artefacts dated incorrectly to the Late Neolithic using the binary scoring system persist as false positives and five new false positives (two non-cortical blades, a retouched blade, a serrated blade and a rejuvenation flake) were introduced (Figure 79). Whilst the number of false positives for the Early Neolithic is broadly consistent for all of the scoring systems, the number of false positives for the Late Neolithic is higher for the fuzzy scoring system than for the other scoring systems and the apparent bias towards the Late Neolithic would appear to be a problem with the scoring system.

Criterion 4. False negatives

The remainder (n=24) of the chronologically diagnostic artefacts from the surface scatter at Wharram-le-Street could not be dated using the fuzzy scoring system. As with the ranked scoring system, the artefacts which could not be dated were all artefacts with unknown dates. Again, all of the conflicts in date were eliminated using the fuzzy scoring system, with two of the artefacts (a broad hafted scraper and a horseshoe scraper) correctly dated to the Late Neolithic and one of the artefacts (an end scraper) incorrectly dated to the Late Neolithic. The artefacts with unknown dates cannot be dated using any of the proposed scoring systems.

5.2.3.2 Aggregated assemblages

Criterion 1. Dated assemblages

Over 90% (n=22) of the independently dated lithic assemblages from the Neolithic burial mounds could be dated using the fuzzy scoring system (Figure 80). One of the assemblages initially dated incorrectly to the Late Neolithic using the binary scoring system, the lithic

assemblage from Wharram Percy 46, was dated correctly to the Early Neolithic using the fuzzy scoring system. One of the conflicts in date was also eliminated, with the lithic assemblage from Grave A at Towthorpe 273 dated incorrectly to the Early Neolithic.

Criterion 2. Correct scores

One additional (n=17) independently dated lithic assemblages from the Neolithic burial mounds was dated correctly using the fuzzy scoring system. Despite the problems in dating the diagnostic artefacts from the surface scatter at Wharram-le-Street correctly, the fuzzy scoring system appears to work well at the level of an assemblage of worked flint. Anomalous scores for individual artefacts are averaged out across a lithic assemblage as a whole. With the exception of arrowheads and debris, there is good separation of the median values of the fuzzy scores of the artefacts from Early Neolithic assemblages and those from Late Neolithic assemblages (Figure 81). The absolute values of the fuzzy scores, however, are typically lower for the stone tools than for the lithic debitage.

Criterion 3. False positives

Five of the independently dated lithic assemblages from the Neolithic burial mounds were dated incorrectly using the fuzzy scoring system. The Late Neolithic assemblage that was dated incorrectly to the Early Neolithic using the binary scoring system persists as a false positive and an additional false positive, the lithic assemblage from Grave A at Towthorpe 273, was introduced using the fuzzy scoring system (Figure 82). One of the Early Neolithic assemblages that was initially dated incorrectly to the Late Neolithic using the binary scoring system, the lithic assemblage from Wharram Percy 46, was also dated correctly using the fuzzy scoring system. Three of the Early Neolithic assemblages that were incorrectly dated using the binary scoring system persisted as false positives using the fuzzy scoring system, namely the lithic assemblage from the outer mound at Towthorpe 273 and the lithic assemblages from the burial mounds at Aldro 116 and Towthorpe 291 (Figure 83).

Criterion 4. False negatives

Only two of the independently dated lithic assemblages from the Neolithic burial mounds could not be dated using the fuzzy scoring system. Two of the lithic assemblages which could not be dated using the binary scoring system persisted as false negatives, namely the Early Neolithic assemblage from the linear zone at Calais Wold 275 and the Late Neolithic

assemblage from the circular pit at Acklam Wold 211. Again, as with the ranked scoring system, the other lithic assemblage that could not be dated using the binary scoring system, the Late Neolithic assemblage from Grave A at Towthorpe 273, was incorrectly dated to the Early Neolithic using the fuzzy scoring system.

5.2.4 Strengths and weakness

The criteria used to assess the efficacy of the proposed scoring systems are summarised in Table 38. At the level of an individual artefact, the ranked scoring system performed best for three of the assessment criteria – with the highest number of dated artefacts, the highest number of correct dates and the lowest number of false negatives. The binary scoring system performed better for the fourth criterion, with the lowest number of false positives, i.e. the fewest incorrect dates. At the level of an aggregated assemblage of worked flint, the fuzzy scoring system performed best for all of the assessment criteria – with the highest number of dated assemblages, the highest number of correct dates, the lowest number of false positives and the lowest number of false negatives. The strengths and weaknesses of the respective scoring systems are summarised below.

First, the binary scoring system minimises the potential for ambiguity by only updating the score for one chronological period for each diagnostic trait. It is particularly well-suited to classes of artefacts with fewer diagnostic traits or smaller assemblages of worked flint where spurious values or dates cannot be averaged out. Despite the polarised nature of the scoring system, the binary scores resulted in fewer incorrect dates than the other scoring systems. The binary scoring system is biased towards the Early Neolithic, with sixteen diagnostic traits that apply to Early Neolithic artefacts and only twelve diagnostic traits that apply to Late Neolithic artefacts. Whilst this bias could result in a disproportionate number of artefacts being dated to the Early Neolithic, the additional traits apply to only a handful of artefacts and in practice have little impact.

Secondly, the ranked scoring system reduces the potential for conflicts in date by increasing the number of unique values for the artefact scores. In contrast to the binary scores which treats all of the diagnostic traits equally, the ranked scores takes into account the likelihood that each of the traits is diagnostic of a particular chronological period and, as such, better reflect the patterns identified through the reconstruction of the life histories and debitage signatures in the previous chapters – although a few of the diagnostic traits were unique to a

specific chronological period, the majority of the diagnostic traits were more likely to be associated with one chronological period than another. Despite better reflecting the patterns in the underlying data, the number of artefacts with incorrect dates was higher for the ranked scoring system than the binary scoring system.

Thirdly, the fuzzy scoring system further reduces the potential for conflicts in date by basing the artefact scores on continuous values rather than discrete values. In contrast to the binary and ranked scoring systems, the scores for both chronological periods are updated for each diagnostic trait. The fuzzy scoring system is best suited to large datasets where spurious scores for individual artefacts will be averaged out. Nevertheless, the fuzzy scoring system performed well for the assemblages of worked flint from the Neolithic burial mounds. The fuzzy scoring system is biased towards the Late Neolithic. Many of the diagnostic traits represent deviations from the expected outcome of a knapping operation[31] – deviations which are more likely to occur as a result of the less controlled and systematic nature of stone working typical of the Late Neolithic.

None of the scoring systems is without fault and it is important to bear in mind the biases inherent in the scoring systems when applying them to any dataset. The bias towards the Early Neolithic inherent in the binary scoring system is a product of the number of traits and is also likely to apply to the other scoring systems – all of the artefact scores are ultimately dependent on the number of diagnostic traits. Similarly, the bias towards the Late Neolithic inherent in the fuzzy scoring system is also likely to apply to the other scoring systems – albeit, seemingly mitigated by only updating the score for one of the chronological periods. The biases inherent in the scoring systems can be corrected by standardising the artefact scores by the count of the number of diagnostic traits or adjusting the thresholds used to assign dates to individual artefacts or lithic assemblages.

5.3 Putting it all together

Having established a series of diagnostic traits that can be used to discriminate between stone tools and lithic debitage characteristic of Early Neolithic and Late Neolithic stone working

[31] The values of the traits that are chronologically diagnostic typically correspond to either the tails of the distribution for variables which are normally distributed or the first and/or last values of variables which are not normally distributed – values which are less likely to occur as a result of the more controlled and systematic nature of stone working typical of the Early Neolithic.

traditions and a mechanism whereby those diagnostic traits can be used to assign dates to individual lithic artefacts and aggregated assemblages of worked flint, it is possible to return to the analysis of the lithic scatter at Wharram-le-Street with a view to isolating groups of artefacts which are broadly contemporary with one another and identifying spatial patterning in those groups of artefacts that can contribute to our understanding of the spatial organisation of stone working and changes in the nature of settlement practice which took place in Eastern Yorkshire during the Neolithic.

Preliminary analysis of the spatial distribution of artefacts within the lithic scatter at Wharram-le-Street identified two clusters of artefacts in the eastern part of the survey area – one to the east of the former source of the Gypsey Race and one to the west of the former source of the Gypsey Race. This analysis was based on the composite distribution of artefacts from all chronological periods which at best represents the most recent or dominant chronological period and at worst is an amalgam which represents none of the chronological periods.

Approximately 15% (n=51) of the stone tools and lithic debitage recovered from the lithic scatter could be dated to the Early Neolithic or Late Neolithic on the basis of artefact typologies. Differential spatial patterning was identified in the spatial distribution of the chronologically diagnostic artefacts, with the Early Neolithic artefacts largely confined to the area of the clusters of artefacts close to the former source of the Gypsey Race and the Late Neolithic artefacts dispersed along an axis aligned from north-east to south-west tentatively thought to correspond to the alignment of a prehistoric trackway. The binary scoring system was used below in order to minimise the number of artefacts dated incorrectly to the Early Neolithic or the Late Neolithic.

5.3.1 Early Neolithic

A total of 113 artefacts from the surface scatter at Wharram-le-Street could be dated to the Early Neolithic (Figure 84). One hundred and one artefacts were dated to the Early Neolithic using the binary scoring system, excluding two false positives, i.e. Late Neolithic artefacts that were incorrectly dated to the Early Neolithic. Twelve additional artefacts could be dated typologically to the Early Neolithic, including three false positives, i.e. Early Neolithic artefacts that were incorrectly dated to the Late Neolithic, and nine false negatives, i.e. Early Neolithic artefacts that could not be dated using the binary scoring system. The dated artefacts included utilitarian tools and knapping debris – classes of artefacts which are not typologically

diagnostic but are critical to understanding the spatial organisation of stone working and changes in the nature of settlement practice.

Early Neolithic artefacts were recovered from eighty-two areal units, with a maximum of four artefacts recovered from each areal unit (Figure 85). Over two thirds (n=60) of the areal units from which Early Neolithic artefacts were recovered contained a single artefact, the majority of which were located in the western and southern parts of the survey area. Eight of the areal units that contained single artefacts were isolated and the associated artefacts could tentatively be interpreted as stray finds. The remainder of the areal units that contained single artefacts were connected to other areal units from which Early Neolithic artefacts were recovered and formed part of a low-density artefact scatter. All of the areal units (n=22) that contained two or more Early Neolithic artefacts were located in the central and eastern parts of the survey area close to the former source of the Gypsey Race.

The clustering evident in the spatial relationships between areal units that contained Early Neolithic artefacts is not immediately obvious from the frequencies of artefacts recovered from individual areal units. Whilst higher frequencies of artefacts were typically recovered from the areal units in the eastern part of the survey area, the low range of values does not permit delineation of areas of higher or lower densities of artefacts: the number of unique values must be increased in order to identify local patterns in the distribution of artefacts. To this end, the binary scores for individual artefacts can be aggregated in order to obtain spatial weights that reflect the magnitude of the Early Neolithic component of each of the areal units. The values of the aggregated scores emphasise the underlying patterns in the spatial distribution of Early Neolithic artefacts (Figure 86).

Focal sums were subsequently calculated from the aggregated binary scores for the Early Neolithic artefacts (see Section 2.2.2). The values of the focal sums are not normally distributed and are skewed towards the lower end of the range of values. A degree of caution should consequently be exercised when interpreting any spatial statistics which assume a normal distribution, including Moran's I and Anselin's Local Moran's I. The values of the focal sums for the Early Neolithic artefacts exhibit positive spatial autocorrelation at all distances between 20m and 300m (Figure 87). Whilst the first peak in the z scores for the Moran's I test statistic occurs at 200m, the values of the test statistic indicate that the focal sums are most similar at much smaller distances and the variance of the test statistic drops sharply at a

distance of c.25m – a distance equivalent to the conceptualisation of spatial relationships based on polygon contiguity (Queen's Move).

Cluster/outlier analysis of the focal sums for the areal units that contained Early Neolithic artefacts identified two discrete clusters of high values – one to the west of the former source of the Gypsey Race and another to the east of the former source of the Gypsey Race (Figure 88). First, the cluster of high values to the west of the former source of the Gypsey Race comprised thirty-one areal units and contained thirty-eight artefacts. Secondly, the cluster of high values to the east of the former source of the Gypsey Race comprised forty areal units and contained thirty-nine artefacts. Two isolated clusters of high values, both comprised of just two areal units, were also identified in the central and eastern parts of the survey area but are not considered to be significant. Clusters of low values, characterised by areal units from which no Early Neolithic artefacts were recovered, were identified in the western part of the survey area. No outliers with unusually high/low values were identified on the basis of the analysis of the focal sums for the Early Neolithic. The remainder of the areal units that contained Early Neolithic artefacts did not exhibit significant spatial patterning.

Rounded to the nearest integer, a mean of 1 artefact was recovered from the areal units corresponding to the clusters of high values and a mean of 0 artefacts was recovered from the areal units in the rest of the survey area (Table 39). These figures are unrepresentative and dramatically underestimate the intensity of Early Neolithic activity. Assuming that the artefacts recovered during the course of the survey are representative of the sample frame and the sample population, it is estimated that the artefact density for the clusters of high values is equivalent to c.4,500 artefacts per hectare and that the artefact density for the rest of the survey area is equivalent to c.600 artefacts per hectare (see Section 1.1.2). Whilst these estimates of the densities of artefacts are approximate, they provide a useful basis for comparing the intensities of activity for different chronological periods.

The apparent lack of quantitative distinction between the areal units corresponding to the clusters of high values and the areal units in the other parts of the survey area highlights the problems of working with low density artefact scatters. These problems are compounded when working with individual artefacts or classes of artefacts. Simulations of repeated episodes of ploughing and surface survey have shown that less common artefacts are likely to be over-represented or under-represented in surface assemblages (Boismier 1997). A degree

of caution should consequently be exercised in interpreting evidence for past human activity based on the presence or absence of specific types of artefacts. Instead, emphasis should be placed on qualitative differences in the types of activity represented by generic classes of artefacts, such as stone tools and lithic debitage.

A kernel density plot was generated for the lithic debitage dated to the Early Neolithic on the basis of the binary scores (Figure 89). The higher density clusters of artefacts in the area of the former source of the Gypsey Race are clearly visible. They would appear to be comprised predominantly of lithic debitage. The majority of tools were not recovered from the clusters of artefacts but from the collection units adjacent to the clusters. The stone tools recovered from the collection units adjacent to the higher density clusters were comprised mainly of maintenance tools such as scrapers and expedient tools – mostly retouched or serrated blades and flakes – consistent with routine occupation activity. In contrast, all of the Early Neolithic cores were recovered from areal units that corresponded to the higher density clusters of artefacts. The distribution of cortical blades/flakes dated to the Early Neolithic, sorted by lowest position in the sequence of knapping operations, shows that a high frequency of debitage associated with the early stages of core working and tool manufacture was found in the area of the clusters of high values (Figure 90).

The character of the lithic artefacts found in the area of the former source of the Gypsey Race area are consistent with middening, associated with either the direct deposition of waste from stone working or the dumping of material cleared from one or more episodes of occupation at the site. Although the potential loss of fine-grained spatial information due to ploughing cannot be dismissed (see Introduction) the differential patterning of the stone tools, cores and cortical blades/flakes would appear to suggest that the clusters of artefacts have maintained their overall spatial integrity. Both of the clusters of Early Neolithic artefacts lie outside the cropmarks and geophysical anomalies associated with the Roman villa or temple/shrine and are not thought to have been disturbed by later activity. Whilst the western cluster of artefacts coincides with the circular enclosure thought to correspond to a Bronze Age shrine, it extends substantially beyond the limits of the cropmarks and thus does not appear to be directly related to the circular enclosure.

5.3.2 Late Neolithic

A total of 143 artefacts from the surface scatter at Wharram-le-Street could be dated to the Late Neolithic (Figure 91). One hundred and twenty-three artefacts were dated to the Late Neolithic using the binary scoring system, excluding three false positives, i.e. Early Neolithic artefacts that were incorrectly dated to the Late Neolithic. Twenty additional artefacts could be dated typologically to the Late Neolithic, including two false positives, i.e. Late Neolithic artefacts that were dated incorrectly to the Early Neolithic, and eighteen false negatives, i.e. Late Neolithic artefacts that could not be dated using the binary scoring system. As with the Early Neolithic, the dated artefacts included utilitarian tools and knapping debris – classes of artefacts which are not typologically diagnostic but are critical to understanding the spatial organisation of stone working and changes in the nature of settlement practice.

Late Neolithic artefacts were recovered from one hundred and sixteen areal units, with a maximum of three artefacts recovered from each areal unit (Figure 92). Over three-quarters (n=92) of the areal units from which Late Neolithic artefacts were recovered contained a single artefact. Thirteen of the areal units that contained single artefacts were isolated and the associated artefacts could be interpreted as stray finds. The remainder of the areal units that contained single artefacts were connected to other areal units from which Late Neolithic artefacts were recovered and formed part of a low-density artefact scatter. In contrast to the Early Neolithic, the areal units (n=24) that contained two or more Late Neolithic artefacts were not clustered around the former source of the Gypsey Race and were instead distributed sporadically throughout the survey area. The clustering evident in the spatial relationships between areal units that contained Late Neolithic artefacts was again not immediately obvious from the frequencies of artefacts. The binary scores for individual artefacts were consequently aggregated in order to obtain spatial weights that reflect the magnitude of the Late Neolithic component of each of the area units (Figure 93).

Focal sums were subsequently calculated from the aggregated binary scores for the Late Neolithic artefacts (see Section 2.2.2). The values of the focal sums are not normally distributed and are skewed towards the lower end of the range of values. Again, a degree of caution should consequently be exercised when interpreting any spatial statistics which assume a normal distribution, including Moran's I and Anselin's Local Moran's I. The values of the focal sums for the Late Neolithic artefacts exhibit positive spatial autocorrelation at all distances between 20m and 300m (Figure 94). The first peak in the z-scores for the Moran's I

test statistic occurs at a distance of 20m, suggesting that the spatial patterning in the values of the focal sums for the Late Neolithic artefacts is more localised than that for the Early Neolithic artefacts. Although a second peak in the z-scores for the Moran's I test statistic occurs at a distance of 280m, the values of the test statistic indicate that the focal sums are most similar at much smaller distances and the variance of the test statistic drops sharply at a distance of c.25m – a distance equivalent to the conceptualisation of spatial relationships based on polygon contiguity (Queen's Move).

Cluster/outlier analysis of the focal sums for the areal units that contained Late Neolithic artefacts identified four clusters of high values – one to the west of the former source of the Gypsey Race, one to the east of the former source of the Gypsey Race and two in the western and southern parts of the survey area (Figure 95):

1. The cluster to the west of the former source of the Gypsey Race comprised six areal units and contained seven artefacts;

2. The cluster to the east of the former source of the Gypsey Race comprised forty-six areal units and contained forty-three artefacts;

3. The smaller cluster along the line of the possible prehistoric trackway comprised seven areal units and contained seven artefacts;

4. The larger cluster along the line of the possible prehistoric trackway comprised seven areal units and contained five artefacts.

Five clusters of low values were also identified in the western part of the survey area. No outliers with unusually high or low values were identified on the basis of the analysis of the focal sums for the Late Neolithic. The remainder of the areal units that contained Late Neolithic artefacts did not exhibit significant spatial patterning.

Again, as with the Early Neolithic artefacts, a mean of 1 artefact was recovered from the areal units corresponding to the clusters of high values and a mean of 0 artefacts was recovered from the areal units in the rest of the survey area (Table 40). Assuming that the artefacts recovered during the course of the survey are representative of the sample frame and sample population, it estimated that the artefact density of the clusters of high values is equivalent to between c.3,600 and c.5,800 artefacts per hectare and that the artefact density for the rest

of the survey area is equivalent to c.1,100 artefacts per hectare (see Section 1.1.2). Although the density of artefacts for the clusters of Late Neolithic artefacts was broadly comparable with that for the clusters of Early Neolithic, the density of Late Neolithic artefacts for the rest of the survey area was higher than that for the Early Neolithic artefacts.

A kernel density plot was generated for the lithic debitage dated to the Late Neolithic on the basis of the binary scores (Figure 96). The clusters of artefacts identified on the basis of the aggregated assemblage of Late Neolithic worked flint are clearly visible. Again, these clusters would appear to be comprised predominantly of lithic debitage and the majority of tools were not recovered from the clusters of artefacts but from the collection units adjacent to the clusters. In contrast to the Early Neolithic, cores were widely distributed throughout the survey area rather than confined to the higher density clusters of artefacts. The distribution of cortical blades/flakes, sorted by lowest position in the sequence of knapping operations, shows that the debitage associated with the early stages of core working and tool manufacture was also widely distributed throughout the survey area (Figure 97).

A marked shift in the nature and extent of occupation can be seen during the Late Neolithic which may relate to communal gatherings associated with the construction and use of the burial mound and circular enclosure at Duggleby Howe. Evidence for Late Neolithic stone working and occupation would appear to be more widespread, with higher frequencies of stone tools and lithic debitage found in the western part of the survey area. The cluster of artefacts to the east of the former source of the Gypsey Race identified for the Early Neolithic persists and again is thought to be consistent with middening. In contrast, the cluster of artefacts to the west of the former source of the Gypsey Race contracts and is confined to the area of the circular enclosure thought to correspond to a Bronze Age shrine. The character of the lithic assemblage from the western cluster is comparable to the assemblages of worked flint from the fabrics of the Neolithic burial mounds, perhaps supporting the interpretation of the smaller circular cropmark within the interior of the circular enclosure as a ring ditch rather than an earlier pond (see Section 1.1.2). Evidence for Late Neolithic occupation and stone working in the western part of the survey area is likely to have been disturbed by later activity associated with the Roman villa or temple/shrine.

Estimates of the frequency or density of artefacts represented by the Early Neolithic and Late Neolithic artefacts from the surface scatter at Wharram-le-Street are comparable to the sizes

of the lithic assemblages recovered from the Early Mesolithic site at Star Carr in the Vale of Pickering (Milner et al. 2018) and the Middle Neolithic site at Sewerby Cottage Farm on the Holderness coast (Dickson and Edmonds 2009). Although direct comparisons between Star Carr and Wharram-le-Street are problematic given the difference in the dates of the two sites, the similarity in the sizes of the lithic assemblages gives an indication of the nature and scale of the evidence for occupation at Wharram-le-Street. Furthermore, both sites are located inland but are reliant on flint from the glacial tills of the Holderness coast, placing the evidence for stone working at Wharram-le-Street within the broader context of a long-term trajectory of procurement strategies that linked communities in Eastern Yorkshire with communities in Northern Britain. In the case of the Neolithic, these links between communities are embedded within patterns of mobility that can be inferred from the analysis of stable isotopes from burial mounds on the Yorkshire Wolds, including the burial mound at Duggleby Howe approximately 1.5km to the north-east of Wharram-le-Street (Towthorpe 273).

5.4 Wharram-le-Street in context

The diagnostic traits distilled from the 'life histories' and debitage signatures reconstructed for the lithic artefacts from the Neolithic burial mounds successfully discriminate between Early Neolithic and Late Neolithic stone working traditions. Three methods of dating artefacts were tested, with the method based on binary scores performing best for individual artefacts, resulting in the fewest incorrect dates, and the method based on fuzzy scores performing best for aggregated assemblages, resulting in the most correct dates. Binary scores were calculated for the lithic artefacts from the surface scatter at Wharram-le-Street and a focal function was applied to the aggregated binary scores for the artefacts from each of the areal units to enhance the spatial patterning in the resultant distributions of artefacts. Early Neolithic occupation and stone working was confined to the central and eastern parts of the survey area, with two clusters of artefacts consistent with middening identified close to the former source of the Gypsey Race. A shift in the nature and extent of occupation and stone working appears to have occurred during the Late Neolithic – stone tools, cores and cortical blades/flakes consistent with the early stages of core working or tool manufacture are found throughout the survey area. Although one of the clusters consistent with middening persists, the other contracts and is confined to the area of the circular enclosure and would appear to be associated with a ring ditch at the centre of the circular enclosure.

Neolithic communities and persistent places in Eastern Yorkshire

This chapter situates the lithic scatter at Wharram-le-Street and the assemblages of worked flint from the burial mounds on the Yorkshire Wolds within the broader context of evidence for Neolithic occupation in Eastern Yorkshire. The first part of the chapter reviews the evidence for farming and feasting in Neolithic Britain and uses stable isotopes and radiocarbon dates from Neolithic burial mounds to evaluate the dietary contributions of plants and animals and determine the geographic origins of the individuals who were buried on the Yorkshire Wolds. The second part of the chapter explores the role of persistent places in the transportation of raw materials and the exchange of stone axes, drawing upon evidence for episodic or seasonal occupation at Early Mesolithic sites in the Vale of Pickering and Holderness and evidence for burial and communal gatherings at Neolithic and Bronze Age monument complexes in the Vale of Mowbray and Yorkshire Wolds. Both the source of the Gypsey Race at Wharram-le-Street and the circular enclosure at Duggleby Howe would have played a pivotal role in a wider network of communities that extended across Northern Britain from the Cumbria High Fells in the west to Holderness in the east.

6.1 Isotopes, diet and mobility

Recent excavations at the Early Mesolithic site at Star Carr and the Middle Neolithic site at Sewerby Cottage Farm have characterized the nature of occupation as 'perhaps episodic and probably of varying intensity, throughout an 800-year period' from c.9300 BC onwards (Milner et al. 2018, 244) and 'perhaps episodic, sometimes persistent' throughout the second half of the fourth millennium BC (Dickson and Edmonds 2009, 147). Similarly, technological analysis of the lithic assemblages from the Early Mesolithic axe factory at Star Carr and Late Neolithic specialist workshops at North Dale and South Landing have demonstrated that reduction sequences are dispersed across the landscape, with the procurement of raw materials from the glacial tills of the Yorkshire coastline and the production of stone tools taking place inland in the Vale of Pickering and on the Yorkshire Wolds (Conneller, Little, and Birchenall 2018; Durden 1994). Understanding the spatial and temporal scale of mobility is consequently central to the interpretation of the nature of settlement practice and stone working

represented by the lithic scatter from the source of the Gypsey Race at Wharram-le-Street and the lithic assemblages from the Neolithic burial mounds on the Yorkshire Wolds.

Isotope analysis of tooth enamel (Montgomery, Evans, and Cooper 2007; Neil et al. 2018) and cremated bone (Snoeck et al. 2016, 2018) from Neolithic and Early Bronze Age individuals has begun to allow us to move beyond models of settlement practice grounded in human geography and/or ethnographic analogy and to develop models for patterns of landscape use based on the scale and extent of mobility observed through the geographic origins of contemporary burials (Neil et al. 2018). While limited isotope data are currently available for Eastern Yorkshire, the published data nevertheless provides a useful insight into the interactions between communities in Northern England and reflects similar patterns identified elsewhere within Britain and Europe. Strontium isotope data has been published for 22 individuals from 9 burial mounds on the Yorkshire Wolds, including Duggleby Howe, Calais Wold 275 and Aldro 116 (Montgomery, Evans, and Cooper 2007; Evans, Chenery, and Montgomery 2012). Additional data for 19 individuals from a further 16 burial mounds, including Aldro C75 and Painsthorpe Wold 98 will be published as part of the *Beaker People Project* but are not currently available (Parker Pearson et al. 2018).

Strontium is an alkaline earth metal with four naturally occurring isotopes (^{84}Sr, ^{86}Sr, ^{87}Sr and ^{88}Sr) which are formed during primordial nucleogenesis. ^{87}Sr is radiogenic and is also formed as a result of the decay of the radioactive alkaline metal rubidium (^{87}Rb). The ratio of $^{87}Sr/^{86}Sr$ for bedrock and surface geology are related to both the mineral composition and the age of the geological formation (Faure 1986). Strontium derived from the weathering of a geological formation will have the same $^{87}Sr/^{86}Sr$ ratio as the formation. Consequently, the $^{87}Sr/^{86}Sr$ ratios of soil and groundwater are related to the geological formations from which they are derived. The $^{87}Sr/^{86}Sr$ ratio for rainwater is related to the mineral composition of the water vapour (evaporated sea or freshwater) and aerosolised particles in the atmosphere (including Saharan dust) which act as condensation nuclei for excess water vapour. In coastal regions such as Britain and Ireland, the $^{87}Sr/^{86}Sr$ ratio of rainfall is equivalent to that of seawater (Hodell et al. 1989). Strontium from soil, groundwater and rainwater is absorbed into plants and once it enters the food chain becomes incorporated into the tissues of humans and animals (Capo, Stewart, and Chadwick 1998).

$^{87}Sr/^{86}Sr$ ratios are used to make inferences about mobility and migration (e.g. Montgomery, Budd, and Evans 2000; Price, Burton, and Bentley 2002; Bentley and Knipper 2005). The time of life for which these inferences can be made, however, is dependent on the mode of burial. In the case of inhumations, the crystalline structure of tooth enamel preserves the original *in vivo* $^{87}Sr/^{86}Sr$ ratio, while bone is susceptible to diagenesis and through the exchange of calcium for strontium equilibrates with the value of the soil in which it is buried (Budd et al. 2000). $^{87}Sr/^{86}Sr$ ratios of tooth enamel represent an average of the food/drink consumed during tooth formation and depending on the teeth sampled can indicate where an individual spent different stages of their childhood. In the case of cremations, high temperatures cause spalling and the destruction of tooth enamel, while cremation results in the crystallisation of bone making it resistant to diagenesis and fully calcined bone retains its original *in vivo* $^{87}Sr/^{86}Sr$ ratio (Snoeck et al. 2015). $^{87}Sr/^{86}Sr$ ratios of cremated bone represent an average of the food/drink consumed over the decade or so before death and can indicate where an individual spent the last c.10 years of their life.

It has only recently been demonstrated that cremated bone provides a reliable substrate for $^{87}Sr/^{86}Sr$ ratios and the paucity of strontium data from Neolithic burials in Eastern Yorkshire at least in part reflects the prevalence of cremation within local funerary traditions. Crematoria – "linear constructions of interleaved rubble and timber, deliberately fired to high temperatures and burning interments in situ" (Kinnes 1992, 84) – and crematorium pits are a distinctive feature of non-megalithic long barrows and Neolithic round barrows (Kinnes Stage A) on the Yorkshire Wolds (Kinnes 1979, 1992). At Raisthorpe Manor (Towthorpe 3), the earliest phase of the monument was characterised by an Early Neolithic mortuary enclosure with a façade trench, crematorium and chalk mound; a crematorium pit was later cut across the centre of the façade trench, and during the final phase of the monument an Early Bronze Age round barrow was constructed over the western end of the chalk mound (Kinnes 1992, 40–41). Cremation cemeteries are also found in Neolithic round barrows (Kinnes Stage F) on the Yorkshire Wolds (Kinnes 1979). At Duggleby Howe, 53 cremations were interred within the Late Neolithic inner mound (Kinnes 1979, 20).

All of the strontium isotope data from Neolithic and Early Bronze Age burial mounds on the Yorkshire Wolds is for tooth enamel and relates to inhumations rather than cremations. The strontium isotope data from these burial mounds has been used to make two points which have been woven into broader narratives about mobility during the Neolithic and Early Bronze

Age (e.g. Gibson 2016; Loveday 2016). First, although the $^{87}Sr/^{86}Sr$ ratios and strontium concentrations for the Neolithic and Early Bronze Age individuals overlap, differences can be seen in the structure of the two groups of individuals – the values for the Neolithic form a diffuse cloud, consistent with multiple sources of strontium and episodic shifts in settlement locale associated with early cereal cultivation; whereas the values for the Early Bronze Age exhibit mixing lines, consistent with two sources of strontium and seasonal transhumance associated with pastoralism. Secondly, the $^{87}Sr/^{86}Sr$ ratios indicate that many of the individuals did not appear to have spent their childhood on the chalk of the Yorkshire Wolds and in the case of one of the individuals from Duggleby Howe may have come from as far afield as Western Scotland or Cornwall.

6.1.1 Plants and animals in Neolithic Britain

Interpretation of the $^{87}Sr/^{86}Sr$ ratios and strontium concentrations for the two groups of individuals is contingent upon evidence for early cereal cultivation and pastoralism. Booms and busts in cereal cultivation and population levels during the Neolithic and Early Bronze Age are often linked to episodes of climate change (Whitehouse et al. 2014; Stevens and Fuller 2015; Collard et al. 2010; Shennan et al. 2013). The introduction of cereals to Britain and Ireland around 4000 BC coincided with a period of higher temperatures (c.2-3°C warmer than today) and lower rainfall, well suited to autumn sown and spring flowering emmer wheat and barley, and was accompanied by a rapid increase in population during the Early Neolithic. This was followed by a shift to colder and wetter conditions around 3600 to 3350 BC which coincided with a decline in cereal cultivation and an apparent collapse in population during the Middle Neolithic. There is limited evidence for cereal cultivation during the Late Neolithic until around 2300 to 2200 BC, the start of a period of warmer and drier conditions that lasted until around 1900 BC and coincided with the fission horizon for the Beaker tradition at the start of the Early Bronze Age (Needham 2005).

Early cereal cultivation in Neolithic Britain is characterised by small scale, semi-permanent plots of land which are intensively cultivated, and in terms of both the occurrence of cereal grains and the composition of weed assemblages is comparable to Neolithic farming in Central Europe (Bogaard and Jones 2007). Summed probability distributions for directly dated cereal grains and wild foods are used as proxies for the rise and fall of farming and suggest that the decline in cereal cultivation in Northern Britain during the Middle and Late Neolithic was offset by the continued exploitation of wild resources (Stevens and Fuller 2012). A limited range of

charred plant remains was recovered from the Middle Neolithic occupation site at Sewerby Cottage Farm on the Holderness coastline, including hazelnuts and small quantities of emmer wheat and hulled barley (Fenton-Thomas 2009; Jones and Rowley-Conwy 1997). In contrast, a wider range of charred plant remains was recovered from the Late Neolithic or Early Bronze Age pits at Marton-le-Moor in the Vale of Mowbray, with hazelnuts, apples, rosehips, rowan berries and blackberries and large quantities of barley and emmer wheat (Tavener 1996; Jones and Rowley-Conwy 1997).

The sharp decline in evidence for cereal cultivation between 3600 and 3350 BC has been linked to the rise of a more mobile pastoral-based society (Stevens and Fuller 2012). Stable isotope analysis of human bone collagen from Neolithic sites in southern Britain has indicated a terrestrial diet high in animal protein (Richards 2000). Comparative data for the Yorkshire Wolds has been generated as a by-product of the programme of radiocarbon dating carried out as part of recent research on Neolithic burial mounds of the Upper Great Wold Valley (Gibson and Bayliss 2009, 2010). Ratios of carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) isotopes are recorded in order to assess the preservation of the fraction of protein extracted for radiocarbon dating and to provide confidence in the accuracy of the measurements (Tuross, Fogel, and Hare 1988). These isotope ratios can also be used to reconstruct diet and land management practices by comparing values from archaeological samples with known values from modern foods and agriculture (c.f. Jay and Richards 2006; Bogaard et al. 2013). $\delta^{13}C$ and $\delta^{15}N$ values are reported for 35 radiocarbon dates from the Yorkshire Wolds, including dates for burials from Duggleby Howe and Towthorpe 18 (Table 41).

$\delta^{13}C$ values are used to differentiate between protein from marine and terrestrial sources: 1) protein from marine sources will have $\delta^{13}C$ values c.-12‰ consistent with plants/animals from seawater; 2) protein from terrestrial sources will have $\delta^{13}C$ values c.-20‰ consistent with plants/animals from C_3 pathways (Schwarcz and Schoeninger 1991). Values between -12‰ and -20‰ reflect diets based on protein from a mixture of marine and terrestrial sources (Jay and Richards 2006). The $\delta^{13}C$ values for the burials from the Yorkshire Wolds range between -19.0‰ and -22.7‰, consistent with a terrestrial diet that has little or no marine protein. $\delta^{15}N$ values are used to characterise the source of protein: 1) $\delta^{15}N$ values are related to the trophic level of an organism; 2) there is a c.3-5‰ increase in $\delta^{15}N$ values between each trophic level (Schoeninger and DeNiro 1984). Diets based on animal protein are widely considered to have higher $\delta^{15}N$ values than those based on plant protein (Hedges and Reynard 2007). The $\delta^{15}N$

values for the burials from the Yorkshire Wolds range between 7.8‰ and 12.2‰, consistent with a diet that was high in animal protein.

Interpretation of $\delta^{13}C$ and $\delta^{15}N$ values for both individuals and populations must be tempered by an understanding of the factors that can influence the values of a particular isotope ratio. $\delta^{13}C$ values, for example, are influenced by environmental conditions - low-light levels in dense woodland will result in lower $\delta^{13}C$ values for plants and animals, while lighter open conditions will result in higher $\delta^{13}C$ values (van der Merwe and Medina 1991). Similarly, $\delta^{15}N$ values are influenced by land management practices – crop manuring will result in higher $\delta^{15}N$ values (Bogaard et al. 2013). The sources of animal/plant protein and their overall contribution to diet will also influence $\delta^{13}C$ and $\delta^{15}N$ values. Mixing models are routinely used to determine the types of diet that would result in the observed $\delta^{13}C$ and $\delta^{15}N$ values from archaeological contexts. Modelling of the dietary protein for the Linearbandkeramik site at Vaihingen an der Enz, Baden-Württemberg has shown that the mean $\delta^{15}N$ value for the human population could be the product of a range of diets, including a diet dominated by 60% animal protein or a diet comprised of 70% cereal protein and 30% animal protein (Fraser et al. 2013). The contributions of cereals, pulses and wild resources are routinely underestimated using standard models of dietary protein.

Temporal variation can be seen in the $\delta^{15}N$ values of the burials that can be linked to the changes in climate and fluctuations in cereal cultivation and population levels described above (Figure 98). Only two $\delta^{15}N$ values are available for terrestrial plants and animals from the Yorkshire Wolds – a wild boar (6.4‰) from Burial C at Duggleby Howe (Gibson and Bayliss 2009) and a fox (8.8‰) from Towthorpe 18 (Gibson and Bayliss 2010). Baseline $\delta^{15}N$ values for trophic levels have instead been estimated as follows: 1) $\delta^{15}N$ values for wild resources (-1.2±1.0‰) are estimated by subtracting 4‰ from the values for large herbivores (Bogaard et al. 2013); 2) $\delta^{15}N$ values for early cereals (5.4±0.3‰) are estimated using the mean and standard deviation of the values for emmer wheat from Lismore Fields, Derbyshire (Bogaard et al. 2013); 3) $\delta^{15}N$ values for herbivores (2.8±1.0‰) are estimated using the mean and standard deviation of the values for aurochs, elks and red deer from Star Carr (Schulting and Richards 2009; Knight et al. 2018), and; 4) $\delta^{15}N$ values for carnivores (11.1±2.0‰) are estimated using the mean and standard deviation of the values for domestic dogs from Star Carr (Schulting and Richards 2009; Knight et al. 2018).

Domestic dogs are often used as a proxy for human diets in chronological periods or geographic regions, including Mesolithic Britain, where there is limited direct evidence due to the paucity of burials (e.g. Noe-Nygaard 1988; Guiry 2012). The δ^{15}N values of the domestic dogs from Star Carr fall more than one trophic level above the δ^{15}N values for the aurochs, elks and red deer, and reflect a terrestrial diet with additional protein from the consumption of freshwater resources (Schulting and Richards 2002, 2009; Knight et al. 2018). Evidence for a range of freshwater resources, including fish (carp, minnow, salmon, trout and perch) and aquatic birds (common crane, divers and a goose), has been identified at the site (Knight et al. 2018). The common crane have δ^{15}N values of 8.0‰ and 8.7‰, one trophic level below the values for the domestic dogs, and δ^{15}C values of -20.3‰ and -20.1‰, consistent with terrestrial rather than marine protein (Schulting and Richards 2002, 2009). Freshwater resources would also have been available from the numerous meres or small lakes in Holderness, including the former mere at Skipsea Withow which was known to have been exploited from the Mesolithic onwards (Sheppard 1957; Cadman et al. 2018).

The burials from the Yorkshire Wolds can be divided into three chronological periods on the basis of radiocarbon dates, namely Early Neolithic (c.4000-3300 cal BC), Middle/Late Neolithic (c.3300-2200 cal BC) and Early Bronze Age (c.2200-1600 cal BC). First, the Early Neolithic burials (n=12) form two distinct groups – those with δ^{15}N values between 10.0‰ and 11.2‰ which fall within the range of the domestic dogs from Star Carr, and those with values less than 9.0‰ which fall between the range of the domestic dogs from Star Carr and the range for the emmer wheat from Lismore Fields. All of the burials with values less than 9.0‰ were from the mortuary enclosure at Wold Newton. Secondly, the Middle/Late Neolithic burials (n=9) are tightly clustered with δ^{15}N values between 10.3‰ and 11.1‰ which fall within the range of the domestic dogs from Star Carr. Thirdly, the Early Bronze Age burials (n=11) form two distinct groups – those with values between 8.7‰ and 10.5‰ which with the exception of one of the secondary burials from Towthorpe 18 fall at the lower end of the range for the domestic dogs from Star Carr, and those with values greater than 11.0‰ which fall within the range for the domestic dogs from Star Carr.

Whilst interpretation of the differences in the δ^{15}N values of the burials from the Yorkshire Wolds is problematic due to the small sample size and the overlap between the ranges of values, two key points can be made with regard to the temporal variation in the δ^{15}N values of the burials. First, the Early Neolithic burials from the mortuary enclosure at Wold Newton

and Early Bronze Age secondary burial from Towthorpe 18 with $\delta^{15}N$ values less than 9.0‰ are consistent with a diet which included protein from cereals and are thought to reflect early farming. The $\delta^{15}N$ values for these burials fall between the baselines for early cereals and carnivores and correspond to the peaks in the summed probability densities for early cereals from Northern Britain. Secondly, the $\delta^{15}N$ values for the Early Bronze Age burials are higher than the $\delta^{15}N$ values for the Early Neolithic and Middle/Late Neolithic burials and are consistent with a diet based predominantly on protein from animals, thought to reflect increased reliance on pigs and cattle. The $\delta^{15}N$ values for these burials compare directly to the baseline for carnivores and correspond to the tail off in the summed probability densities for wild resources from Northern Britain.

Assemblages of animal bone, including cattle, pigs and sheep/goats, were frequently noted in 19th century accounts of the excavation of Neolithic and Early Bronze Age burial mounds on the Yorkshire Wolds. At Aldro 116, for example, it was noted that:

> *"From the undisturbed portion of this barrow was taken an unusually large quantity of bones of the ox, consisting of three heads with horn cores, three pelvises, six scapulae, fourteen leg bones, three vertebrae, and ribs and other bones all fragmentary, as was as a portion of the head of a goat with horn core attached, fragments of two drinking-cups, pieces of three vases of different types, 105 flint chippings, 6 cores or slingstones, 2 leaf-shaped arrow points, 1 spearhead, 1 circular disc, and 1 greenstone flake knife (fig. 106) 3½ inches long, 1¾ inches broad, chipped to a cutting edge on one side. No trace of a sharp instrument has been observed on any of the animal bones; nearly all have been smashed with a blunt tool. Most of these bones were taken from the bed of flints, which had escaped removal; and many more must have been found when the barrow was first disturbed. The quantity of bones would seem to indicate that the early inhabitants of this neighbourhood reared cattle on a large scale, the flesh of which was eaten" (Mortimer 1905, 56).*

The character of this assemblage of animal bone, pottery and worked flint is suggestive of feasting – a practice widely documented at Late Neolithic and Early Bronze Age sites in southern Britain, most notably at Durrington Walls, Wiltshire (Craig et al. 2015).

A degree of caution should be exercised in interpreting the assemblages of animal bone from the fabrics of burial mounds; at Calais Wold 275, it was noted that the tenants of the farm had at various times buried their cattle in the burial mound (Mortimer 1905, 161). Nevertheless, strong parallels can be seen between the faunal assemblage from the fabric of the burial mound at Towthorpe 18 – the only assemblage of animal bone from a burial mound on the Yorkshire Wolds for which a detailed breakdown by species and age has been published – and the faunal assemblage from Durrington Walls. The faunal assemblages from both sites contain a high proportion of younger animals (Gibson and Bayliss 2009; Wright et al. 2014), with the younger pigs (<2 years old) from Durrington Walls linked to the provision of meat for winter-based feasting events. Organic residue analysis of sherds of Grooved Ware from Durrington Walls has identified a mixture of porcine adipose fat, and ruminant adipose and dairy fat (Craig et al. 2015). While the faunal assemblages from Durrington Walls are dominated by pigs, the organic residues from pottery suggest that beef and cow's milk also played an important role in Late Neolithic diets.

Organic residue analysis of sherds of Peterborough Ware from Sewerby Cottage Farm has identified ruminant adipose and dairy fat, suggesting that beef and cow's milk also played an important role in Middle Neolithic diets (Berstan and Evershed 2009). Although no animal bone was recovered from Sewerby Cottage Farm, both wild and domestic species of cattle are represented amongst the faunal assemblages from Neolithic pit contexts in Eastern Yorkshire – the latter from pit contexts associated with Grooved Ware (Carver 2012). The faunal assemblages from pit contexts in Eastern Yorkshire are dominated by pigs and cattle, with smaller quantities of animal bone from domestic dogs, horses, red deer, sheep/goats and wild boar (Bramwell 1974). Shellfish, including limpets, oysters and a periwinkle, and a pig bone with an engraving of a fish were found at North Carnaby Temple (Manby 1974). Evidence for the exploitation of marine resources, however, is confined to the pit contexts from North Carnaby Temple and Low Caythorpe – both less than c.10km from the coast (Harding 2006). Assemblages of animal bone from Neolithic sites across Britain and Europe are dominated by pigs and cattle (see Serjeantson and Field 2006).

Direct comparisons with Durrington Walls are contentious due to the nature of the site, with ritual activity, related to the henge enclosure and south circle excavated in advance of the new A345 between 1966 and 1968 (Wainwright 1971), and domestic activity, related to the house floors and midden deposits excavated as part of the Stonehenge Riverside Project

between 2004 and 2007 (Parker Pearson et al. 2006, 2007), seemingly taking place side by side. Juxtaposition of ritual and domestic activity is not uncommon in the Neolithic and Bronze Age; the cairns associated with the Bronze Age field systems at Gardom's Edge in the Peak District, for instance, blur the boundaries between clearance and ceremonial activity (Barnatt, Bevan, and Edmonds 2002). Similarly, the Beaker occupation layer at Calais Wold 275 and evidence for feasting at Aldro 116 also blur the boundaries between funerary and domestic activity. Comparisons between Durrington Walls and the evidence for Late Neolithic and Early Bronze Age settlement at Wharram-le-Street are perhaps justified given both the proximity of the site to the Late Neolithic enclosure at Duggleby Howe and the possible Bronze Age shrine identified from aerial photographs (see Section 1.1.2).

Strontium isotope analysis of cattle teeth from Durrington Walls has suggested that only a handful of the teeth were from cattle raised on the chalk downland surrounding the site (Viner et al. 2010). The majority of the teeth were from cattle raised in other parts of Britain and in some instances were brought to the site on the hoof from regions at least 100km away. Two of the cattle teeth had $^{87}Sr/^{86}Sr$ ratios consistent with the bedrock geology of central Wales; however, similar $^{87}Sr/^{86}Sr$ ratios can be found in the bedrock geology of Cumbria and Scotland (Evans et al. 2010) and have been reported for modern plants from the Malvern Hills (Chenery et al. 2010). The analysis of the cattle teeth from Durrington Walls suggests that long distance movement of animals was taking place during the Late Neolithic, most likely linked to gatherings associated with large-scale feasting (Albarella and Serjeantson 2002; Richards and Thomas 1984). Strontium isotope analysis of the cremated human bone from Stonehenge has also suggested links between communities in different geographic regions, with a fifth of the individuals having $^{87}Sr/^{86}Sr$ ratios consistent with the bedrock geology of Western and Northern Britain (Snoeck et al. 2018).

Whilst long distance movement was certainly taking place during the Late Neolithic for large-scale gatherings, it is unclear whether this movement is representative of residential mobility throughout the calendar year. The $^{87}Sr/^{86}Sr$ ratios from tooth enamel represent a long-term average of the food/drink consumed during childhood and communal feasting would only have contributed a modest amount of the food that was consumed by an individual; the bulk of the food consumed by an individual would have been from cereal cultivation and from herding pigs and cattle, supplemented at various times by hunting wild animals and collecting wild fruit, seeds and nuts. Understanding the scale of farming and herding is critical to

determining whether an individual was local or non-local to a particular region. Comparisons with Neolithic settlements in Central Europe suggest that early farming was characterised by small unenclosed plots of land, intensively managed through manuring and probably located within 1km of settlements (Bogaard and Jones 2007), while pannage for pigs and grazing for cattle could have been found within 5km of settlements, with some animals moving over longer distances (Bogaard et al. 2017).

6.1.2 Placing the dead in the domain of the living

Returning to the strontium isotope analysis of the Neolithic and Early Bronze Age burial mounds on the Yorkshire Wolds, the scale of mobility is dependent on the importance of early cereal cultivation and herding pigs and cattle which in turn is dependent on the dating of the burials. The dating of the burials in the original analysis is crude, either differentiating between Neolithic and Bronze Age burials (Montgomery and Jay 2013) or Middle Neolithic and Early Bronze Age burials (Montgomery, Evans, and Cooper 2007). A more refined chronology can be proposed on the basis of the original accounts of the excavations of the burial mounds (Mortimer 1905) and recent radiocarbon dates for the burials and associated structures (Gibson and Bayliss 2009, 2010). The burials can be divided into four groups, namely: Early Neolithic (c.4000-3300 cal BC) burials associated with early cereal cultivation; Middle Neolithic (c.3300-2900 cal BC) burials associated with a decline in cereal cultivation offset by the collection of wild foods; Late Neolithic (c.2900-2200 cal BC) burials associated with increased reliance on pigs and cattle, and; Early Bronze Age (c.2200-1600 cal BC) burials associated with a revival in cereal cultivation (Table 42).

There are inconsistencies in the data in the tables (Montgomery, Evans, and Cooper 2007 Table 1; Evans, Chenery, and Montgomery 2012 Appendix 1) and figures (Montgomery, Evans, and Cooper 2007 Figure 2; Montgomery and Jay 2013 Figure 10.2) published along with the original analysis, with discrepancies in the teeth sampled and the burial mounds to which specific values relate. More importantly, in the context of this discussion, the dates of a number of the burials are incorrect, including burials from Duggleby Howe, Calais Wold 275 and Towthorpe 3. Bayesian modelling of the radiocarbon dates from Duggleby Howe has shown that the sequence of burials was episodic and was spread out over a period of at least 1,000 years (Gibson and Bayliss 2009). The earliest burials in the sequence, the burials from the large shaft grave (Grave B) at the centre of the barrow, date to the Early Neolithic (Burials H, I and K), while the latest burials in the sequence, the burials from the inner mound, date to

the Late Neolithic (Burials E and F and possibly Burial L) and Early Bronze Age (Burial M). Only the burial from Grave A (Burial C) and the simple burials (Burials D and G) from the old land surface date to the Middle Neolithic (*sensu stricto*[32]).

Similarly, the sequence of burials from Calais Wold 275 represents a considerable time depth, with the earliest burials in the sequence, the burials from the limestone pavement (Burials 7, 8 and 9) associated with the mortuary enclosure, dating to the Early Neolithic, and the latest burial in the sequence, the burial (Burial 3) from the old land surface beneath the interim mound, dating to the Late Neolithic or Early Bronze Age (Coombs 1976b; Kinnes 1979). Parallels have been drawn between the mortuary enclosure at Calais Wold 275 and the mortuary enclosure associated with the earliest phase of the monument at Raisthorpe Manor (Towthorpe 3). The burial from Towthorpe 3, part of a small quantity of disarticulated human bone found within the mortuary enclosure, dates to the Early Neolithic (Mortimer 1905; Kinnes 1992). Radiocarbon dates for three of the burials from Aldro 116 (Burials 2, 3 and 6) obtained as part of the Beaker People Project all fall within the Late Neolithic or Early Bronze Age (Pellegrini et al. 2016; Parker Pearson et al. 2016). No radiocarbon dates exist for the burial mounds at Calais Wold 23, Calais Wold 100, Towthorpe 72 and Towthorpe 73 and the dates for the remainder of the burials are assumed to be correct.

While the differences observed in the structure of the Neolithic and Bronze Age burials break down when the refined chronology is applied to the dataset, the mixing lines identified in the $^{87}Sr/^{86}Sr$ ratios and strontium concentrations persist (Figure 99). Line A, with end members of 0.7075 (chalk) and >0.7120 (unknown), corresponds to a combination of Early Neolithic, Late Neolithic and Early Bronze Age burials. Line B, with end members of 0.7075 (chalk) and <0.7092 (water), corresponds to a combination of Late Neolithic and Early Bronze Age burials. Furthermore, the values which fall between or outside the confidence intervals for Lines A and B also correspond to a combination of Early Neolithic, Middle Neolithic, Late Neolithic and Early Bronze Age burials. The only chronological period without burials that fall inside the confidence intervals for the mixing lines is the Middle Neolithic but the number of samples is not sufficient to draw any meaningful conclusions. There does not appear to be a relationship between the mixing lines and particular chronological periods and therefore different forms

[32] http://heritage-standards.org.uk/wp-content/uploads/2015/08/Periods-List-HE-FISH-WP.pdf (visited 12/09/2018).

of mobility associated with farming and herding. The mixing lines may simply reflect differences between locals and non-locals.

Assertions that none of the burials from Duggleby Howe were chalk dwellers and that Burial K could have come from as far away as Western Scotland or Cornwall (Hutton 2014; Gibson 2016; Loveday 2016) have been accepted at face value for several reasons: 1) they fit with current models of settlement practice which regard the uplands of the Yorkshire Wolds as a place where people buried their dead and the lower-lying areas to the south and east as the epicentre of Neolithic settlement, despite evidence for Neolithic settlement in the Vale of Pickering (Haughton and Powlesland 1999) to the north and the Vale of York (Halkon et al. 2010) to the west; 2) they explain the prestige goods found with several of the burials, which include the polished adze and polished rectangular knife from Burial G thought to have been manufactured in the specialist workshops at North Dale and South Landing (Pierpoint 1980); 3) they fit with narratives about mobility and migration which prioritise the exotic over the mundane, with the possible origins of the Amesbury Archer in the Austrian Alps and the Boscombe Bowmen in Wales (Evans, Chenery, and Fitzpatrick 2006) more captivating than an 'everyday tale of country folk' in Wiltshire.

- The $^{87}Sr/^{86}Sr$ ratios of the burials from Duggleby Howe range between 0.7086 for Burial K and 0.7102 for Burial G (Montgomery, Evans, and Cooper 2007 Table 1). Modern plants and dentine are commonly used to establish a local signal for bioavailable strontium (BASr), i.e. strontium which is incorporated into the food chain from surface geology, superficial deposits, sea spray, rainfall and atmospheric dust (Evans et al. 2010; Snoeck et al. 2016). The $^{87}Sr/^{86}Sr$ ratios of the burials from Duggleby Howe are higher than those recorded for modern plants (0.7078, n=1) and dentine (0.7082±0.0003, n=9) from the Cretaceous chalk of the Yorkshire Wolds (Table 43). $^{87}Sr/^{86}Sr$ ratios similar to those for the burials from Duggleby Howe, however, have been recorded for modern plants from the Jurassic clay of the Howardian Hills (0.7090±0.0003, n=2) and the Triassic rocks of the Humberhead Levels (0.7098±0.0004, n=2), and dentine from the undifferentiated Triassic rocks of the Vale of Pickering (0.7106, n=1) and the Vale of York (0.7093±0.0000, n=2). The individuals buried at Duggleby Howe might not have spent their childhood on the chalk of the Yorkshire Wolds, but this does not necessarily mean that they were not locals.

Possible geographic origins of the burials from Duggleby Howe and the other burial mounds on the Yorkshire Wolds can be determined by calculating probability density surfaces for the burials and assigning each burial to the geographic region with the highest probability density (Wunder 2010). A map of bioavailable strontium based on polygons from the British Geological Survey 1:625,000 bedrock geology digital mapping (DiGMapGB-625[33]) and strontium isotope ratios from mainland Britain (Evans et al. 2010; Chenery et al. 2010; Snoeck et al. 2018; Schulting et al. 2019) was used as a baseline for the purposes of geographic assignment (Snoeck et al. 2018 Figure 2). Means and standard deviations were calculated for samples from each polygon, with single part polygons representing discrete outcrops of rock. Only values from modern plants were used where possible, with gaps filled using values from other samples from the same outcrop, rock type or isotope package (after Evans et al. 2010). With the exception of a limited number of outcrops from the Vale of Pickering, the Howardian Hills, the North York Moors and the Vale of Mowbray, the majority of the values for Eastern Yorkshire were based on modern plants.

No baseline is without limitations and the drawback of the baselines currently available for mainland Britain is that they are based on bedrock geology and do not directly take into account other factors which might influence spatial variation in bioavailable strontium (Ryan et al. 2018). Critically, in the context of determining the geographic origins of the burials from Eastern Yorkshire, they do not directly take into account superficial deposits. Quaternary deposits are not represented in the baseline used for the purposes of the geographic assignment of the burials and the glacial till and river gravels of Holderness are not differentiated from the Cretaceous chalk of the Yorkshire Wolds. The value for modern plants (0.7085) from Holderness is higher than the value for modern plants from the Yorkshire Wolds (0.7078) and is comparable with the value for modern plants from the Southern Magnesian Limestone (0.7086). Comparable values can also be found in samples from the Gault Formation and Upper Greensand Formation of the North Downs, Lower Greensand Group of the Lincolnshire Coast and Marshes, the Lincolnshire Wolds and The Fens. Care must taken in the interpretation of burials assigned to these geographic regions.

[33] https://www.bgs.ac.uk/products/digitalmaps/digmapgb_625.html (visited 12/09/2018)

Building on an approach developed for the analysis of cremated bone from Neolithic and Bronze Age burial mounds in Northern Ireland (Snoeck et al. 2016), the map of bioavailable strontium was converted to a raster dataset with a cell size of 100m (intended to preserve all outcrops) and focal means were calculated to represent the BASr catchment of every cell in the resultant raster dataset (c.f. Snoeck et al. 2018). Focal means were calculated for search radii between 1km and 20km in order to model differences in the BASr catchments for early cereal cultivation (1km), herding pigs and cattle (1km and 5-10km), and the collection of wild foods and hunting (10-20km). There is a degree of overlap between the search radii and BASr catchments for different modes of food production which reflects the uncertainty of the archaeological record. The geographic assignments of the Neolithic and Bronze Age burials are therefore scale dependent. If a burial is assigned to the same region at all scales of analysis there is greater confidence in the geographic assignment of the individual, whereas if a burial is assigned to different regions at different scales of analysis there is less confidence in the geographic assignment of the individual.

Probability density surfaces were calculated from the focal means using Bayes' Rule, with the prior probability distribution defined using the probability density function for a continuous distribution as a non-informative prior and the sampling probability distribution defined using the probability density function for a normal distribution with location μ and scale σ (Wunder et al. 2005; Bowen et al. 2014). The parameters for the normal distribution were estimated using the $^{87}Sr/^{86}Sr$ ratio for the burial and the standard deviation of the $^{87}Sr/^{86}Sr$ ratios of samples from the Cretaceous chalk respectively (c.f. Laffoon et al. 2017), and the resultant posterior probability densities were rescaled by the largest observed density with values ranging between 0 and 1 (c.f. Wunder 2010). Euclidean distance surfaces were also calculated for each of the burial mounds. Zonal statistics were then calculated from the probability densities and euclidean distances using geographic regions based on National Character Areas[34], National Landscape Character Areas[35] and Landscapes of Scotland[36]. Geographic assignments for the burials were based on the zonal statistics, with the regions ranked by highest probability density and lowest euclidean distance.

[34] https://naturalengland-defra.opendata.arcgis.com/datasets/national-character-areas-england (visited 12/09/2018)
[35] https://landmap-maps.naturalresources.wales (visited 12/9/2018)
[36] https://gateway.snh.gov.uk/natural-spaces/ (visited 12/9/2018).

Approximately a third of the Neolithic and Bronze Age burials were assigned to the Yorkshire Wolds (Table 44), including two of the Early Neolithic burials from the linear zone at Calais Wold 275 (Burials 7 and 8), the Middle Neolithic burial from the Grave A at Duggleby Howe (Burial C) and three of the Late Neolithic burials from Grave C at Aldro 116 (Burials 3, 4 and 5). Unexpectedly, the basal inhumation from the shaft grave at Duggleby Howe (Burial K), which had previously been identified as possibly coming from Western Scotland or Cornwall (Montgomery, Cooper, and Evans 2007), was also assigned to the Yorkshire Wolds. The geographic assignments of these burials are independent of the scale of analysis, i.e. the burials were assigned to the Yorkshire Wolds at all scales of analysis, and as such are thought to be correct. Furthermore, the burials from Grave C at Aldro 116 fall within the confidence envelope for the mixing line (Line B) thought to reflect burials that were local to the chalk of the Yorkshire Wolds (Montgomery, Evans, and Cooper 2007). All of the burials from this grave date to the first period of the Beaker tradition and are contemporary with the earliest evidence for the use of copper and gold in Britain (Needham 2005).

The remainder of the burials were assigned to different regions at different scales of analysis and there is a greater degree of uncertainty in the geographic assignments of these burials. Where a burial was assigned to more than one region, preference was given to the geographic assignments for the scales of analysis most appropriate for the date of the burial – 1km and 5km for the Early Neolithic burials, 5km and 10km for the Middle Neolithic and Late Neolithic burials, and 1km and 5km for the Early Bronze Age burials – and greater weighting was given to regions to which a burial was assigned at more than one scale of analysis (highlighted in bold below). The burials that were assigned to more than one geographic region can be divided into two groups, namely those which were assigned to the Yorkshire Wolds and/or regions adjacent to the Yorkshire Wolds (the Vale of York, the Vale of Pickering, the Howardian Hills, and the Humberhead Levels) and could be regarded as locals, and those which were assigned to regions further afield (the Southern Magnesian Limestone, the Vale of Mowbray, the Yorkshire Dales, the Shropshire, Cheshire and Staffordshire Plain, and the Cumbria High Fells) and could be regarded as non-locals.

Only two of the burials from Neolithic burial mounds were non-locals, namely the Early Neolithic burial from the non-megalithic chamber at Towthorpe 3 (Burial D) assigned to the North York Moors and Cleveland Hills or **Southern Magnesian Limestone**, and one of the Middle Neolithic burials from the old land surface beneath Duggleby Howe (Burial G) assigned

to the Southern Magnesian Limestone or the **Vale of Mowbray**. In contrast, five of the burials from Early Bronze Age burial mounds at face value appear to have been non-locals. Three of these burials have values similar to the modern plant value from Holderness, however, and are more likely to have been locals. Only two of the Early Bronze Age burials can reliably be identified as non-locals, namely the burial from Grave A at Aldro 116 (Burial 1) assigned to the Yorkshire Dales or Southern Magnesian Limestone and the burial from Calais Wold 23 – the only burial for which multiple teeth were sampled and would appear to have spent the first part of its childhood on the Cumbria High Fells[37] (age 1-6 years) before moving to Holderness[38] (age 7-16 years). The majority of the burials from Neolithic and Early Bronze Age burial mounds from Eastern Yorkshire were locals.

The geographic assignments based on probability densities paint a different picture to the previous analysis of the burials from Neolithic and Early Bronze Age burials mounds on the Yorkshire Wolds (Montgomery, Evans, and Cooper 2007; Montgomery, Cooper, and Evans 2007; Evans, Chenery, and Montgomery 2012; Montgomery and Jay 2013). Links with Western Scotland and Cornwall cannot be evidenced on the basis of the strontium isotope ratios of the burials and are instead based on the comparison of the oxygen isotope ratios of the burials to modern water values (Darling, Bath, and Talbot 2003). Although oxygen isotope ratios are available for seventeen of the burials, the process of converting from tooth enamel values to water values is known to be problematic (Pollard, Pellegrini, and Lee-Thorp 2011). Furthermore, oxygen isotope ratios from tooth enamel can be affected by a wide range of factors, including short-term climate conditions, sourcing waters from reservoirs, preparation of food and drink, and analytical errors (Pellegrini et al. 2016). Analysis of the oxygen isotope ratios carried out as part of the Beaker People Project has shown that burials from several of the burial mounds from Eastern Yorkshire, including Garton Slack 37, exhibit more than half of the national variation (Pellegrini et al. 2016).

Geographic assignments of the burials based on probability densities calculated using both strontium and oxygen isotope ratios include Skye (Calais Wold 275, Burial 9), the Byrniau

[37] The first premolar from this burial was assigned to the Shropshire, Cheshire and Staffordshire Plan at 1km and the Cumbria High Fells at 5km; however, the geographic assignment to the Cumbria High Fells is more plausible given the high frequency of Langdale axes found in Eastern Yorkshire.
[38] The third molar from this burial was assigned to the Lincolnshire Wolds and Lincolnshire Coast and Marshes, regions with values similar to the modern plant value from Holderness which is more plausible given the large expanse of water which separates the Yorkshire Wolds and Lincolnshire Wolds.

Preseli/Preseli Hills (Towthorpe 3 Burial D), the Isle of Wight (Duggleby Howe, Burial H), The Lizard (Duggleby Howe, Burial K and Aldro 116, Burials 3 and 4), the High Weald (Duggleby Howe, Burial C), Devon Redlands (Duggleby Howe, Burial G), Shetland and Fair Isle (Aldro 116, Burial 5 and Duggleby Howe, Burial L), the Vale of Taunton and Quantock Fringes (Aldro 116, Burial 6 and Duggleby Howe, Burial M), Cornish Killas (Calais Wold 23, first premolar), Mull (Calais Wold 23, third molar), and Breadalbane (Calais Wold 100). None of the burials was assigned to the Yorkshire Wolds or the surrounding regions which seems unlikely and raises significant questions about the utility of oxygen as a tracer isotope and the modern water values (Darling, Bath and Talbot 2003, Figure 6) that are used as a baseline for the study of mobility and migration in mainland Britain. Whilst oxygen isotope ratios are commonly used to narrow the range of possible locations based on strontium isotope ratios in multi-tracer approaches (e.g. Laffoon et al. 2017), the analysis of the burials from the Yorkshire Wolds is disproportionately skewed by the oxygen isotope ratios – to the point where the geographic assignments are effectively based on a single tracer isotope.

6.2 Persistent places in the landscape

Analysis of the strontium isotope ratios of tooth enamel from Neolithic and Bronze Age burials in Eastern Yorkshire (Figure 100), places the Yorkshire Wolds at the centre of a wider network of communities that operated at different spatial scales: 1) at a local scale, it connected communities on the chalk uplands of the Yorkshire Wolds to the communities in the surrounding lowlands of Holderness to the east, the Vale of Pickering to the north, the Vale of York to the west and the Humberhead levels to the south; 2) at a regional scale, it connected communities on the chalk uplands of the Yorkshire Wolds with communities in the Yorkshire Dales and Cumbria High Fells via communities on the Howardian Hills, the Vale of Mowbray and the Southern Magnesian Limestone. This network is consistent with evidence for Neolithic settlement from the region, with Neolithic houses, hearths and occupation layers found on the Yorkshire Wolds and Holderness coast, Neolithic or Bronze Age lake-dwellings found in Holderness, and Neolithic pits, stray finds and lithic scatters found widely across the Yorkshire Wolds, Holderness, Vale of Pickering, Vale of York, Howardian Hills, Vale of Mowbray, and North York Moors and Cleveland Hills (Manby, King, and Vyner 2003).

Wharram-le-Street occupies a pivotal position within this network of communities, situated next to the source of the Gypsey Race at the head of the Great Wold Valley and located approximately 1.5km to the south-west of the round barrow and circular enclosure at

Duggleby Howe. The source of the Gypsey Race was a persistent place in the landscape that, like Star Carr in the Vale of Pickering (Clark 1954; Mellars and Dark 1998; Milner, Conneller, and Taylor 2018a, 2018b) and Skipsea Withow in Holderness (Armstrong 1924; Gilbertson 1984; Cadman et al. 2018), was a focus for episodic or seasonal occupation (c.f. Barton et al. 1995). Duggleby Howe was also a persistent place in the landscape but, like the barrow cemeteries on the Yorkshire Wolds (Greenwell 1877, 1890; Mortimer 1905) and the monument complex at Rudston in the Great Wold Valley (Pegge 1779; Greenwell 1877; Dymond 1966; McInnes 1964; Harding 1999), was a focus for burial and communal gatherings (c.f. Parker Pearson et al. 2009). Parallels can be drawn between the evidence for occupation at Wharram-le-Street and the areas of occupation identified around the monument complex at Thornborough in the Vale of Mowbray (Harding 2013).

6.2.1 Regional settlement and the movement of stone

A series of Early Mesolithic sites have been identified in the area of Lake Flixton (Conneller 2000b), a Late Glacial or Early Holocene lake at the eastern end of the Vale of Pickering (Palmer et al. 2015). These sites include Star Carr (Clark 1954; Milner, Conneller, and Taylor 2018a, 2018b) and Seamer Carr (Schadla-Hall 1987, 1988, 1989) on the lakeshore and Flixton Island (Moore 1950; Clark 1954) and No Name Hill (Conneller and Schadla-Hall 2003) on islands in the middle of the lake. Star Carr has played a pivotal role in accounts of Early Mesolithic mobility and is widely assumed to have a home range that extended from the Pennines to the Yorkshire Coast (after Clark 1972). It has been characterised variously as a winter residential site with logistic sites on the North York Moors and Pennines in the summer (Jacobi 1979), a summer logistic site with residential sites in the Vale of Pickering in the winter and the Yorkshire Coast in the summer (Legge and Rowley-Conwy 1988) and an autumn/spring residential site with logistic and/or extraction sites on the Yorkshire Wolds, North York Moors and Pennines in the autumn/winter, and residential, logistical and extraction sites on the Yorkshire Coast in the spring/summer (Donahue and Lovis 2006).

Excavations at Star Carr have identified evidence for episodic occupation over an 800-year period, starting within a generation of 9300BC (Milner et al. 2018). The earliest evidence for occupation dates to the 93rd-91st centuries BC and includes evidence for working wood, bone and antler from the brushwood close to the shore and the detrital wood scatter in the central part of the site and a possible structure with a central hollow surrounded by postholes on the dryland. Two further structures defined by central hollows surrounded by postholes on the

dryland, one associated with the remnants of a hearth and another associated with a large midden, may also relate to this activity[39]. The central platform, a substantial timber platform extending c.17m into the reed swamp on the lakeshore, was constructed in the middle of the 90th century BC. Several clusters of artefacts were found on the platform, including a cluster of abandoned cores and tools associated with animal processing thought to have been deposited in a bag or basket. A wide range of tools related to antler working (mostly burins) and a refitting sequence interpreted as an axe factory were also found in the area of the platform (Conneller, Little, and Birchenall 2018).

The further platforms (the eastern platform and the western platform) were constructed on the lakeshore during the 89th and early 88th centuries BC – the eastern platform was covered by a fallen tree only a few decades after its initial construction, and the western platform was covered by a birch bark mat laid on the surface of a shallow accumulation of peat (Milner et al. 2018). A large assemblage of bone, antler, wood and flint, including the antler frontlets and barbed points which are iconic of Star Carr (Conneller 2004), was deposited in the reed swap on the lakeshore at around the time the platforms were constructed. Whilst this assemblage has previously been interpreted as an occupation layer (Clark 1954; Mellars 2009), it would appear to represent material deposited in the shallow water and waterlogged sediments on the lakeshore (Milner et al. 2018). Two scatters of worked flint, one related to antler working and another related to the manufacture of shale beads, are also thought to be broadly contemporary with the platforms. The latest evidence for occupation at Star Carr dates to the 87th-86th centuries BC and includes small hearths and scatters of flint thought to have been associated with a specialised craft area.

Evidence for site maintenance in the form of the middening of material, the clearance of structures and the scavenging of usable flint was identified at Star Carr – a phenomenon rarely seen at other Early Mesolithic sites around Lake Flixton (Conneller and Overton 2018). The coherence of the material from the small midden at Seamer K, for example, suggests that it was short-lived. Similarly, the possible structure at Seamer C lacked the central hollow and postholes which defined the structures at Star Carr and does not appear to have undergone

[39] The posterior probability distributions for the radiocarbon dates relating to these structures are bimodal – the first mode corresponds to the earliest evidence for occupation at Star Carr, while the second mode corresponds to the construction of the timber platforms.

clearance. Key differences can also be seen in the patterns of animal deposition and stone working from Star Carr and other sites around Lake Flixton. With the exception of three barbed points from No Name Hill and Flixton Island, the antler frontlets and barbed points which are typical of Star Carr have not been found at other Early Mesolithic sites around Lake Flixton. Conversely, despite the evidence for craft activities (including both antler working and bead manufacture) and the production and repair of tranchet axes, evidence for the specialised production of microliths and scrapers typical of many of the Early Mesolithic sites around Lake Flixton has not been identified at Star Carr.

Whilst the antler frontlets and barbed points from Star Carr have fed into models of Early Mesolithic mobility based on seasonal transhumance, the seasonal migration of red deer to the uplands which is integral to these models is unlikely to have taken place during the Early Mesolithic (Caulfield 1978; Legge and Rowley-Conwy 1988). Links between Star Carr and the uplands of the North York Moors and the Pennines are instead based on similarities in material culture and the raw materials used in Early Mesolithic industries (Conneller and Overton 2018). Star Carr type microliths with their distinctive short obliquely blunted points, trapezes and triangles (Reynier 2005) have been found at Pointed Stone on the North York Moors (Jacobi 1979) and Warcock Hill and Rushy Brow on the Pennines (Stonehouse 1992; Howard-Davis et al. 1996). The raw materials represented amongst the lithic assemblages from these sites are dominated by till flint from the Yorkshire Coast, with limited quantities of flint from the Yorkshire Wolds and chert from the Pennines (Conneller and Overton 2018). Caches of till flint from the Yorkshire Coast have been found at Star Carr and several other sites around Lake Flixton (Conneller, Little, and Birchenall 2018).

Long distance movement of raw materials from the Yorkshire Coast, whether directly through the migration of people or indirectly through exchange networks, was certainly taking place in Northern England from the Early Mesolithic onwards. The Mesolithic coastline at the time that Star Carr was occupied was much further to the east than the current coastline, receding with the rapid incursion of the North Sea into Doggerland (Jelgersma 1979; Gaffney, Thomson, and Fitch 2007). With the exception of the model proposed by Donahue and Lovis (2006), the uplands of the Yorkshire Wolds and the lowlands of Holderness are not included in models of Early Mesolithic mobility in Northern England. Although there is currently no evidence for Early Mesolithic occupation on the Yorkshire Wolds, evidence for later Mesolithic occupation has been identified at several sites on the Wolds including Wharram-le-Street (Rahtz and

Bateman 1986; Hayfield, Pouncett, and Wagner 1995). Moreover, tabular flint from the Yorkshire Wolds was routinely used for making axes at Star Carr (Taylor et al. 2018) and Wolds flint was used preferentially at the Early Mesolithic site at Deepcar on the Yorkshire Southern Pennine Fringe (Radley and Mellars 1964).

Evidence for Early Mesolithic activity has also been identified around several of the Late Glacial and Early Holocene meres in Holderness (Ellis and Van de Noort 1995). Barbed points similar to those from Star Carr have been found at Brandesburton (Clark and Godwin 1957; Radley 1969; Davis-King 1980), Gransmoor (Sheldrick, Lowe, and Reynier 1997), Hornsea (Armstrong 1922, 1924) and Skipsea Withow (Armstrong 1922, 1924; Godwin and Godwin 1933). The barbed point from Skipsea Withow was associated with a small quantity of worked flint, including an axe, and an assemblage of animal bone, including red deer, reindeer and northern pike (Armstrong 1922). Two red deer, one of which has been dated to 9140-8740 cal BC (SUERC-65809, 9531±43 BP) and falls within the date range for Star Carr, have recently been found on the lakeshore at Skipsea Withow (Cadman et al. 2018). A timber structure thought to have been an Early Mesolithic platform was found at Round Hill on the edge of Skipsea Bail mere during the course of the cleaning of the Skipsea Drain (Smith 1911). This platform, dated to 8570-7960 cal BC (GU-5451, 9080±100 BP), is later than the platforms at Star Carr (Ellis and Van de Noort 1995 Appendix 3).

Round Hill is one of a series of 'lake dwellings', including the sites at West Furze (Skipsea) and Barmston Drain (Ulrome) found by Thomas Boynton during the course of the cleaning of the Skipsea Drain (Davis 1888; Smith 1911). These 'lake dwellings' were re-assessed as part of the Humber Wetlands Project and, with the exception of Round Hill, their interpretation has been challenged (Van de Noort 1995; Fletcher and Van de Noort 2007). At West Furze, the timber structures found by Thomas Boynton have been re-interpreted as a Late Neolithic trackway and a Bronze Age dam or beaver lodge on the lakeshore of Skipsea Bail mere. At Barmston Drain, the timber structures found by Thomas Boynton have been re-interpreted as a Middle or Late Bronze Age settlement built on the site of a former mere. Both sites are Neolithic or Bronze Age in date and are later than Round Hill and Skipsea Withow. Neolithic and Bronze Age worked flint including a perforated 'hour-glass' macehead, however, have been found at Round Hill (Smith 1911). An Early Neolithic trackway, dated to 3700-3370 cal BC (HAR-3378, 4,700±70 BP), was also found in the deposits of peat that accumulated around the lakeshore at Skipsea Withow (Gilbertson 1984).

The Neolithic trackways at Skipsea Withow and West Furze are of interest in the context of the procurement of till flint from the Holderness coast, providing a way to cross the shallow waters and reed swamps of the meres that once existed along the River Hull and its tributaries. Long distance movement of raw materials is likely to have taken place along river valleys, with till flint taken inland from the coastline following either the course of the Gypsey Race in the Great Wold Valley or the River Hertford in the Vale of Pickering. East to west movement took place from the Early Mesolithic onwards, with till flint from the Yorkshire Coast and Wolds flint represented in lithic assemblages throughout Northern England (Conneller and Overton 2018). West to east movement meanwhile took place during the Neolithic and Bronze Age, with Group VI axes from Langdale in the Cumbria High Fells found widely along the Great Wold Valley (Clough and Cummins 1988) and Group VI flakes found in pit contexts and burial mounds on the adjacent uplands (Carver 2012). Strontium isotope ratios from tooth enamel also suggest that the burial from Calais Wold 23 moved from the Cumbria Hill Fells to Holderness during their childhood (this chapter).

6.2.2 Monument complexes and the gathering of communities

Recent research at Duggleby Howe has identified evidence for Late Mesolithic or Early Neolithic occupation (Bradley 2011) and clarified the dating of the sequence of burials from the round barrow (Gibson and Bayliss 2009) and the circular enclosure that surrounds the barrow (Gibson et al. 2011). Three microliths, including an obliquely blunted point from the Neolithic fill of the enclosure ditch, and three blade cores, including an opposed platform core from the Bronze Age secondary silts of the enclosure ditch, were found during the course of the excavation of the circular enclosure. Thirty-five blades or blade-like flakes, two multi-platform cores and two scrapers made from cortical flakes were also identified amongst the assemblage of worked flint recovered during the course of the excavation. The stone tools and lithic debitage from Duggleby Howe represent two phases of activity, which echo the principal phases of activity at Wharram-le-Street: 1) residual Late Mesolithic or Early Neolithic occupation pre-dating the round barrow and circular enclosure, perhaps related to a short-term logistic camp nearby, and; 2) Late Neolithic stone working activities associated with the construction and use of the round barrow and circular enclosure.

Radiocarbon dates have been obtained for ten of the burials from Duggleby Howe and two of the prestige goods found with the burials (Gibson and Bayliss 2009). The earliest burials are from the shaft grave (Grave B) at the centre of the mound: an adult male (Burial K) buried in

a wooden coffin at the base of the shaft grave dated to 3630-3370 cal BC (OxA-16751, 4701±32 BP; SUERC-13938, 4675±35 BP[40]); an adult male (Burial I) and a skull (Burial J) buried about four feet above the base of the shaft grave both dated to 3630-3360 cal BC (OxA-16750, 4670±34 and GrA-33107, 4660±35 BP) and; a child (Burial H) buried about six feet above the base of the shaft grave dated to 3630-3360 cal BC (OxA-16749, 4679±34 BP). A fourth burial was later inserted into the upper levels of the shaft grave: an adult male (Burial G), found with an antler macehead and a polished flint adze, dated to 3335-3025 cal BC (GrA-33104, 4470±35 BP; OxA-17243, 4485±31 BP; SUERC-13938, 4460±35 BP). The antler macehead found with Burial G was dated to 3500-3130 cal BC (OxA-16749, 4597±35 BP) and was approximately a century older than the burial, suggesting that the macehead was a curated item placed with the burial (Gibson and Bayliss 2009).

Several centuries elapsed before the next burials: an adult male (Burial C), found with twelve boar tusk blades, buried in a shallow grave (Grave A) dated to 2930-2870 cal BC (GrA-33102, 4280±35 BP[41]), and; an adult male (Burial D), found with a polished rectangular flint knife, buried on the old land surface dated to 3090-2890 cal BC (OxA-16747, 4344±33 BP). One of the boar tusk blades found with Burial C was dated to 3100-2900 cal BC (OxA-16709, 4374±30 BP) and, like the antler macehead found with Burial G, was approximately a century earlier than the burial, suggesting that the boar tusk blades may also have been curated items place with the burial. The latest dated burials were from the earthen core of the inner mound: two child burials (Burial E and F) dated to 2880-2570 cal BC (GrA-33103, 4140±35 BP) and 2900-2690 cal BC (OxA-16748, 4211±31 BP), and; an adult burial (Burial M) dated to 2290-2030 cal BC (GrA-33108, 3750±35 BP). Two child burials (Burials A and B), an adult burial (Burial L) in a wooden coffin and fifty-three cremations (Cremations 1 to 53) from the earthen core and/or chalk body of the inner mound were not dated. The burials from the outer mound are all Early Mediaeval in date (Meaney 1964).

The sequence of burials was episodic, spanning a period of more than 1,000 years from the middle of the fourth millennium BC to the late third millennium BC:

[40] A third date for Burial K (GrA-33105, 4440±35 BP) was thought to have been contaminated by material used to consolidate the bone and has therefore been excluded.
[41] A second date for Burial C (OxA-17242, 3747±30 BP) was thought to have been contaminated by material used to consolidate the bone and has therefore been excluded.

1. Two adults (Burials K and I) and a child (Burial H) were buried in the shaft grave in the 35th century BC or early 34th century BC;

2. A simple burial (Burial G) was inserted into the upper levels of the shaft grave in the generations around 3400 BC;

3. An adult (Burial C) was buried in a shallow grave adjacent to the shaft grave in the generations around 3000 BC;

4. A simple burial (Burial D) was placed on the old land surface beneath the inner mound in the generations around 2900 BC;

5. Two children (Burials E and F) were buried in the inner mound in the 28th century BC or early 27th century BC;

6. Two further children (Burials A and B) and an adult (Burial L) may also have been buried in the inner mound at around this time;

7. Fifty-three cremations (Cremations 1 to 53) were buried in the inner mound during the middle of the third millennium BC;

8. An adult (Burial M) was buried in the inner mound sometime between the early 22nd century BC and the late 20th century BC.

Much like the nature of occupation at Star Carr and Sewerby Cottage Farm, the funerary activity at Duggleby Howe was of varying intensity and sometimes persistent.

Topographic and geophysical survey has shown that the circular enclosure identified at Duggleby Howe from aerial photographs survives as a broad shallow earthwork and is defined by a series of causewayed ditches (Gibson and Bayliss 2009). A trench excavated across the western edge of the circular enclosure identified a Neolithic enclosure ditch with a submerged causeway, a Roman boundary ditch, a Mediaeval chalk pit, an undated pit and an area of disturbance possibly thought to correspond to a second chalk pit (Gibson et al. 2011). The enclosure ditch was between 5.25m and 7.75m wide and between c.1.5m and c.2.9m deep. No evidence of a bank was identified during the course of the topographic and geophysical survey and the only evidence for unidirectional silting was associated with the Roman boundary ditch. The primary silts of the enclosure ditch were comprised of chalk rubble,

superseded by decalcified silts and fine sands, and would appear to have formed rapidly within no more than a generation of the excavation of the ditch. A small patch of *in situ* burning (with charred plant material) and fragments from six antlers picks were found on top of the primary silts along with a small quantity of knapping debris.

Radiocarbon dates were obtained for two fragments of hazelnut shell from the patch of burning and two of the antler picks from the top of the primary silts. The fragments of hazelnut shell were both dated to 2470-2200 cal BC (SUERC-30982, 3880±35 BP; OxA-23149, 3849±28 BP) and the antler picks were dated to 2550-2410 cal BC (OxA-23273, 3978±26 BP; SUERC-31659, 3895±35 BP) and 2470-2290 cal BC (OxA-23274, 3885±26 BP; SUERC-31663 3895±30 BP) respectively. These dates indicate that the primary silts formed in the 25th century BC to the 23rd century BC and suggest that the circular enclosure was Late Neolithic or Early Bronze Age in date. Analysis of the sediments, land snails and charred plant remains from the enclosure ditch indicate that the enclosure was built in chalk grassland or open woodland: the lenses of decalcified soils and the lack of shade-loving species from the primary silts suggest that if a dense post-glacial woodland habitat had developed it had been cleared long before the enclosure was built, and; the presence of blackthorn and hawthorn charcoal in the primary silts and the frequency of hazelnut shells from the patch of burning suggest sunny conditions found in woodland margins, open scrub or hedgerows.

A structural sequence with five phases of construction can be proposed for Duggleby Howe (Figure 101) on the basis of the radiocarbon dates for the burials and enclosure ditch:

- Phase 1 (Early Neolithic) – the earliest phase of the monument was characterised by a shaft grave, marked by an up-cast mound of chalk adjacent to the grave. The burials from the shaft grave were dated to the 35th century BC or the early 34th century BC;

- Phase 2 (Middle Neolithic) – two simple burials on the old land surface and a burial in a shallow grave were then added respecting the position of the shaft grave. These burials dated from the 34th century BC to the 29th century BC;

- Phase 3 (Late Neolithic) – an interim mound (the inner mound, comprised of an earthen core and chalk body capped by a layer of Kimmeridge Clay) was constructed and a series of burials and cremations were inserted into the mound.

The burials from the interim mound were dated to the 28th century BC or early 27th century BC;

- Phase 4 (Chalcolithic) – a circular enclosure, defined by a causewayed ditch c.350m in diameter, was built around the interim mound. The enclosure was dated to sometime between the 25th century BC and the 23rd century BC;

- Phase 5 (Early Bronze Age) – the interim mound was enlarged substantially with the construction of the chalk outer mound. The final burial inserted into the interim mound was dated to between the early 22nd century BC and late 20th century BC;

- Undated – three burials mounds were excavated close to the eastern edge of the circular enclosure in the mid to late 19th century (Greenwell 1877; Mortimer 1905). A ring ditch was also identified within the interior of the enclosure from aerial photographs.

This structural sequence represents a long history of use that culminated in the enclosure and enlargement of the burial mound during the late 3rd millennium BC.

Parallels have been drawn between the enclosure and enlargement of Duggleby Howe and the structural sequences at Silbury Hill, Stonehenge and Durrington Walls (Gibson et al. 2011). Like the burial mound at Duggleby Howe, Silbury Hill was constructed in two stages: the initial gravel and organic mound was constructed between the late 25th century BC and the mid 24th century BC and was enlarged substantially with the construction of a chalk mound during the late 24th century BC or early 23rd century BC (Marshall et al. 2013). The circular enclosure at Duggleby Howe is broadly contemporary with Stages 2 and 3 in the structural sequence recently proposed for Stonehenge (Darvill et al. 2012). Stonehenge underwent major transformations during the Late Neolithic when the trilithon horseshoe, sarsen circle and north/south barrows were built (Stage 2), and when the avenue was built and cremations ceased to be buried at the site (Stage 3). Durrington Walls also underwent major transformation at this time, when the large timber circle identified beneath the bank though geophysical survey was dismantled (Gaffney et al. 2018) and the henge enclosure, north/south circles and houses were constructed (Darvill et al. 2012).

The dates for the circular enclosure at Duggleby Howe fall within the first period of the Beaker tradition and are consistent with the dates for the burials from Grave C at Aldro 116. Burials from this period are often associated with evidence for communal feasting and an assemblage of animal bone, pottery and worked flint consistent with feasting was found in the burial mound at Aldro 116. The high frequency of younger animals represented in assemblages of animal bone from contemporary sites suggests that communal feasting often took place during the winter. Strontium isotope ratios from tooth enamel suggest that the individuals buried at Duggleby Howe were drawn from communities across Eastern Yorkshire, including individuals who spent their childhoods on the Yorkshire Wolds, the Vale of Pickering, the Howardian Hills, the Vale of York, the Vale of Mowbray and the Southern Magnesian Limestone. Members of these communities would have gathered at focal points in the landscape, such as the burial mound and circular enclosure at Duggleby Howe and the Neolithic and Bronze Age monument complexes at Rudston and Thornborough, to bury their dead and to celebrate key events in the prehistoric calendar.

Neolithic monuments are commonly located in river valleys along which people, animals and objects would have moved (Bradley 1993; Tilley 1994; Richards 1996; Haughey 2016). Duggleby Howe is no exception and is located close to the source of the Gypsey Race at the head of the Great Wold Valley. A series of monuments were built along the course of the Gypsey Race during the Neolithic and Bronze Age, including a possible Early Neolithic mortuary enclosure beneath the burial mound at Wold Newton (Mortimer 1905; Kinnes 1979; Gibson and Bayliss 2010) and the Middle Neolithic to Early Bronze Age monument complex at Rudston (Pegge 1779; Greenwell 1877; McInnes 1964; Dymond 1966; Harding 1999). The monument complex at Rudston is centred on a group of cursus monuments built close to a bend in the Gypsey Race at the eastern end of the Great Wold Valley. Four of the cursus monuments converged on the site of the Rudston Monolith, a large standing stone in the graveyard at All Saint's Church[42]. A round barrow built over the southern terminal of the Woldgate Cursus (Cursus A) formed part of a wider barrow cemetery on Rudston Wold. Several henge monuments were also built in the Rudston area, including the henge monument at Maiden's Graves which lies next to the Gypsey Race cursus (Cursus D).

[42] According to local folklore the monolith was an arrow thrown at church by the devil, echoing the place-name from the stone alignment at the Devil's Arrows in the Vale of Mowbray.

A Neolithic and Bronze Age monument complex was also built along the course of the River Ure at Thornborough in the Vale of Mowbray (Harding 2013). The monument complex at Thornborough was centred on a group of three henge monuments built on a common axis that projected through the springs at St Michael's Well to the north, and the henge monument at Nunwick and the stone alignment at the Devil's Arrows to the south. A cursus monument, perpendicular to the axis of the henge monuments, extended beneath the southern part of the central henge. An oval barrow or mortuary enclosure was identified to the east of the central henge close to the line of the cursus. A series of round barrows and ring ditches, one of which has been dated to the Early Neolithic, were built in the area surrounding the henge monuments. An extensive scatter of worked flint has been recovered from Thornborough through fieldwalking, suggesting that the Neolithic and Bronze Age monument complex was built in an area occupied during the Late Mesolithic and Early Neolithic. Scatters of worked flint have also been recovered from the uplands adjacent to the Neolithic and Bronze Age monument complex at Rudston (Harding 1999).

While discussion of the evidence for Neolithic occupation at Rudston has typically focussed on pit contexts rather than surface scatters (Manby 1974, 1975; Harding 2006; Carver 2012), the evidence for Neolithic occupation at Thornborough from surface scatters has formed an integral part of the discussion of the monument complex (Harding 2013). Several similarities can be seen between the scatter of worked flint from Thornborough and the surface scatter from the source of the Gypsey Race at Wharram-le-Street. Both scatters of worked flint were dominated by till flint from the Yorkshire Coast, with increased evidence for the use of poorer quality Wolds flint during the Late Neolithic and Early Bronze Age. The role that river valleys and monument complexes played in the transportation of Group VI axes from the Cumbria High Fells to the Yorkshire Wolds has long been recognised (Bradley and Edmonds 1993). Communal gatherings at henge monuments on the River Ure and the Gypsey Race would have provided opportunities for the exchange of Group VI axes and the reciprocal exchange of till flint (Harding 1999, 2000). The circular enclosure at Duggleby Howe almost certainly played a similar role in this exchange network.

Both scatters of worked flint also contained a high frequency of cortical flakes and stone tools manufactured from cortical flakes: at Thornborough, emphasis was placed on the paucity of flakes and tools with >25% cortex which was thought to indicate that the initial stages of core working were conducted elsewhere, while; at Wharram-le-Street, emphasis was placed on the

abundance of flakes and tools with <25% cortex which was thought to indicate that cortex was not removed prior to core working or tool manufacture, reflecting constraints imposed by the nature of the raw materials. The interpretation of the cortical flakes from Thornborough, however, acknowledges the constraints of raw materials and highlights their impact on the size of tools (Harding and Johnson 2013, 158). A growing body of evidence suggests that the raw materials available to communities on the central Wolds imposed restrictions on the maximum size of cores and tools (Makey 1989, 1996). Although models of stone working based on nascent removal of cortex may be appropriate for the specialist workshops at North Dale and South Landing, they cannot necessarily be applied to every Neolithic site in Eastern Yorkshire and alternative models are required.

6.3 Neolithic occupation on the Yorkshire Wolds

Accounts of Neolithic occupation on the uplands of the Yorkshire Wolds have traditionally been divorced from evidence from the adjacent lowlands and surrounding regions. Analysis of stable isotopes from Neolithic burial mounds suggests that many of the individuals buried on the Yorkshire Wolds were drawn from communities from these regions. The isotope data support links between communities in Northern Britain which have previously been inferred from the sources of flint that were used in contemporary lithic industries and the spatial distribution of particular classes of stone tools. Wharram-le-Street is a persistent place within a changing world, with episodes of occupation embedded within patterns of mobility linked to the procurement of flint from the glacial tills of the Holderness coast during the Early Neolithic and episodes of occupation linked to burials and communal gatherings at monument complexes in the Vale of Mowbray and Yorkshire Wolds during the Late Neolithic. The proximity of the lithic scatter at Wharram-le-Street to the circular enclosure at Duggleby Howe mirrors the lithic scatters around the monument complex at Thornborough in the Vale of Mowbray. Similarities can also be seen in the character of the assemblages of worked flint from the scatters at Wharram-le-Street and Thornborough, with both assemblages dominated by till flint and containing high frequencies of cortical blades/flakes.

Neolithic occupation and stone working on the Yorkshire Wolds

Analysis of the lithic assemblages from the Neolithic burial mounds and the surface scatter at Wharram-le-Street has identified evidence for occupation and stone working on the Yorkshire Wolds. The evidence for occupation and stone working from the Neolithic burial mounds represents three main types of activity:

1) Stone working directly associated with funerary deposits, including a cache of worked flint with a sequence of refitting blades placed with Burial 1 at Aldro C75 and two artefacts at opposite end of the reduction sequence (a plano-convex knife placed on a blank for a plano-convex knife) from Grave C at Painsthorpe Wold 98;

2) Evidence for pre-barrow activity, including a cortical flake, a non-cortical flake and a retouched flake from a pit context beneath the burial mound at Acklam Wold 211 and a plano-convex knife, edge-retouched knife and a cortical flake from the old land surface beneath the burial mound at Aldro 49;

3) Evidence for feasting and communal gatherings, including large assemblages of animal bone and worked flint from the surface of the interim mound at Calais Wold 275 and the undisturbed portion of the burial mound at Aldro 116.

The evidence for occupation and stone working from the surface scatter at Wharram-le-Street suggests episodic or seasonal activity around the source of the Gypsey Race from the Late Mesolithic onwards, with estimates of between c.26,500 and c.32,500 pieces of worked flint circulating within the ploughsoil.

People were not just burying their dead on the Yorkshire Wolds but living there too. The bias towards the Rudston area reflected in traditional models of Neolithic settlement in Eastern Yorkshire is perpetuated by continued focus on the evidence from pit contexts and cannot be sustained on the basis of the evidence from stray finds and lithic scatters. Surface evidence from the Ruston area is heavily skewed by material from the Greenwell Collection and does

not reflect the broader pattern of activity on the Yorkshire Wolds. Intensive survey around known surface contexts on the High Wolds is required to correct this imbalance.

Much of the evidence for occupation and stone working on the Yorkshire Wolds is characterised by low-density artefact scatters. A maximum of 7 artefacts per collection unit was recovered during the course of the surface survey at Wharram-le-Street. The low frequency of artefacts, or more specifically the low number of values, presents challenges for quantitative approaches to the analysis of surface contexts. Tobler's proposal for a resel-based GIS was implemented using a network dataset to enable focal functions/spatial filters to be applied to polygon features and increase the number of unique values. Spatial statistics can be applied to the filtered survey data in order to identify areas of higher and lower densities of artefacts that reflect different types of occupation and stone working.

In order to identify meaningful patterning, however, it is necessary to isolate groups of stone tools and lithic debitage which are contemporary with one another. Although this will reduce the number of artefacts per collection unit, the implementation of Tobler's resel-based GIS can be applied to any dataset even if the survey data are comprised solely of collection units which only yielded single artefacts. Dating of lithic assemblages is traditionally reliant upon the presence of typologically diagnostic artefacts – predominantly stone tools and cores with distinctive forms which typically represent only a small proportion of the total number of lithic artefacts (15% in the case of the surface scatter at Wharram-le-Street).

Dating expedient or utilitarian tools and non-diagnostic forms of debitage is reliant upon the technological and morphometric analysis of lithic assemblages from excavated contexts which have been dated independently. The methods and techniques employed in Early Neolithic and Late Neolithic stone working traditions were characterised through the reconstruction of the 'life histories' of the stone tools from the Neolithic burial mounds. Debitage signatures characteristic of these methods and techniques were subsequently defined through the analysis of the morphological attributes and metric properties of the complete blades and flakes from the Neolithic burial mounds.

The reconstruction of the 'life histories' and debitage signatures of the stone tools and lithic debitage from the Neolithic burial mounds both suggest that local industries were reliant upon the used of 'small rocks' and that trimming of cortex did not play an important role in the initial stages of core working or tool manufacture. Constraints imposed by the nature of the

raw materials used in Neolithic stone working on the Yorkshire Wolds are consistent with observations from other sites in Eastern Yorkshire, including the Neolithic and Bronze Age monument complex at Thornborough in the Vale of Mowbray (Harding 2013).

A series of diagnostic traits was distilled from the 'life histories' and debitage signatures and used to calculate scores for the artefacts from the Neolithic burial mounds and the surface scatter at Wharram-le-Street. The aggregated scores for the stone tool and lithic debitage from the Neolithic burial mounds successfully discriminated between lithic assemblages dated to the Early Neolithic and those dated to the Late Neolithic. Several methods of calculating scores were tested and the method best suited to the dating of individual artefacts (the binary method) was applied to the stone tools and lithic debitage from Wharram-le-Street.

The method that underpins the artefact scores accommodates the variation that can be expected within a lithic scatter, artefacts are not rigidly dated to a chronological period based on a single trait. Where an artefact is dated to the same chronological period based on multiple traits there is greater confidence in the date. Conversely, where an artefact is dated to multiple chronological periods there is less confidence in the date. 75% of the artefacts from the surface scatter at Wharram-le-Street were assigned dates using the binary scores.

Differential patterning in the spatial distribution of artefacts was identified both on the basis of the spatial statistics calculated from focal means generated using the implementation of Tobler's resel-based GIS and on the basis of the aggregated binary scores for each of the collection units. Although marked differentiation could be seen in the distributions and densities of Early Neolithic and Late Neolithic artefacts, the artefacts from both chronological periods both contained maintenance items indicative of occupation and high frequencies of cortical flakes consistent with the early stages of core working and tool manufacture.

Two higher density clusters of Early Neolithic artefacts thought to correspond to middens were identified in the area of the former source of the Gypsey Race with lower densities of Early Neolithic artefacts found in other parts of the survey area. In contrast, the Late Neolithic artefacts were more widely distributed, with lower density clusters of artefacts found throughout the survey area. These clusters may relate to communal gatherings associated with the nearby burial mound and circular enclosure at Duggleby Howe.

Parallels can be drawn between the Early Neolithic activity at Wharram-le-Street and evidence for Mesolithic occupation in the Vale of Pickering and Holderness. Parallels can also be drawn between the Late Neolithic activity at Wharram-le-Street and the evidence for communal gatherings around monument complexes in the Vale of Mowbray.

Analysis of strontium isotope ratios from Neolithic burial mounds, including burials from Towthorpe 18, Duggleby Howe, Painsthorpe Wold 98 and Calais Wold 275, places the Yorkshire Wolds at the centre of a network of communities spread throughout Eastern Yorkshire. By shifting the emphasis away from pit contexts at Rudston, the analysis of the lithic assemblages from the Neolithic burial mounds and the surface scatter at Wharram-le-Street has challenged established models of settlement practice for Eastern Yorkshire.

The surface scatter at Wharram-le-Street can now be added to the canon of sites used to discuss Neolithic occupation and stone working, alongside the houses at Mill Street, Driffield, Sewerby Cottage Farm, Bridlington and Beacon Hill, Flamborough, the specialist workshops at North Dale and South Landing, and the pit contexts at Rudston and Low Caythorpe.

The methodology for this thesis was developed to address two problems that have placed fundamental constraints on the analysis of stray finds and lithic scatters from surface contexts and comprised: 1) a method of applying spatial filters to polygon features to enhance patterns in surface scatters characterised by low densities of artefacts and allow the identification of those patterns through the use of spatial statistics; 2) a method of dating stone tools and lithic debitage through the calculation of artefact scores that reflect the likelihood an artefact is dated to a particular chronological period, and can be used to isolate groups of artefacts which are contemporary with one another for the purposes of spatial analysis.

This methodology can be applied to datasets from other regions: 1) the method of applying spatial filters to polygon features can also be applied to surface scatters characterised by high densities of artefacts and lithic scatters from excavated contexts; 2) the method of dating stone tools and lithic debitage can be applied to different geographic regions, identifying recurrent patterns which are characteristic of the stone working traditions employed in those regions, or to different chronological periods, increasing the temporal resolution of analysis by incorporating additional chronological periods – the diagnostic traits, however, will vary from one geographic region or chronological period to the next.

Three priorities for future research can be identified on the basis of the surface scatters and excavated assemblages analysed as part of this thesis: 1) expansion of the survey around the former source of the Gypsey Race at Wharram-le-Street, including systematic survey of the interior of the circular enclosure at Duggleby Howe; 2) analysis of the remainder of the assemblages of worked flint from the Neolithic round barrows to understand the nature of the representation of stone working in funerary contexts; 3) analysis of the lithic assemblages from the pit contexts at Rudston and occupation sites on the Holderness coast to characterise the stone working traditions in other parts of the Yorkshire Wolds.

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Abramson, Philip. 1996. 'Excavations along the Caythorpe Gas Pipeline'. *Yorkshire Archaeological Journal* 68: 1–88.

Albarella, Umberto, and Dale Serjeantson. 2002. 'A Passion for Pork: Meat Consumption at the British Late Neolithic Site of Durrington Walls'. In *Consuming Passions and Patterns of Consumption*, edited by Preston Miracle, Nicky Milner and Umberto Albarella, 33–49. McDonald Institute Monographs. Cambridge: McDonald Institute for Archaeological Research.

Alker, Hayward. 1969. 'A Typology of Ecological Fallacies'. In *Quantitative Ecological Analysis in the Social Sciences*, edited by Mattei Dogan and Stein Rokkan, 69–86. Cambridge: MIT Press.

Allen, Michael. 1991. 'Analysing the Landscape: A Geographical Approach to Archaeological Problems'. In *Interpreting Artefact Scatters: Contributions to Ploughzone Archaeology*, edited by A. John Schofield, 41–57. Oxford: Oxbow Books.

Ammerman, Albert. 1985. 'Plow-Zone Experiments in Calabria, Italy'. *Journal of Field Archaeology* 12 (1): 33–40. https://doi.org/10.2307/529373.

Andrefsky, William. 1998. *Lithics: Macroscopic Approaches to Analysis*. Cambridge: Cambridge University Press.

———, ed. 2001. *Lithic Debitage: Context, Form, Meaning*. Salt Lake City: University of Utah Press.

Anselin, Luc. 1988. *Spatial Econometrics: Methods and Models*. Boston: Kluwer Academic Publishers.

———. 1995. 'Local Indicators of Spatial Association-LISA'. *Geographical Analysis* 27 (2): 93–115. https://doi.org/10.1111/j.1538-4632.1995.tb00338.x.

Ard, Vincent, and Timothy Darvill. 2015. 'Revisiting Old Friends: The Production, Distribution and Use of Peterborough Ware in Britain'. *Oxford Journal of Archaeology* 34 (1): 1–31. https://doi.org/10.1111/ojoa.12046.

Armstrong, A. Leslie. 1922. 'Two East Yorkshire Bone Harpoons.' *Man* 22: 130–31. https://doi.org/10.2307/2840354.

———. 1924. 'The Maglemose Remains of Holderness and Their Baltic Counterparts'. *Proceedings of the Prehistoric Society of East Anglia* 4 (1): 57–70. https://doi.org/10.1017/S0958841800024893.

Arnold, John, Martin Green, Barry Lewis, and Richard Bradley. 1988. 'The Mesolithic of Cranborne Chase'. *Proceedings of the Dorset Natural History and Archaeological Society*, 117–25.

Bailey, Trevor, and Anthony Gatrell. 1995. *Interactive Spatial Data Analysis*. Harlow: Longman Scientific and Technical.

Barber, Martyn, David Field, and Peter Topping. 1999. *The Neolithic Flint Mines of England*. Swindon: English Heritage.

Barnatt, John, Bill Bevan, and Mark Edmonds. 2002. 'Gardom's Edge: A Landscape Through Time'. *Antiquity* 76 (291): 50–56. https://doi.org/10.1017/S0003598X00089791.

Barrett, John. 1990. 'The Monumentality of Death: The Character of Early Bronze Age Mortuary Mounds in Southern Britain'. *World Archaeology* 22 (2): 179–89. https://doi.org/10.1080/00438243.1990.9980139.

———. 1994. *Fragments from Antiquity: An Archaeology of Social Life in Britain, 2900-1200 BC*. Oxford: Blackwell.

Barrett, John, Richard Bradley, and Martin Green. 1991. *Landscape, Monuments and Society: The Prehistory of Cranborne Chase*. Cambridge: Cambridge University Press.

Barrett, John, Richard Bradley, Martin Green, and Barry Lewis. 1981. 'The Earlier Prehistoric Settlement of Cranborne Chase-the First Results of Current Fieldwork'. *The Antiquaries Journal* 61 (2): 203–37. https://doi.org/10.1017/S0003581500029498.

Barton, R. Nick, Peter Berridge, Michael Walker, and Richard Bevins. 1995. 'Persistent Places in the Mesolithic Landscape: An Example from the Black Mountain Uplands of South Wales'. *Proceedings of the Prehistoric Society* 61: 81–116. https://doi.org/10.1017/S0079497X00003042.

Bell, Martin. 1983. 'Valley Sediments as Evidence of Prehistoric Land-Use on the South Downs.' *Proceedings of the Prehistoric Society* 49: 119–50. https://doi.org/doi.org/10.1017/S0079497X00007969.

Bentley, R. Alexander, and Corina Knipper. 2005. 'Geographical Patterns in Biologically Available Strontium, Carbon and Oxygen Isotope Signatures in Prehistoric SW Germany'. *Archaeometry* 47 (3): 629–44. https://doi.org/10.1111/j.1475-4754.2005.00223.x.

Berstan, Robert, and Richard Evershed. 2009. 'Organic Residue Analyses of Pottery'. In *A Place by the Sea: Excavations at Sewerby Cottage Farm, Bridlington*, edited by Chris Fenton-Thomas, 186–96. York: On-Site Archaeology Ltd.

Bevan, Bill. 1997. 'Bounding the Landscape: Place and Identity During the Yorkshire Wolds Iron Age'. In *Reconstructing Iron Age Societies: New Approaches to the British Iron Age*, edited by Adam Gwilt and Colin Haselgrove, 181–91. Oxford: Oxbow Books.

Binford, Lewis. 1978. *Nunamiut Ethnoarchaeology*. New York: Academic Press.

———. 1981. 'Behavioral Archaeology and the "Pompeii Premise"'. *Journal of Anthropological Research* 37 (3): 195–208. https://doi.org/10.1086/jar.37.3.3629723.

Bispham, Edward, Keith Swift, and Nicholas Wolff. 2008. '"What Lies Beneath": Ploughsoil Assemblages, The Dynamics of Taphonomy and the Interpretation of Field Walking Data'. In *Archaeology and Landscape in Central Italy: Papers in Memory of John A. Lloyd*, edited by John Lloyd, Gary Lock, and Amalia Faustoferri, 53–76. Oxford: School of Archaeology.

Bogaard, Amy, Rose-Marie Arbogast, Renate Ebersach, Rebecca Fraser, Corina Knipper, Christiane Krahn, Marguerita Shäfer, Amy Styring, and Rüdiger Krause. 2017. 'The Bandkeramik Settlement of Vaihingen an Der Enz, Kreis Ludwigsburg (Baden-Württemberg): An Integrated Perspective on Land Use, Economy and Diet'. *Germania : Anzeiger Der Römisch-Germanischen Kommission Des Deutschen Archäologischen Instituts* 94 (May): 1–60.

Bogaard, Amy, Rebecca Fraser, Tim Heaton, Michael Wallace, Petra Vaiglova, Michael Charles, Glynis Jones, et al. 2013. 'Crop Manuring and Intensive Land Management by Europe's First Farmers'. *Proceedings of the National Academy of Sciences* 110 (31): 12589–94. https://doi.org/10.1073/pnas.1305918110.

Bogaard, Amy, and Glynis Jones. 2007. 'Neolithic Farming in Britain and Central Europe: Contrast or Continuity?' In *Going Over: The Mesolithic-Neolithic Transition in North-West Europe*, edited by Alasdair Whittle and Vicki Cummings, 357–375. Proceedings of the British Academy 144. British Academy. http://britishacademy.universitypressscholarship.com/view/10.5871/bacad/9780197264140.001.0001/upso-9780197264140-chapter-19.

Boismier, William. 1997. *Modelling the Effects of Tillage Processes on Artefact Distribution in the Ploughzone : A Simulation Study of Tillage-Induced Pattern Formation*. BAR British Series. Oxford: Archaeopress.

Boismier, William, and Paul Reilly. 1988. 'Expanding the Role of Computer Graphics in the Analysis of Survey Data'. In *Computer and Quantitative Methods in Archaeology CAA87*, edited by Clive Ruggles and Sebastian Rahtz, 221–25. BAR International Series. Oxford: British Archaeological Reports.

Bordes, François. 1988. *Typologie du Paléolithique Ancien et Moyen*. Paris: Press du CNRS.

Bordes, François, and Jean Gaussen. 1970. *Un Fond de Tente Magdalénien Pres de Mussidan (Dordogne)*. Frühe Menschheit Und Umwelt 1: 313-29.

Bowen, Gabriel, Zhongfang Liu, Hannah Vander Zanden, Lan Zhao, and George Takahashi. 2014. 'Geographic Assignment with Stable Isotopes in IsoMAP'. *Methods in Ecology and Evolution* 5 (3): 201–6. https://doi.org/10.1111/2041-210X.12147.

Bradley, Philippa. 2011. 'The Worked Flint'. *Archaeological Journal* 168 (1): 14–23. https://doi.org/10.1080/00665983.2011.11020828.

Bradley, Richard. 1987. 'A Field Method for Investigating the Spatial Structure of Lithic Scatters'. In *Lithic Analysis and Later British Prehistory: Some Problems and Approaches*, edited by Antony Brown and Mark Edmonds, 39–47. BAR British Series. Oxford: British Archaeological Reports.

———. 1991. 'Ritual, Time and History'. *World Archaeology* 23 (2): 209–19. https://doi.org/10.1080/00438243.1991.9980173.

———. 1993. *Altering the Earth: The Origins of Monuments in Britain and Continental Europe : The Rhind Lectures 1991-92*. Society of Antiquaries of Scotland Monograph 8. Edinburgh: Society of Antiquaries of Scotland.

Bradley, Richard, and Richard Chambers. 1988. 'A New Study of the Cursus Complex at Dorchester on Thames'. *Oxford Journal of Archaeology* 7 (3): 271–89. https://doi.org/10.1111/j.1468-0092.1988.tb00181.x.

Bradley, Richard, and Mark Edmonds. 1993. *Interpreting the Axe Trade: Production and Exchange in Neolithic Britain*. Cambridge: Cambridge University Press.

Bradley, Richard, Roy Entwhistle, and Frances Raymond. 1994. *Prehistoric Land Divisions on Salisbury Plain : The Work of the Wessex Linear Ditches Project*. London: English Heritage.

Bramwell, Don. 1974. 'Animal Remains from Rudston and Boynton Grooved Ware Sites'. In *Grooved Ware Sites in Yorkshire and the North of England*, by Terry Manby, 103–8. BAR British Series. Oxford: British Archaeological Reports.

Brown, Anthony. 1991. 'Structured Deposition and Technological Change among the Flaked Stone Artefacts from Cranborne Chase'. In *Papers on the Prehistoric Archaeology of Cranborne Chase*, edited by John Barrett, Richard Bradley, and Melanie Hall, 101–33. Oxford: Oxbow Books.

———. 1995. 'Beyond Stone Age Economies: A Strategy for a Contextual Lithics Analysis'. In *Lithics in Context: Suggestions for the Future Direction of Lithic Studies*, edited by A. John Schofield, 27–36. London: Lithic Studies Society.

Budd, Paul, Janet Montgomery, Barbara Barreiro, and Richard Thomas. 2000. 'Differential Diagenesis of Strontium in Archaeological Human Dental Tissues'. *Applied Geochemistry* 15 (5): 687–94. https://doi.org/10.1016/S0883-2927(99)00069-4.

Burrough, Peter. 1986. *Principles of Geographical Information Systems*. Oxford: Clarendon Press.

Burrough, Peter, and Rachael McDonnell. 1998. *Principles of Geographical Information Systems*. Oxford: Oxford University Press.

Butler, Chris. 2005. *Prehistoric Flintwork*. Stroud: Tempus.

Cadman, Sheila, Becky Knight, Ben Elliott, Tim Schadla-Hall, Harry Robson, and Nicky Milner. 2018. 'The Discovery of Mesolithic Red Deer at Skipsea Withow'. *Yorkshire Archaeological Journal* 90 (1): 1–12. https://doi.org/10.1080/00844276.2018.1481675.

Callahan, Errett. 1979. 'The Basics of Biface Knapping in the Eastern Fluted Point Tradition: A Manual for Flint Knappers and Lithic Analysts'. *Archaeology of Eastern North America* 7 (1): 1–180.

Capo, Rosemary, Brian Stewart, and Oliver Chadwick. 1998. 'Strontium Isotopes as Tracers of Ecosystem Processes: Theory and Methods'. *Geoderma* 82 (1): 197–225. https://doi.org/10.1016/S0016-7061(97)00102-X.

Carver, Genevieve. 2012. 'Pits and Place-Making: Neolithic Habitation and Deposition Practices in East Yorkshire c. 4000–2500 BC'. *Proceedings of the Prehistoric Society* 78: 111–34. https://doi.org/10.1017/S0079497X00027134.

Catt, John, and Lewis Penny. 1966. 'The Pleistocene Deposits of Holderness, East Yorkshire'. *Proceedings of the Yorkshire Geological Society* 35 (3): 375–420. https://doi.org/10.1144/pygs.35.3.375.

Caulfield, Seamus. 1978. 'Star Carr: An Alternative View'. *Irish Archaeological Research Forum* 5: 15–22.

Chenery, Carolyn, Gundula Müldner, Jane Evans, Hella Eckardt, and Mary Lewis. 2010. 'Strontium and Stable Isotope Evidence for Diet and Mobility in Roman Gloucester, UK'. *Journal of Archaeological Science* 37 (1): 150–63. https://doi.org/10.1016/j.jas.2009.09.025.

Clare, Tom. 1986. 'Towards a Reappraisal of Henge Monuments'. *Proceedings of the Prehistoric Society* 52: 281–316. https://doi.org/10.1017/S0079497X0000668X.

Clark, Graham. 1929. 'Discoidal Polished Flint—Their Typology and Distribution'. *Proceedings of the Prehistoric Society of East Anglia* 6 (01): 41–54. https://doi.org/10.1017/S0958841800025734.

———. 1932a. 'The Date of the Plano-Convex Flint-Knife in England and Wales'. *The Antiquaries Journal* 12 (02): 158–62. https://doi.org/10.1017/S0003581500047132.

———. 1932b. "The Curved Flint Sickle Blades of Britain." *Proceedings of the Prehistoric Society of East Anglia* 7 (1): 67–81. https://doi.org/10.1017/S0958841800026399.

———. 1954. *Excavations at Star Carr; An Early Mesolithic Site at Seamer near Scarborough, Yorkshire.* Cambridge: Cambridge University Press.

———. 1972. *Star Carr: A Case Study in Bioarchaeology*. Addison-Wesley Modular Publications, 10. New York: Addison-Wesley.

Clark, Graham, and Harry Godwin. 1957. 'A Maglemosian Site at Brandesburton, Holderness, Yorkshire'. *Proceedings of the Prehistoric Society* 22 (March): 6–22. https://doi.org/10.1017/S0079497X0001714X.

Clark, Graham, Eric Higgs, and Ian Longworth. 1960. 'Excavations at the Neolithic Site at Hurst Fen, Mildenhall, Suffolk (1954, 1957 and 1958).' *Proceedings of the Prehistoric Society* 26: 202–45. https://doi.org/10.1017/S0079497X00016315.

Clark, Royston, and A. John Schofield. 1991. 'By Experiment and Calibration: An Integrated Approach to Archaeology of the Ploughsoil'. In *Interpreting Artefact Scatters: Contributions to Ploughzone Archaeology*, edited by A. John Schofield, 93–105. Oxford: Oxbow Books.

Clarke, David. 1970. *Beaker Pottery of Great Britain and Ireland*. Cambridge: Cambridge University Press.

Cliff, Andrew, and Keith Ord. 1973. *Spatial Autocorrelation*. London: Pion.

Clough, Timothy, and William Cummins, eds. 1988. *Stone Axe Studies, 2: The Petrology of Prehistoric Implements from the British Isles*. London: Council for British Archaeology.

Cole, E. Maule. 1888. 'Notes on the Ancient Entrenchments in the Neighbourhood of Wetwang'. *Proceedings of the Yorkshire Geological and Polytechnic Society* 11 (1): 45–53. https://doi.org/10.1144/pygs.11.1.45.

———. 1892. 'British and Roman Roads in the East Riding of Yorkshire'. *The Antiquary* 26 (November): 206–9.

———. 1901. 'Duggleby Howe'. *Transactions of the East Riding Antiquarian Society* 9: 57–61.

Collard, Mark, Kevan Edinborough, Stephen Shennan, and Mark Thomas. 2010. 'Radiocarbon Evidence Indicates That Migrants Introduced Farming to Britain'. *Journal of Archaeological Science* 37 (4): 866–70. https://doi.org/10.1016/j.jas.2009.11.016.

Conneller, Chantal. 2000a. 'Fragmented Spaces? Hunter-Gatherer Landscapes in the Vale of Pickering'. *Archaeological Review from Cambridge* 17 (1): 139–50.

———. 2000b. 'Space, Time and Technology: The Early Mesolithic of the Vale of Pickering, North Yorkshire'. Thesis, University of Cambridge. https://doi.org/10.17863/CAM.19089.

———. 2004. 'Becoming Deer. Corporeal Transformations at Star Carr'. *Archaeological Dialogues* 11 (1): 37–56. https://doi.org/10.1017/S1380203804001357.

———. 2007. 'Inhabiting New Landscapes: Settlement and Mobility in Britain after the Last Glacial Maximum'. *Oxford Journal of Archaeology* 26 (3): 215–37. https://doi.org/10.1111/j.1468-0092.2007.00282.x.

Conneller, Chantal, Aimée Little, and Julie Birchenall. 2018. 'Making Space through Stone'. In *Star Carr Volume 1*, edited by Nicky Milner, Chantal Conneller, and Barry Taylor, 157–221. White Rose University Press. https://doi.org/10.22599/book1.

Conneller, Chantal, Aimée Little, Virginia Garcia-Diaz, and Shannon Croft. 2018. 'The Worked Flint'. In *Star Carr Volume 2*, edited by Nicky Milner, Chantal Conneller, and Barry Taylor, 493–534. White Rose University Press. https://doi.org/10.22599/book2.

Conneller, Chantal, and Nick Overton. 2018. 'The British Mesolithic Context'. In *Star Carr Volume 1*, edited by Nicky Milner, Chantal Conneller, and Barry Taylor, 275–303. White Rose University Press. https://doi.org/10.22599/book1.

Conneller, Chantal, and Tim Schadla-Hall. 2003. 'Beyond Star Carr: The Vale of Pickering in the 10th Millennium BP'. *Proceedings of the Prehistoric Society* 69: 85–105. https://doi.org/10.1017/S0079497X00001262.

Conolly, James, and Mark Lake. 2006. *Geographical Information Systems in Archaeology*. Cambridge: Cambridge University Press.

Coombs, David. 1976a. 'Beakers from Callis Wold, Barrow 275, Humberside'. In *Settlement and Economy in the Third and Second Millennia B.C.: Papers Delivered at a Conference Organised by the Department of Adult Education, University of Newcastle upon Tyne, January*

1976, edited by Colin Burgess and Roger Miket, 143–50. BAR British Series. Oxford: British Archaeological Reports.

———. 1976b. 'Callis Wold Round Barrow, Humberside'. *Antiquity* 50 (198): 130–31. https://doi.org/10.1017/S0003598X0010153X.

Cotterell, Brian, and Johan Kamminga. 1987. 'The Formation of Flakes'. *American Antiquity* 52 (4): 675. https://doi.org/10.2307/281378.

Cotterell, Brian, Johan Kamminga, and Frank Dickson. 1985. 'The Essential Mechanics of Conchoidal Flaking'. *International Journal of Fracture* 29 (4): 205–21. https://doi.org/10.1007/BF00125471.

Craig, Oliver, Lisa-Marie Shillito, Umberto Albarella, Sarah Viner-Daniels, Ben Chan, Ros Cleal, Robert Ixer, et al. 2015. 'Feeding Stonehenge: Cuisine and Consumption at the Late Neolithic Site of Durrington Walls'. *Antiquity* 89 (347): 1096–1109. https://doi.org/10.15184/aqy.2015.110.

Darling, W. George, Adrian Bath, and John Talbot. 2003. 'The O and H Stable Isotope Composition of Freshwaters in the British Isles. 2. Surface Waters and Groundwater'. *Hydrol. Earth Syst. Sci.* 7 (2): 183–95. https://doi.org/10.5194/hess-7-183-2003.

Darvill, Timothy. 1996. 'Neolithic Buildings in England, Wales and the Isle of Mann'. In *Neolithic Houses in Northwest Europe and Beyond*, edited by Timothy Darvill and Julian Thomas, 77–111. Oxford: Oxbow Books.

Darvill, Timothy, Peter Marshall, Mike Parker Pearson, and Geoff Wainwright. 2012. 'Stonehenge Remodelled'. *Antiquity* 86 (334): 1021–40. https://doi.org/10.1017/S0003598X00048225.

Darvill, Timothy, and Julian Thomas. 2001. *Neolithic Enclosures in Atlantic Northwest Europe*. Oxford: Oxbow.

Davis, James. 1888. 'On the Lake-Dwellings in East Yorkshire'. *Proceedings of the Yorkshire Geological Society* 11 (1): 101–13. https://doi.org/10.1144/pygs.11.1.101.

Davis-King, Shelly. 1980. 'A Note on New Barbed Points from Brandesburton, North Humberside'. *Archaeological Journal* 137 (1): 22–26. https://doi.org/10.1080/00665983.1980.11078477.

Dent, Borden, Jeff Torguson, and Thomas Hodler. 2008. *Cartography: Thematic Map Design*. 6th ed. Maidenhead: McGraw Hill Education EMEA.

Dent, John. 1988. 'Some Problems of Continuity in Rural Settlement'. In *Archaeology in Eastern Yorkshire: Essays in Honour of T. C. M. Brewster*, edited by Terry Manby, 94–100. Sheffield: Department of Archaeology and Prehistory, University of Sheffield.

Dickson, Antony, and Mark Edmonds. 2009. 'Flint and Other Stone Artefacts'. In *A Place by the Sea: Excavations at Sewerby Cottage Farm, Bridlington*, edited by Chris Fenton-Thomas, 97–150. York: On-Site Archaeology Ltd.

Donahue, Randolph, and William Lovis. 2006. 'Regional Settlement Systems in Mesolithic Northern England: Scalar Issues in Mobility and Territoriality'. *Journal of Anthropological Archaeology*, Mesolithic mobility, exchange, and interaction, 25 (2): 248–58. https://doi.org/10.1016/j.jaa.2005.11.006.

Dorling, Daniel. 1996. *Area Cartograms: Their Use and Creation*. Norwich: School of Environmental Sciences, University of East Anglia.

Durden, Tess. 1994. 'The Production and Consumption of Specialised Flint Artefacts from the Yorkshire Wolds'. PhD, Reading: University of Reading.

———. 1995. 'The Production of Specialised Flintwork in the Later Neolithic: A Case Study from the Yorkshire Wolds'. *Proceedings of the Prehistoric Society* 61 (January): 409–32. https://doi.org/10.1017/S0079497X00003157.

———. 1996. 'Lithics in the North of England: Production and Consumption on the Yorkshire Wolds'. In *Neolithic Studies in No-Man's Land: Papers on the Neolithic of Northern England from the Trent to the Tweed*, edited by Paul Frodsham, 13/14:79–86. Northern Archaeology. Newcastle upon Tyne: Northumberland Archaeological Group.

Dymond, David. 1966. 'Ritual Monuments at Rudston, E. Yorkshire, England.' *Proceedings of the Prehistoric Society (New Series)* 32: 86–95. https://doi.org/10.1017/S0079497X00014353.

Ebdon, David. 1985. *Statistics in Geography*. 2nd ed. Oxford: Blackwell.

Edmonds, Mark. 1987. 'Rocks and Risk: Problems with Lithic Procurement Strategies'. In *Lithic Analysis and Later British Prehistory: Some Problems and Approaches*, edited by Antony Brown and Mark Edmonds, 155–79. BAR British Series. Oxford: British Archaeological Reports.

———. 1989. 'The Gift of Stones: The Production and Exchange of Stone Axes in the Neolithic of Britain'. PhD, Reading: University of Reading.

———. 1995. *Stone Tools and Society: Working Stone in Neolithic and Bronze Age Britain*. London: Batsford.

———. 1999. *Ancestral Geographies of the Neolithic: Landscape, Monuments and Memory*. London: Routledge.

Edmonds, Mark, Christopher Evans, and David Gibson. 1999. 'Assembly and Collection: Lithic Complexes in the Cambridgeshire Fenlands'. *Proceedings of the Prehistoric Society* 65: 47–82. https://doi.org/10.1017/S0079497X00001948.

Elgee, Frank, and Harriet Elgee. 1933. *The Archaeology of Yorkshire*. County Archaeologies. London: Methuen.

Ellis, Stephen, and Robert Van de Noort, eds. 1995. *Wetland Heritage of Holderness: An Archaeological Survey*. Kingston upon Hull: Humber Wetlands Project, University of Hull.

Evans, Ian. 1972. 'General Geomorphometry, Derivatives of Altitude, and Descriptive Statistics'. In *Spatial Analysis in Geomorphology*, edited by Richard Chorley, 17–90. London: Methuen.

Evans, Jane, Carolyn Chenery, and Andrew Fitzpatrick. 2006. 'Bronze Age Childhood Migration of Individuals Near Stonehenge, Revealed by Strontium and Oxygen Isotope Tooth Enamel Analysis'. *Archaeometry* 48 (2): 309–21. https://doi.org/10.1111/j.1475-4754.2006.00258.x.

Evans, Jane, Carolyn Chenery, and Janet Montgomery. 2012. 'A Summary of Strontium and Oxygen Isotope Variation in Archaeological Human Tooth Enamel Excavated from Britain'. *Journal of Analytical Atomic Spectrometry* 27 (5): 754–64. https://doi.org/10.1039/ C2JA10362A.

Evans, Jane, Janet Montgomery, Geraldine Wildman, and Neil Boulton. 2010. 'Spatial Variations in Biosphere $^{87}Sr/^{86}Sr$ in Britain'. *Journal of the Geological Society* 167 (1): 1–4. https://doi.org/10.1144/ 0016-76492009-090.

Evans, John. 1897. *The Ancient Stone Implements, Weapons and Ornaments of Great Britain*. 2nd ed. London: Longmans, Green, and Co.

Eyles, Nicholas, A. Marshall McCabe, and David Bowen. 1994. 'The Stratigraphic and Sedimentological Significance of Late Devensian Ice Sheet Surging in Holderness, Yorkshire, U.K.' *Quaternary Science Reviews* 13 (8): 727–59. https://doi.org/10.1016/0277-3791(94) 90102-3.

Faure, Gunter. 1986. *Principles of Isotope Geology*. 2nd ed. New York: Wiley.

Fell, Clare, and R. Vin Davis. 1988. 'The Petrological Identification of Stone Implements from Cumbria'. In *Stone Axe Studies, 2: The Petrology of Prehistoric Implements from the British Isles*, edited by Timothy Clough and William Cummins, 71–77. London: Council for British Archaeology.

Fenton-Thomas, Chris. 2003. *Late Prehistoric and Early Historic Landscapes on the Yorkshire Chalk*. Oxford: Archaeopress.

———, ed. 2009. *A Place by the Sea: Excavations at Sewerby Cottage Farm, Bridlington*. York: On-Site Archaeology Ltd.

Finlayson, Bill, Nyree Finlay, and Steven Mithen. 2000. 'The Cataloguing and Analysis of the Lithic Assemblages'. In *Hunter-Gatherer Landscape Archaeology: The Southern Hebrides Mesolithic Project, 1988-98*, edited by Steven Mithen, 61–72. Cambridge: McDonald Institute for Archaeological Research.

Fisher, Peter, Jo Wood, and Tao Cheng. 2004. 'Where Is Helvellyn? Fuzziness of Multi-Scale Landscape Morphometry'. *Transactions of the Institute of British Geographers* 29 (1): 106–28. https://doi.org/10.1111/j.0020-2754.2004.00117.x.

Fleming, Andrew. 1988. *The Dartmoor Reaves: Investigating Prehistoric Land Divisions*. London: Batsford.

Fletcher, William, and Robert Van de Noort. 2007. 'The Lake-Dwellings in Holderness, East Yorkshire, Revisited: A Journey into Antiquarian and Contemporary Wetland Archaeology'. In *Archaeology from the Wetlands: Recent Perspectives : Proceedings of the 11th WARP Conference, Edinburgh 2005*, edited by John Barber and Catherine Green, 313–22. WARP Occasional Paper 18. Edinburgh: Society of Antiquaries of Scotland.

Foley, Robert. 1981a. ‘A Model of Regional Archaeological Structure’. *Proceedings of the Prehistoric Society* 47: 1–17. https://doi.org/10.1017/S0079497X00008823.

———. 1981b. ‘Off-Site Archaeology: An Alternative Approach for the Short-Sighted’. In *Pattern of the Past: Studies in Honour of David Clarke*, edited by David Clarke, Ian Hodder, Glynn Isaac, and Norman Hammond, 157–83. Cambridge: Cambridge University Press.

Ford, Stephen, Richard Bradley, John Hawkes, and Peter Fisher. 1984. ‘Flint-Working in the Metal Age’. *Oxford Journal of Archaeology* 3 (2): 157–73. https://doi.org/10.1111/j.1468-0092.1984.tb00324.x.

Fraser, Rebecca, Amy Bogaard, Marguerita Schäfer, Rose-Marie Arbogast, and Tim Heaton. 2013. ‘Integrating Botanical, Faunal and Human Stable Carbon and Nitrogen Values to Reconstruct Land Use and Palaeodiet at LBK Vainhingen an Der Enz, Baden-Württemberg’. *World Archaeology* 45 (3): 492–517. https://doi.org/10.1080/00438243.2013.820649.

Gaffney, Vincent, and Martijn van Leusen. 1995. ‘Postscript: GIS, Environmental Determinism and Archaeology. A Parallel Text’. In *Archaeology and Geographical Information Systems: A European Perspective*, edited by Gary Lock and Zoran Stančič, 367–82. London: Taylor & Francis.

Gaffney, Vincent, Wolfgang Neubauer, Paul Garwood, Christopher Gaffney, Klaus Löcker, Richard Bates, Philippe De Smedt, et al. 2018. ‘Durrington Walls and the Stonehenge Hidden Landscape Project 2010-2016’. *Archaeological Prospection* 25 (3): 255–269. https://doi.org/0.1002/arp.1707.

Gaffney, Vincent, Kenneth Thomson, and Simon Fitch. 2007. *Mapping Doggerland: The Mesolithic Landscapes of the Southern North Sea*. Oxford: Archaeopress.

Gardiner, Julie. 1987. ‘Tales of the Unexpected: Approaches to the Assessment and Interpretation of Museum Flint Collections’. In *Lithic Analysis and Later British Prehistory: Some Problems and Approaches*, edited by Antony Brown and Mark Edmonds, 49–65. BAR British Series. Oxford: British Archaeological Reports.

Garrow, Duncan. 2007. ‘Placing Pits: Landscape Occupation and Depositional Practice During the Neolithic in East Anglia’. *Proceedings of the Prehistoric Society* 73: 1–24. https://doi.org/10.1017/S0079497X00000037.

Garwood, Paul. 1999. ‘Grooved Ware in Southern Britain: Chronology and Interpretation’. In *Grooved Ware in Britain and Ireland*, edited by Rosamund Cleal and Ann MacSween, 3:145–76. Neolithic Studies Group Seminar Papers. Oxford: Oxbow Books.

Gastner, Michael, and Mark Newman. 2004. ‘Diffusion-Based Method for Producing Density-Equalizing Maps’. *Proceedings of the National Academy of Sciences of the United States of America* 101 (20): 7499–7504. https://doi.org/10.1073/pnas.0400280101.

Getis, Arthur, and Jared Aldstadt. 2004. ‘Constructing the Spatial Weights Matrix Using a Local Statistic’. *Geographical Analysis* 36 (2): 90–104. https://doi.org/10.1111/j.1538-4632.2004.tb01127.x.

Gibson, Alex. 1982. *Beaker Domestic Sites: A Study of the Domestic Pottery of the Late Third and Early Second Millennia B.C. in the British Isles*. BAR British Series. Oxford: British Archaeological Reports.

———. 2016. 'Who Were These People? A Sideways View and a Non-Answer of Political Proportions'. In *The Neolithic of Mainland Scotland*, edited by Kenneth Brophy, Gavin MacGregor, and Ian Ralston, 57–73. Edinburgh: Edinburgh University Press.

Gibson, Alex, Mike Allen, Philippa Bradley, Wendy Carruthers, Dana Challinor, Charles French, Derek Hamilton, et al. 2011. 'Report on the Excavation at the Duggleby Howe Causewayed Enclosure, North Yorkshire, May—July 2009'. *Archaeological Journal* 168 (1): 1–63. https://doi.org/10.1080/00665983.2011.11020828.

Gibson, Alex, and Alex Bayliss. 2009. 'Recent Research at Duggleby Howe, North Yorkshire'. *Archaeological Journal* 166 (1): 39–78. https://doi.org/10.1080/00665983.2009.11078220.

———. 2010. 'Recent Work on the Neolithic Round Barrows of the Upper Great Wold Valley, Yorkshire'. In *Round Mounds and Monumentality in the British Neolithic and Beyond*, edited by Jim Leary, Timothy Darvill, and David Field, 72–107. Neolithic Studies Group Seminar Papers ; 10. Oxford: Oxbow Books.

Gibson, Alex, and Ian Kinnes. 1997. 'On the Urns of a Dilemma: Radiocarbon and the Peterborough Problem'. *Oxford Journal of Archaeology* 16 (1): 65–72. https://doi.org/10.1111/1468-0092.00025.

Gibson, Alex, and Ann Woods. 1997. *Prehistoric Pottery for the Archaeologist*. 2nd ed. London: Leicester University Press.

Gilbertson, David. 1984. 'Early Neolithic Utilisation and Management of Alder Carr at Skipsea Withow Mere, Holderness'. *Yorkshire Archaeological Journal* 56: 17–22.

Gillings, Mark. 2000. 'The Utility of the GIS Aprroach in the Collection, Management, Storage and Analysis of Durface Survey Data'. In *The Future of Surface Artefact Survey in Europe*, edited by John Bintliff, Martin Kuna, and Natalie Venclová, 105–20. Sheffield: Sheffield Academic Press.

Gillings, Mark, and Kostas Sbonias. 1999. 'Regional Survey and GIS: The Boeotia Project'. In *Geographical Information Systems and Landscape Archaeology*, edited by Mark Gillings, David Mattingly, and Jan van Dalen, 35–54. Oxford: Oxbow Books.

Godwin, Harry, and Margaret Godwin. 1933. 'British Maglemose Harpoon Sites'. *Antiquity* 7 (25): 36–48. https://doi.org/10.1017/S0003598X00007614.

Goodchild, Michael. 1988. *Spatial Autocorrelation*. CATMOG 47. Norwich: Geo Books.

Gosden, Chris. 1994. *Social Being and Time*. Oxford: Blackwell.

Gosden, Chris, and Gary Lock. 1998. 'Prehistoric Histories'. *World Archaeology* 30 (1): 2–12. https://doi.org/10.1080/00438243.1998.9980393.

Green, Stephen. 1980. *The Flint Arrowheads of the British Isles: A Detailed Study of Material from England and Wales with Comparanda from Scotland and Ireland*. BAR British Series. Oxford: British Archaeological Reports.

———. 1984. 'Flint Arrowheads: Typology and Interpretation'. *Lithics* 5: 19–39.

Greenacre, Michael. 2007. *Correspondence Analysis in Practice*. 2nd ed. Boca Raton, Fla; London: Chapman & Hall.

Greenwell, William. 1877. *British Barrows: A Record of the Examination of Sepulchral Mounds in Various Parts of England*. Oxford: Clarendon Press.

———. 1890. 'Recent Researches in Barrows in Yorkshire, Wiltshire, Berkshire, Etc.' *Archaeologia* 52 (January): 1–72.

Grimaldi, Stefano. 1998. 'Methodological Problems in the Reconstruction of "Chaînes Opératoires" in Lower-Middle Palaeolithic Industries'. In *Lithic Technology: From Raw Material Procurement to Tool Production: Workshop No. 12 of the XIII International Congress of Prehistoric and Protohistoric Sciences*, edited by Sarah Milliken and Marco Peresani, 19–22. Forlì: MAC.

Guiry, Eric. 2012. 'Dogs as Analogs in Stable Isotope-Based Human Paleodietary Reconstructions: A Review and Considerations for Future Use'. *Journal of Archaeological Method and Theory* 19 (3): 351–76. https://doi.org/10.1007/s10816-011-9118-z.

Haggett, Peter. 1965. 'Scale Components in Geographical Problems'. In *Frontiers in Geographical Teaching: The Madingley Lectures for 1963*, edited by Richard Chorley and Peter Haggett, 164–85. London: Methuen.

Halkon, Peter, Terry Manby, Martin Millett, Helen Woodhouse, Rachel Ballantyne, Barry Bishop, Jacqui Huntley, and Deborah Jaques. 2010. 'Neolithic Settlement Evidence from Hayton, East Yorks'. *Yorkshire Archaeological Journal* 82 (1): 31–57. https://doi.org/10.1179/yaj.2010.82.1.31.

Haraway, Donna. 1991. *Simians, Cyborgs, and Women: The Reinvention of Nature*. New York: Routledge.

Harding, Anthony, and Graham Lee. 1987. *Henge Monuments and Related Sites of Great Britain: Air Photographic Evidence and Catalogue*. BAR British Series. Oxford: British Archaeological Reports.

Harding, Jan. 1996. 'Reconsidering the Neolithic Round Barrows of Eastern Yorkshire'. In *Neolithic Studies in No-Man's Land: Papers on the Neolithic of Northern England from the Trent to the Tweed*, edited by Paul Frodsham, 13/14:67–78. Northern Archaeology. Newcastle upon Tyne: Northumberland Archaeological Group.

———. 1999. 'Pathways to New Realms: Cursus Monuments and Symbolic Territories'. In *Pathways and Ceremonies: The Cursus Monuments of Britain and Ireland*, edited by Alistair Barclay and Jan Harding, 30–38. Neolithic Studies Group Seminar Papers 4. Oxford: Oxbow Books.

———. 2000. ‘Later Neolithic Ceremonial Centres, Ritual and Pilgrimage: The Monument Complex of Thornborough, North Yorkshire’. In *Neolithic Orkney in Its European Context*, edited by Anna Ritchie, 31–46. McDonald Institute Monographs. Cambridge: McDonald Institute for Archaeological Research, University of Cambridge.

———. 2006. ‘Pit-Digging, Occupation and Structured Deposition on Rudston Wold, Eastern Yorkshire’. *Oxford Journal of Archaeology* 25 (2): 109–26. https://doi.org/10.1111/j.1468-0092.2006.00252.x.

———. 2013. *Cult, Religion, and Pilgrimage: Archaeological Investigations at the Neolithic and Bronze Age Monument Complex of Thornborough, North Yorkshire*. CBA Research Report 174. York: Council for British Archaeology.

Harding, Jan, and Benjamin Johnson. 2013. ‘Widespaced Fieldwalking’. In *Cult, Religion, and Pilgrimage: Archaeological Investigations at the Neolithic and Bronze Age Monument Complex of Thornborough, North Yorkshire*, by Jan Harding, 148–73. CBA Research Report 174. York: Council for British Archaeology.

Harding, Phil. 1990. ‘The Comparative Analysis of Four Stratified Flint Assemblages and a Knapping Cluster’. In *The Stonehenge Environs Project*, edited by Julian Richards and Michael Allen, 213–25. London: English Heritage.

Harris, Trevor. 2006. ‘Scale as Artefact: GIS, Ecological Fallacy, and Archaeological Analysis’. In *Confronting Scale in Archaeology: Issues of Theory and Practice*, edited by Gary Lock and Brian Molyneaux, 39–54. New York: Springer.

Harvey, David. 1969. *Explanation in Geography*. London: Edward Arnold.

Haselgrove, Colin. 1985. ‘Inference from Ploughsoil Artefact Samples’. In *Archaeology from the Ploughsoil: Studies in the Collection and Interpretation of Field Survey Data*, edited by Colin Haselgrove, Martin Millett, and Ian Smith, 7–29. Sheffield: Department of Archaeology and Prehistory, University of Sheffield.

Haughey, Fiona. 2016. ‘Routeways of the Neolithic’. In *Moving on in Neolithic Studies: Understanding Mobile Lives*, edited by Jim Leary and Thomas Kador, 110–21. Havertown: Oxbow Books.

Haughton, Christine, and Dominic Powlesland. 1999. *West Heslerton: The Anglian Cemetery*. Yedingham: Landscape Research Centre.

Hayfield, Colin. 1987. *An Archaeological Survey of the Parish of Wharram Percy, East Yorkshire: The Evolution of the Roman Landscape*. Vol. 5. Wharram, a Study of Settlement on the Yorkshire Wolds. BAR British Series. Oxford: British Archaeological Reports.

Hayfield, Colin, and Terry Manby. 1996. ‘A Flint Axe from Aldro, East Yorkshire’. *Yorkshire Archaeological Journal* 68: 235–40.

Hayfield, Colin, John Pouncett, and Pat Wagner. 1995. ‘Vessey Ponds: A “Prehistoric” Water Supply in East Yorkshire?’ *Proceedings of the Prehistoric Society* 61: 393–408. https://doi.org/10.1017/S0079497X00003145.

Hedges, Robert, and Linda Reynard. 2007. 'Nitrogen Isotopes and the Trophic Level of Humans in Archaeology'. *Journal of Archaeological Science* 34 (8): 1240–51. https://doi.org/10.1016/j.jas.2006.10.015.

Henson, Don. 1985. 'The Flint Resources of Yorkshire and the East Midlands'. *Lithics* 6: 2–9.

Hodell, David, Paul Mueller, Judith McKenzie, and Gregory Mead. 1989. 'Strontium Isotope Stratigraphy and Geochemistry of the Late Neogene Ocean'. *Earth and Planetary Science Letters* 92 (2): 165–78. https://doi.org/10.1016/0012-821X(89)90044-7.

Holgate, Robin. 1988. *Neolithic Settlement of the Thames Basin*. BAR British Series. Oxford: British Archaeological Reports.

Howard-Davis, Christine, Morag Bain, Heather Bamford, Bernard Barnes, Roger Leech, and Jamie Quartermaine. 1996. 'Seeing the Sites: Survey and Excavation on the Anglezarke Uplands, Lancashire'. *Proceedings of the Prehistoric Society* 62: 133–66. https://doi.org/10.1017/S0079497X0000 2772.

Hutton, Ronald. 2014. *Pagan Britain*. New Haven: Yale University Press.

Ingold, Tim. 1993. 'The Temporality of the Landscape'. *World Archaeology* 25 (2): 152–74. https://doi.org/10.1080/00438243.1993.9980235.

———. 2000. *The Perception of the Environment: Essays on Livelihood, Dwelling and Skill*. London: Routledge.

Inizan, Marie-Louise, Michèle Reduron-Ballinger, Hélène Roche, and Jacques Tixier. 1999. *Technology and Terminology of Knapped Stone*. Nanterre: CREP.

Jacobi, Roger. 1979. 'Northern England in the Eighth Millennium BC: An Essay'. In *Early Postglacial Settlement of Northern Europe*, edited by Paul Mellars, 295–332. London: Gerald Duckworth & Co Ltd.

Jay, Mandy, and Michael Richards. 2006. 'Diet in the Iron Age Cemetery Population at Wetwang Slack, East Yorkshire, UK: Carbon and Nitrogen Stable Isotope Evidence'. *Journal of Archaeological Science* 33 (5): 653–62. https://doi.org/10.1016/j.jas.2005.09.020.

Jelgersma, Saskia. 1979. 'Sea-Level Changes in the North Sea Basin'. In *The Quaternary History of the North Sea*, edited by Erno Oele and Lars-König Königsson, 233–48. Acta Universitatis Upsaliensis. Symposia Universitatis Upsaliensis Annum Quingentesimum Celebrantis 2. Uppsala: Societas Upsaliensis pro geologia quaternaria.

Jones, Glynis, and Peter Rowley-Conwy. 1997. 'On the Importance of Cereal Cultivation in the British Neolithic'. In *Origins and Spread of Domestic Plants in Southwest Asia and Europe*, edited by Sue Colledge, James Conolly, and Steven Shennan, 392–420. Walnut Creek, UNITED STATES: Left Coast Press.

Kain, Roger, and Richard Oliver. 2001. *The Historic Parishes of England and Wales: An Electronic Map of Boundaries before 1850 with a Gazetteer and Metadata*. Colchester: History Data Service, UK Data Archive.

Keen, Laurence, and Jeffrey Radley. 1971. “Report on the Petrological Identification of Stone Axes from Yorkshire.” *Proceedings of the Prehistoric Society* 37 (1): 16–37. https://doi.org/10.1017/S0079497X00012743.

Kinnes, Ian. 1979. *Round Barrows and Ring-Ditches in the British Neolithic*. London: British Museum.

———. 1992. *Non-Megalithic Long Barrows and Allied Structures in the British Neolithic*. London: British Museum.

Kinnes, Ian, Timothy Schadla-Hall, Paul Chadwick, and Philip Dean. 1983. ‘Duggleby Howe Reconsidered’. *Archaeological Journal* 140 (1): 83–108. https://doi.org/10.1080/00665983.1983.11077686.

Knight, Becky, Nicky Milner, Terry O’Connor, Ben Elliott, Harry Robson, Mike Buckley, Piotr Witkowski, Sophy Charlton, Oliver Craig, and Matthew Collins. 2018. ‘Faunal Remains: Results by Species’. In *Star Carr Volume 2*, edited by Nicky Milner, Chantal Conneller, and Barry Taylor, 195–254. White Rose University Press. https://doi.org/10.22599/book2.

Laffoon, Jason, Till Sonnemann, Termeh Shafie, Corinne Hofman, Ulrik Brandes, and Gareth Davies. 2017. ‘Investigating Human Geographic Origins Using Dual-Isotope ($^{87}Sr/^{86}Sr$, $\Delta^{18}O$) Assignment Approaches’. *PLOS ONE* 12 (2): e0172562. https://doi.org/10.1371/journal.pone.0172562.

Lanting, Jan, and Johannes van der Waals. 1972. ‘British Beakers as Seen from the Continent’. *Helinium* 12: 20–46.

Legge, Anthony, and Peter Rowley-Conwy. 1988. *Star Carr Revisited: A Re-Analysis of the Large Mammals*. London: Centre for Extra-Mural Studies, Birbeck College, University of London.

Lock, Gary, Tyler Bell, and John Lloyd. 1999. ‘Towards a Methodology for Modelling Surface Survey Data: The Sangro Valley Project’. In *Geographical Information Systems and Landscape Archaeology*, edited by Mark Gillings, David Mattingly, and Jan van Dalen, 55–64. Oxford: Oxbow Books.

Lock, Gary, and Patrick Daly. 1999. ‘Looking at Change, Continuity and Time in GIS: An Example from the Sangro Valley, Italy’. In *New Techniques for Old Times: CAA 98, Computer Applications and Quantitative Methods in Archaeology, Proceedings of the 26th Conference, Barcelona, March 1998*, edited by Juan Barceló, Ivan Briz, and Asunción Vila, 259–63. Oxford: Archaeopress. https://proceedings.caaconference.org/paper/40_lock_daly_caa_1998/.

Longworth, Ian. 1984. *Collared Urns of the Bronze Age in Great Britain and Ireland*. Gulbenkian Archaeological Series. Cambridge: Cambridge University Press.

Longworth, Ian, Andrew Herne, Gillian Varndell and Stuart Needham. 1991. *Excavations at Grimes Graves, Norfolk 1972-1976. Fascicule 3. Shaft X: Bronze Age Flint, Chalk and Metal Working.* London: British Museum Publications.

Loughlin, Neil, and Keith Miller. 1979. *A Survey of Archaeological Sites in Humberside*. Hull: Humberside Libraries and Amenities.

Loveday, Roy. 2002. 'Duggleby Howe Revisited'. *Oxford Journal of Archaeology* 21 (2): 135–46. https://doi.org/10.1111/1468-0092.00153.

———. 2009. 'From Ritual to Riches – the Route to Individual Power in Later Neolithic Eastern Yorkshire?' In *Defining a Regional Neolithic*, edited by Kenneth Brophy and Gordon Barclay, 9:35–52. Evidence from Britain and Ireland. Oxford: Oxbow Books.

———. 2011. 'Polished Rectangular Flint Knives - Elaboration or Replication?' In *Flint and Stone in the Neolithic Period*, edited by Alan Saville, 37–61. Neolithic Studies Group Seminar Papers 11. Oxford: Oxbow.

———. 2016. 'Monuments to Mobility? Investigating Cursus Patterning in Southern Britain'. In *Moving on in Neolithic Studies: Understanding Mobile Lives*, edited by Jim Leary and Thomas Kador, 67–109. Oxford: Oxbow Books.

Mackay, William. 1979. "A Discoidal Knife from Kepwick and Neolithic Finds from Pocklington." *Yorkshire Archaeological Journal* 51: 137–39.

Makey, Peter. 1989. 'A Study of the Flint Arrowheads in the Grantham Collection (East Yorkshire): With an Emphasis on Distribution and Raw Materials'. Sheffield: University of Sheffield.

———. 1996. 'The Flint'. *Yorkshire Archaeological Journal* 68: 54–64.

Manby, Terry. 1974. *Grooved Ware Sites in Yorkshire and the North of England*. BAR British Series. Oxford: British Archaeological Reports.

———. 1975. 'Neolithic Occupation Sites on the Yorkshire Wolds'. *Yorkshire Archaeological Journal* 47: 23–59.

———. 1988. 'The Neolithic in Eastern Yorkshire'. In *Archaeology in Eastern Yorkshire: Essays in Honour of T. C. M. Brewster*, edited by Terry Manby, 35–88. Sheffield: Department of Archaeology and Prehistory, University of Sheffield.

Manby, Terry, Alan King, and Blaize Vyner. 2003. 'The Neolithic and Bronze Ages: A Time of Early Agriculture'. In *The Archaeology of Yorkshire: An Assessment at the Beginning of the 21st Century: Papers Arising out of the Yorkshire Archaeological Resource Framework Forum Conference at Ripon, September 1998*, edited by Terry Manby, Stephen Moorhouse, and Patrick Ottaway, 35–113. Leeds: Yorkshire Archaeological Society.

Manby, Terry, Stephen Moorhouse, and Patrick Ottaway, eds. 2003. *The Archaeology of Yorkshire: An Assessment at the Beginning of the 21st Century: Papers Arising out of the Yorkshire Archaeological Resource Framework Forum Conference at Ripon, September 1998*. Leeds: Yorkshire Archaeological Society.

Marshall, Pete, Alex Bayliss, Jim Leary, Gill Campbell, Fay Worley, Chris Bronk Ramsey, and Gordon Cook. 2013. 'The Silbury Chronology'. In *Silbury Hill: The Largest Prehistoric Mound in Europe*, edited by Jim Leary, David Field, and Gill Campbell, 97–116. Swindon: English Heritage.

McFadyen, Lesley. 2006. 'Material Culture as Architecture: Neolithic Long Barrows in Southern Britain'. *Journal of Iberian Archaeology* 8: 91–102.

McInnes, Isla. 1964. ‘A Class II Henge in the East Riding of Yorkshire’. *Antiquity* 38 (151): 218–19. https://doi.org/10.1017/S0003598X00105083.

———, Isla. 1966. “The Yorkshire Archaeological Register 1965.” *Yorkshire Archaeological Journal* 41: 555–65.

Meaney, Audrey. 1964. *A Gazetteer of Early Anglo-Saxon Burial Sites*. London: Allen & Unwin.

Meirion-Jones, Gwyn. 1979. “Excavations in 1978.” *Mediaeval Village Research Group Annual Report* 26: 5–16.

Mellars, Paul. 1996. *The Neanderthal Legacy: An Archaeological Perspective from Western Europe*. Princeton: Princeton University Press.

———. 2009. ‘Moonshine over Star Carr: Post-Processualism, Mesolithic Myths and Archaeological Realities’. *Antiquity* 83 (320): 502–17. https://doi.org/10.1017/S0003598X00098616.

Mellars, Paul, and Martha Andrews. 1987. *Excavations on Oronsay: Prehistoric Human Ecology on a Small Island*. Edinburgh: Edinburgh University Press.

Mellars, Paul, and Petra Dark, eds. 1998. *Star Carr in Context: New Archaeological and Palaeoecolgical Investigations at the Early Mesolithic Site of Star Carr, North Yorkshire*. Cambridge: McDonald Institute for Archaeological Research.

Merwe, Nikolaas van der, and Ernesto Medina. 1991. ‘The Canopy Effect, Carbon Isotope Ratios and Foodwebs in Amazonia’. *Journal of Archaeological Science* 18: 249–59. https://doi.org/10.1016/0305-4403(91)90064-V.

Millett, Martin. 1991. ‘Pottery: Population or Supply Patterns? The Ager Tarraconensis Approach’. In *Roman Landscapes: Archaeological Survey in the Mediterranean Region*, edited by Graeme Barker and John Lloyd, 18–26. London: British School at Rome.

Milner, Nicky, Chantal Conneller, and Barry Taylor, eds. 2018a. *Star Carr Volume 1*. White Rose University Press. https://doi.org/10.22599/book1.

———, eds. 2018b. *Star Carr Volume 2*. White Rose University Press. https://doi.org/10.22599/book2.

Milner, Nicky, Barry Taylor, Chantal Conneller, and Alex Bayliss. 2018. ‘Interpretative Narrative of the Historic of Occupation’. In *Star Carr Volume 1*, edited by Nicky Milner, Chantal Conneller, and Barry Taylor, 225–44. White Rose University Press. https://doi.org/10.22599/book1.

Mizoguchi, Koji. 1993. ‘Time in the Reproduction of Mortuary Practices’. *World Archaeology* 25 (2): 223–35. https://doi.org/10.1080/00438243.1993.9980239.

Montgomery, Janet, Paul Budd, and Jane Evans. 2000. ‘Reconstructing the Lifetime Movements of Ancient People: A Neolithic Case Study from Southern England’. *European Journal of Archaeology* 3 (3): 370–85. https://doi.org/10.1177/146195710000300304.

Montgomery, Janet, Rachel Cooper, and Jane Evans. 2007. 'Foragers, Farmers or Foreigners? An Assessment of Dietary Strontium Isotope Variation in Middle Neolithic and Early Bronze Age East Yorkshire'. In *From Stonehenge to the Baltic: Living with Cultural Diversity in the Third Millennium BC*, edited by Mats Larsson and Michael Parker Pearson, 65–75. BAR International Series. Oxford: Archaeopress.

Montgomery, Janet, Jane Evans, and Rachel Cooper. 2007. 'Resolving Archaeological Populations with Sr-Isotope Mixing Models'. *Applied Geochemistry* 22 (7): 1502–14. https://doi.org/10.1016/j.apgeochem.2007.02.009.

Montgomery, Janet, and Mandy Jay. 2013. 'The Contribution of Skeletal Isotope Analysis to Understanding the Bronze Age in Europe'. *The Oxford Handbook of the European Bronze Age*, June. https://doi.org/10.1093/oxfordhb/9780199572861.013.0010.

Moore, John. 1950. 'Mesolithic Sites in the Neighbourhood of Flixton, North-East Yorkshire'. *Proceedings of the Prehistoric Society* 16: 101–8. https://doi.org/10.1017/S0079497X00018946.

Moorhouse, Stephen. 1977. "The Yorkshire Archaeological Register: 1976." *Yorkshire Archaeological Journal* 49: 1–18.

———. 1964. 'Excavations at Beacon Hill, Flamborough Head, East Yorkshire'. *Yorkshire Archaeological Journal* 41: 191–202.

Mortimer, John. 1880. '"Kemp How", Cowlam'. *The Journal of the Anthropological Institute of Great Britain and Ireland* 9: 394.

———. 1891. 'Evidence of the Religious Beliefs of the Ancient Britons'. *Yorkshire Archaeological Journal* 19: 446–52.

———. 1892. 'An Account of the Opening of the Tumulus "Howe Hill" Duggleby'. *Proceedings of the Yorkshire Geological and Polytechnical Society* xii: 215–25.

———. 1893. 'Further Observations on the Contents of the Howe Tumuls [Duggleby]'. *Proceedings of the Yorkshire Geological and Polytechnical Society* xii: 242–45.

———. 1905. *Forty Years' Researches in British and Saxon Burial Mounds of East Yorkshire: Including Romano-British Discoveries, and a Description of the Ancient Entrenchments of a Section of the Yorkshire Wolds*. London: A Brown and Sons, Limited.

Needham, Stuart. 2005. 'Transforming Beaker Culture in North-West Europe; Processes of Fusion and Fission'. *Proceedings of the Prehistoric Society* 71: 171–217. https://doi.org/10.1017/S0079497X00001006.

Neil, Samantha, Jane Evans, Janet Montgomery, and Chris Scarre. 2018. 'Isotopic Evidence for Landscape Use and the Role of Causewayed Enclosures During the Earlier Neolithic in Southern Britain'. *Proceedings of the Prehistoric Society*, 1–21. https://doi.org/10.1017/ppr.2018.6.

Noe-Nygaard, Nanna. 1988. 'Δ^{13}C-Values of Dog Bones Reveal the Nature of Changes in Man's Food Resources at the Mesolithic-Neolithic Transition, Denmark'. *Chemical Geology: Isotope Geoscience Section* 73 (1): 87–96. https://doi.org/10.1016/0168-9622(88)90023-1.

Nooy, Wouter de, Andrej Mrvar, and Vladimir Batagelj. 2005. *Exploratory Social Network Analysis with Pajek*. Cambridge: Cambridge University Press.

Odell, George, and Frank Cowan. 1987. 'Estimating Tillage Effects on Artifact Distributions'. *American Antiquity* 52 (3): 456–84. https://doi.org/10.2307/281594.

Openshaw, Stan. 1983. *The Modifiable Areal Unit Problem*. Norwich: Geo Books.

Orton, Clive. 2000. *Sampling in Archaeology*. Cambridge: Cambridge University Press.

Oswald, Alastair, Martyn Barber, and Carolyn Dyer. 2001. *The Creation of Monuments: Neolithic Causewayed Enclosures in the British Isles*. Swindon: English Heritage.

Palmer, Adrian, Ian Matthews, Ian Candy, Simon Blockley, Alison MacLeod, Christopher Darvill, Nicky Milner, Chantal Conneller, and Barry Taylor. 2015. 'The Evolution of Palaeolake Flixton and the Environmental Context of Star Carr, NE. Yorkshire: Stratigraphy and Sedimentology of the Last Glacial-Interglacial Transition (LGIT) Lacustrine Sequences'. *Proceedings of the Geologists' Association* 126 (1): 50–59. https://doi.org/10.1016/j.pgeola. 2014.10.002.

Parker Pearson, Mike, Andrew Chamberlain, Mandy Jay, Peter Marshall, Josh Pollard, Colin Richards, Julian Thomas, Chris Tilley, and Kate Welham. 2009. 'Who Was Buried at Stonehenge?' *Antiquity* 83 (319): 23–39. https://doi.org/10.1017/S0003598X00098069.

Parker Pearson, Mike, Andrew Chamberlain, Mandy Jay, Mike Richards, and Jane Evans, eds. 2018. *The Beaker People: Isotopes, Mobility and Diet in Prehistoric Britain*. Vol. 7. Prehistoric Society Research Papers. Oxford: Oxbow Books.

Parker Pearson, Mike, Andrew Chamberlain, Mandy Jay, Mike Richards, Alison Sheridan, Neil Curtis, Jane Evans, et al. 2016. 'Beaker People in Britain: Migration, Mobility and Diet'. *Antiquity* 90 (351): 620–37. https://doi.org/10.15184/aqy.2016.72.

Parker Pearson, Mike, Ros Cleal, Peter Marshall, Stuart Needham, Joshua Pollard, Colin Richards, Clive Ruggles, et al. 2007. 'The Age of Stonehenge'. *Antiquity* 81 (313): 617–39. https://doi.org/10.1017/S0003598X00095624.

Parker Pearson, Mike, Joshua Pollard, Colin Richards, Julian Thomas, Christopher Tilley, Kate Welham, and Umberto Albarella. 2006. 'Materializing Stonehenge: The Stonehenge Riverside Project and New Discoveries'. *Journal of Material Culture* 11 (1–2): 227–61. https://doi.org/ 10.1177/1359183506063024.

Parker Pearson, Mike, Joshua Pollard, Christopher Tilley, Julian Thomas, Colin Richards, and Kate Welham. 2005. 'The Stonehenge Riverside Project: Summary Interim Report, 2005'.

———. 2006. 'The Stonehenge Riverside Project: Summary Interim Report on the 2006 Season'.

Parker Pearson, Mike, and Ramilisonina. 1998. 'Stonehenge for the Ancestors: The Stones Pass on the Message'. *Antiquity* 72 (276): 308–326. https://doi.org/10.1017/S0003598 X00086592.

Pegge. 1779. 'Mr. Pegge, on the Rudston Pyramidal Stone'. *Archaeologia* 5: 95–97. https:// doi.org/10.1017/S0261340900014673.

Pellegrini, Maura, John Pouncett, Mandy Jay, Mike Parker Pearson, and Michael Richards. 2016. 'Tooth Enamel Oxygen "Isoscapes" Show a High Degree of Human Mobility in Prehistoric Britain'. *Scientific Reports* 6 (October). https://doi.org/10.1038/srep34986.

Penny, Lewis, G. Russell Coope, and John Catt. 1969. 'Age and Insect Fauna of the Dimlington Silts, East Yorkshire'. *Nature* 224 (5214): 65–67. https://doi.org/10.1038/224065b0.

Phillips, Patricia. 1989. 'Flint Procurement in Prehistoric Quarry Ditches'. In *Breaking the Stony Silence: Papers from the Sheffield Lithics Conference 1988*, edited by Ian Brooks and Patricia Phillips, 33–51. BAR International Series. Oxford: British Archaeological Reports.

Phillips, Patricia, William Cummins, and Laurence Keen. 1988. "The Petrological Identification of Stone Implements from Yorkshire: Second Report." In *Stone Axe Studies, 2: The Petrology of Prehistoric Implements from the British Isles*, edited by Timothy Clough and William Cummins, 52–59. London: Council for British Archaeology.

Pierpoint, Stephen. 1980. *Social Patterns in Yorkshire Prehistory 3500-750 B.C.* BAR British Series. Oxford: British Archaeological Reports.

Piggott, Stuart. 1954. *The Neolithic Cultures of the British Isles: A Study of the Stone-Using Agricultural Communities of Britain in the Second Millennium B.C.* Cambridge: Cambridge University Press.

———. 1973. 'The Dalladies Long Barrow: NE Scotland'. *Antiquity* 47 (185): 32–36. https://doi.org/10.1017/S0003598X00034645.

Pollard, A. Mark, Maura Pellegrini, and Julia Lee-Thorp. 2011. 'Technical Note: Some Observations on the Conversion of Dental Enamel $\Delta^{18}O_p$ Values to $\Delta^{18}O_w$ to Determine Human Mobility'. *American Journal of Physical Anthropology* 145 (3): 499–504. https://doi.org/10.1002/ ajpa.21524.

Pollard, Joshua. 1994. 'Excavations at Millbarrow Neolithic Chambered Tomb, Winterbourne Monkton, North Wiltshire. Appendix 2: Dating, Associations and Contexts of Flint Polished-Edge Blade Knives'. *The Wiltshire Archaeological and Natural History Magazine* 87: 51–52.

———. 1999. '"These Places Have Their Moments": Thoughts on Settlement Practices in the British Neolithic'. In *Making Places in the Prehistoric World: Themes in Settlement Archaeology*, edited by Joanna Brück and Melissa Goodman, 76–93. London: UCL Press.

———. 2005. 'Memory, Monuments and Middens in the Neolithic Landscape'. In *The Avebury Landscape: Aspects of the Field Archaeology of the Marlborough Downs*, edited by Graham Brown, David Field, and David McOmish, 103–14. Oxford: Oxbow.

Pouncett, John. 2007. 'Network Analysis and Landscape Stratigraphy'. In *The World Is in Your Eyes*, edited by Alexandra Figueiredo and Gonçalo Velho, 397–402. Tomar: CAA Portugal. http://proceedings.caaconference.org/paper/58_pouncett_caa_2005/.

———. 2010. 'Lithics and Landscape: GIS Approaches to the Analysis of Lithic Artefact Scatters - CAA Online Proceedings'. In *Beyond the Artifact: Digital Interpretation of the Past*, edited by Franco Nicolucci and Sorin Hermon, 195–200. Budapest: Archaeolingua. http://proceedings.caaconference.org/paper/37_pouncett_caa_2004/.

Price, T. Douglas, James Burton, and R. Alexander Bentley. 2002. 'The Characterization of Biologically Available Strontium Isotope Ratios for the Study of Prehistoric Migration'. *Archaeometry* 44 (1): 117–35. https://doi.org/10.1111/1475-4754.00047.

Procter, William. 1855. 'Report of the Proceedings of the Yorkshire Antiquarian Club, in the Excavation of Barrows from the Year 1849'. *Yorkshire Philosophical Society Annual Report*, no. 1855 (Part II): 176–89.

Radley, Jeffrey. 1969. 'A Note on Four Maglemosian Bone Points from Brandesburton, and a Flint Site at Brigham, Yorkshire'. *The Antiquaries Journal* 49 (2): 377–78. https://doi.org/10.1017/S0003581500053841.

———. 1974. "The Prehistory of the Vale of York." *Yorkshire Archaeological Journal* 46: 10–22.

———. 1975. "Polished Flint Arrowheads from East Yorkshire." *Transactions of the East Riding Archaeological Society* 2: 46–48.

Radley, Jeffrey, and Paul Mellars. 1964. 'A Mesolithic Structure at Deepcar, Yorkshire, England, and the Affinities of Its Associated Flint Industries'. *Proceedings of the Prehistoric Society* 30 (December): 1–24. https://doi.org/10.1017/S0079497X00015024.

Rahtz, Philip, and John Bateman. 1986. 'Wharram Le Street Roman Villa'. In *Two Roman Villas at Wharram Le Street*, edited by Philip Rahtz, John Bateman, and Colin Hayfield. Vol. 4. Wharram, a Study of Settlement on the Yorkshire Wolds. York: Department of Archaeology, University of York.

Reynier, Michael. 2005. *Early Mesolithic Britain: Origins, Development and Directions*. BAR British Series; 393. Oxford: Archaeopress.

Reynolds, Peter. 1982. 'The Ploughzone'. In *Festschrift zum 100jährigen Bestehen der Abteilung für Vorgeschichte*, 315–40. Nürnberg: Naturhistorische Gesellschaft.

Richards, Colin. 1996. 'Henges and Water: Towards an Elemental Understanding of Monumentality and Landscape in Late Neolithic Britain'. *Journal of Material Culture* 1 (3): 313–36. https://doi.org/10.1177/135918359600100303.

Richards, Colin, and Julian Thomas. 1984. 'Ritual Activity and Structured Deposition in Late Neolithic Wessex'. In *Neolithic Studies: A Review of Some Current Research*, edited by Richard Bradley and Julie Gardiner, 189–218. Reading Studies in Archaeology 1. Oxford, England: British Archaeological Reports.

Richards, Julian. 1985. 'Scouring the Surface: Approaches to the Ploughzone in the Stonehenge Environs'. *Archaeological Review from Cambridge* 4 (1): 27–42.

Richards, Julian, and Michael Allen. 1990. *The Stonehenge Environs Project*. London: English Heritage.

Richards, Michael. 2000. 'Human Consumption of Plant Foods in the British Neolithic: Direct Evidence from Bone Isotopes'. In *Plants in Neolithic Britain and Beyond*, edited by Andrew Fairbairn, 123–35. Neolithic Studies Group Seminar Papers 5. Oxford: Oxbow Books.

Riley, Derek. 1980. ‘Recent Air Photographs of Duggleby Howe and the Ferrybridge Henge’. *Yorkshire Archaeological Journal* 52: 174–78.

———. 1988. ‘Air Survey of Neolithic Sites on the Yorkshire Wolds’. In *Archaeology in Eastern Yorkshire: Essays in Honour of T. C. M. Brewster*, edited by Terry Manby, 89–93. Sheffield: Department of Archaeology and Prehistory, University of Sheffield.

Riley, Hazel. 1990. ‘The Scraper Assemblages and Petit Tranchet Derivative Arrowheads’. In *The Stonehenge Environs Project*, edited by Julian Richards and Michael Allen, 225–28. London: English Heritage.

Roe, Fiona. 1966. “The Battle-Axe Series in Britain.” *Proceedings of the Prehistoric Society* 32 (December): 199–245. https://doi.org/10.1017/S0079497X00014390.

Roe, Fiona, and Jeffrey Radley. 1968. “Pebble Mace-Heads with Hour-Glass Perforations from Yorkshire, Nottinghamshire and Derbyshire.” *Yorkshire Archaeological Journal* 42: 169–77.

Rutter, James. 1965. “Archaeological Index for North-East Yorkshire 1964-65.” *Transactions of the Scarborough and District Archaeological Society* 8: 33.

———. 1966. “The Yorkshire Archaeological Register 1965.” *Yorkshire Archaeological Journal* 41: 555–65.

———. 1971. “Archaeological Index for North-East Yorkshire 1970-71.” *Transactions of the Scarborough and District Archaeological Society* 14: 53.

Ryan, Saskia, Christophe Snoeck, Quentin Crowley, and Michael Babechuk. 2018. ‘$^{87}Sr/^{86}Sr$ and Trace Element Mapping of Geosphere-Hydrosphere-Biosphere Interactions: A Case Study in Ireland’. *Applied Geochemistry* 92 (May): 209–24. https://doi.org/10.1016/j.apgeochem.2018.01.007.

Saville, Alan. 1990. *Hazleton North, Gloucestershire, 1979-82: The Excavation of a Neolithic Long Cairn of the Cotswold-Severn Group*. London: English Heritage.

———. 2002. ‘Lithic Artefacts from Causewayed Enclosures: Character and Meaning’. In *Enclosures in Neolithic Europe: Essays on Causewayed and Non-Causewayed Sites*, edited by Gillian Varndell and Peter Topping, 91–105. Oxford: Oxbow.

Schadla-Hall, R. Tim. 1987. ‘Recent Investigations of the Early Mesolithic Landscape in the Vale of Pickering, East Yorkshire’. In *Mesolithic Northwest Europe: Recent Trends*, edited by Hans Peter Blankholm, Marek Zvelebil, and Peter Rowley-Conwy, 46–54. Sheffield: Department of Archaeology and Prehistory, University of Sheffield.

———. 1988. ‘The Early Post-Glacial in Eastern Yorkshire’. In *Archaeology in Eastern Yorkshire: Essays in Honour of T. C. M. Brewster*, edited by Terry Manby, 25–34. Sheffield: Department of Archaeology and Prehistory, University of Sheffield.

———. 1989. ‘The Vale of Pickering in the Early Mesolithic in Context’. In *The Mesolithic in Europe: Papers Presented at the Third International Symposium, Edinburgh 1985*, edited by Clive Bonsall, 218–24. Edinburgh: John Donald.

Schoeninger, Margaret, and Michael DeNiro. 1984. 'Nitrogen and Carbon Isotopic Composition of Bone Collagen from Marine and Terrestrial Animals'. *Geochimica et Cosmochimica Acta* 48 (4): 625–39. https://doi.org/10.1016/0016-7037(84)90091-7.

Schofield, A. John. 1987. 'Putting Lithics to the Test: Non-Site Analysis and the Neolithic Settlement of Southern England'. *Oxford Journal of Archaeology* 6 (3): 269–286. https://doi.org/10.1111/j.1468-0092.1987.tb00157.x.

———. 1994. 'Looking Back with Regret; Moving Forward with Optimism: Making More of Surface Lithic Scatters'. In *Stories in Stone*, edited by Nick Ashton and Andrew David, 90–98. London: Lithic Studies Society.

———. 1995. 'Settlement Mobility and La Longue Durée: Towards a Context for Surface Lithic Material'. In *Lithics in Context: Suggestions for the Future Direction of Lithic Studies*, edited by A. John Schofield, 105–13. London: Lithic Studies Society.

———. 1997. 'Staring Through Stereograms: The Future for Surface Artefact Survey'. *Proceedings of the Latvian Academy of Sciences* 51 (5/6): 48–53.

———. 2000a. *Managing Lithic Scatters: Archaeological Guidance for Planning Authorities and Developers*. London: English Heritage.

———. 2000b. 'Reflections on the Future of Surface Lithic Artefact Study in England'. In *The Future of Surface Artefact Survey in Europe*, edited by John Bintliff, Martin Kuna, and Natalie Venclová, 45–55. Sheffield: Sheffield Academic.

Schofield, A. John, and John Humble. 1995. 'Order out of Chaos: Making Sense of Surface Stone Age Finds'. *Conservation Bulletin*, March, 9–11.

Schulting, Rick, and Michael Richards. 2002. 'Dogs, Ducks, Deer and Diet: New Stable Isotope Evidence on Early Mesolithic Dogs from the Vale of Pickering, North-East England'. *Journal of Archaeological Science* 29 (4): 327–33. https://doi.org/10.1006/jasc.2002.0707.

———. 2009. 'Dogs, Divers, Deer and Diet. Stable Isotope Results from Star Carr and a Response to Dark'. *Journal of Archaeological Science* 36 (2): 498–503. https://doi.org/10.1016/j.jas.2008.09.035.

Schulting, Rick, Petrus le Roux, Yee Min Gan, John Pouncett, Julie Hamilton, Christophe Snoeck, Peter Ditchfield, et al. 2019. 'The Ups & Downs of Iron Age Animal Management on the Oxfordshire Ridgeway, South-Central England: A Multi-Isotope Approach'. *Journal of Archaeological Science* 101: 199-212. https://doi.org/10.1016/j.jas.2018.09.006.

Schwarcz, Henry, and Margaret Schoeninger. 1991. 'Stable Isotope Analyses in Human Nutritional Ecology'. *American Journal of Physical Anthropology* 34 (S13): 283–321. https://doi.org/10.1002/ajpa.1330340613.

Serjeantson, Dale, and David Field. 2006. *Animals in the Neolithic of Britain and Europe*. Neolithic Studies Group Seminar Papers 7. Oxford: Oxbow.

Shapiro, M. 2008. 'GRASS GIS Manual: R.Clump'. http://grass.osgeo.org/grass64/manuals/html64_user/r.clump.html.

Sheldrick, Charles, J. John Lowe, and Michael Reynier. 1997. 'Palaeolithic Barbed Point from Gransmoor, East Yorkshire, England'. *Proceedings of the Prehistoric Society* 63: 359–70. https://doi.org/10.1017/S0079497X00002486.

Shennan, Stephen, Sean Downey, Adrian Timpson, Kevan Edinborough, Sue Colledge, Tim Kerig, Katie Manning, and Mark G. Thomas. 2013. 'Regional Population Collapse Followed Initial Agriculture Booms in Mid-Holocene Europe'. *Nature Communications* 4 (October): 2486. https://doi.org/10.1038/ncomms3486.

Sheppard, June. 1957. 'The Medieval Meres of Holderness'. *Transactions and Papers (Institute of British Geographers)*, no. 23: 75–86. https://doi.org/10.2307/621157.

Sheppard, Thomas. 1900. *Descriptive Catalogue of the Specimens in the Mortimer Museum of Archaeology and Geology at Driffield*. London: A Brown & Sons.

———. 1907. "Notes on the More Important Archaeological Discoveries in East Yorkshire." *Transactions of the East Riding Antiquarian Society* 14: 45–66.

———, Thomas. 1910. "Hull Museums Annual Report for 1909." *Hull Museum Publications* 71.

———. 1912. *The Lost Towns of the Yorkshire Coast, and Other Chapters Bearing upon the Geography of the District.* London: A Brown & Sons.

———. 1920. "The Origin of the Materials Used in the Manufacture of Prehistoric Stone Weapons in East Yorkshire." *Transactions of the East Riding Antiquarian Society* 23: 34–54.

———. 1929. *Catalogue of the Mortimer Collection of Prehistoric Remains from East Yorkshire Barrows*. Hull: A Brown & Sons.

———. 1930. "Record of Additions." *Hull Museum Publications* 167.

———. 1940. "Record of Additions." *Hull Museum Publications* 211.

Smith, Isobel. 1965. *Windmill Hill and Avebury: Excavations by Alexander Keiller, 1925-1939.* Oxford: Clarendon Press.

Smith, Reginald. 1911. 'Lake-Dwellings in Holderness, Yorks., Discovered by Thos. Boynton, Esq., F.S.A., 1880–1'. *Archaeologia* 62 (2): 593–610. https://doi.org/10.1017/S0261340900008328.

———. 1931. *The Sturge Collection: Bequeathed in 1919 by William Allen Sturge*. London: Printed by order of the Trustees.

Snashall, Nick. 2004. 'The Idea of Residence in the Neolithic Cotswolds'. Sheffield: University of Sheffield. https://archaeologydataservice.ac.uk/archives/view/snashall_2003/index.cfm.

Snoeck, Christophe, Julia Lee-Thorp, Rick Schulting, Jeroen de Jong, Wendy Debouge, and Nadine Mattielli. 2015. 'Calcined Bone Provides a Reliable Substrate for Strontium Isotope Ratios as Shown by an Enrichment Experiment'. *Rapid Communications in Mass Spectrometry* 29 (1): 107–14. https://doi.org/10.1002/rcm.7078.

Snoeck, Christophe, John Pouncett, Philippe Claeys, Steven Goderis, Nadine Mattielli, Mike Parker Pearson, Christie Willis, Antoine Zazzo, Julia Lee-Thorp, and Rick Schulting. 2018. 'Strontium Isotope Analysis on Cremated Human Remains from Stonehenge Support Links with West Wales'. *Scientific Reports* 8 (1): 10790. https://doi.org/10.1038/s41598-018-28969-8.

Snoeck, Christophe, John Pouncett, Greer Ramsey, Ian Meighan, Nadine Mattielli, Steven Goderis, Julia Lee-Thorp, and Rick Schulting. 2016. 'Mobility during the Neolithic and Bronze Age in Northern Ireland Explored Using Strontium Isotope Analysis of Cremated Human Bone'. *American Journal of Physical Anthropology* 160 (3): 397–413. https://doi.org/10.1002/ajpa.22977.

Stevens, Chris, and Dorian Fuller. 2012. 'Did Neolithic Farming Fail? The Case for a Bronze Age Agricultural Revolution in the British Isles'. *Antiquity* 86 (333): 707–22. https://doi.org/10.1017/S0003598X00047864.

———. 2015. 'Alternative Strategies to Agriculture: The Evidence for Climatic Shocks and Cereal Declines during the British Neolithic and Bronze Age (a Reply to Bishop)'. *World Archaeology* 47 (5): 856–75. https://doi.org/10.1080/00438243.2015.1087330.

Stoertz, Catherine. 1997. *Ancient Landscapes of the Yorkshire Wolds: Aerial Photographic Transcription and Analysis*. Swindon: Royal Commission on the Historical Monuments of England.

Stonehouse, Pat. 1992. 'Two Early Mesolithic Sites in the Central Pennines'. *Yorkshire Archaeological Journal* 64: 1–15.

Sullivan, Alan, and Kenneth Rozen. 1985. 'Debitage Analysis and Archaeological Interpretation'. *American Antiquity* 50 (4): 755. https://doi.org/10.2307/280165.

Sundstrom, Linea. 1993. 'A Simple Mathematical Procedure for Estimating the Adequacy of Site Survey Strategies'. *Journal of Field Archaeology* 20 (1): 91–96. https://doi.org/10.1179/009346993791974316.

Tavener, Nick. 1996. 'Evidence of Neolithic Activity near Marton-Le-Moor, North Yorkshire'. In *Neolithic Studies in No-Man's Land: Papers on the Neolithic of Northern England from the Trent to the Tweed*, edited by Paul Frodsham, 13/14:183–87. Northern Archaeology. Newcastle upon Tyne: Northumberland Archaeological Group.

Taylor, Barry, Chantal Conneller, Nicky Milner, Ben Elliott, Aimée Little, Becky Knight, and Michael Bamforth. 2018. 'Human Lifeways'. In *Star Carr Volume 1*, edited by Nicky Milner, Chantal Conneller, and Barry Taylor, 245–72. White Rose University Press. https://doi.org/10.22599/book1.

Taylor, Jeremy. 2000. 'Cultural Depositional Processes and Post-Depositional Problems'. In *Extracting Meaning from Ploughsoil Assemblages*, edited by Riccardo Francovich, Helen Patterson, and Graeme Barker, 16–26. Oxford: Oxbow.

Thomas, Julian. 1993. 'The Politics of Vision and the Archaeologies of Landscape'. In *Landscape: Politics and Perspectives*, edited by Barbara Bender, 19–48. Oxford: Berg.

———. 1996. *Time, Culture and Identity: An Interpretive Archaeology*. London: Routledge.

———. 1999. *Understanding the Neolithic*. Rev. 2nd ed. London: Routledge.

———. 2010. 'The Return of the Rinyo-Clacton Folk? The Cultural Significance of the Grooved Ware Complex in Later Neolithic Britain'. *Cambridge Archaeological Journal* 20 (1): 1–15. https://doi.org/10.1017/S0959774310000016.

Thorp, F. 1976. "The Yorkshire Archaeological Register: 1975." *Yorkshire Archaeological Journal* 48: 1–13.

Tilley, Christopher. 1994. *A Phenomenology of Landscape: Places, Paths and Monuments*. Oxford: Berg.

Tingle, Martin. 1987. 'Inferential Limits and Surface Scatters: The Case of the Maddle Farm and Vale of the White Horse Fieldwalking Survey'. In *Lithic Analysis and Later British Prehistory: Some Problems and Approaches*, edited by Antony Brown and Mark Edmonds, 87–99. BAR British Series. Oxford: British Archaeological Reports.

Tixier, Jacques, Marie-Louise Inizan, and Hélène Roche. 1980. *Préhistoire de la pierre taillée: Terminologie et technologie*. Antibes: Cercle de recherches et d'études préhistoriques.

Tobler, Waldo. 1995. 'The Resel-Based GIS'. *International Journal of Geographical Information Systems* 9 (1): 95–100. https://doi.org/10.1080/02693799508902027.

Tobler, Waldo, and Susan Kennedy. 2010. 'Smooth Multidimensional Interpolation'. *Geographical Analysis* 17 (3): 251–57. https://doi.org/10.1111/j.1538-4632.1985.tb00846.x.

Tomlin, Dana. 1990. *Geographic Information Systems and Cartographic Modeling*. Englewood Cliffs, NJ: Prentice Hall.

Tuross, Noreen, Marilyn Fogel, and Peter Hare. 1988. 'Variability in the Preservation of the Isotopic Composition of Collagen from Fossil Bone'. *Geochimica et Cosmochimica Acta* 52 (4): 929–35. https://doi.org/10.1016/0016-7037(88)90364-X.

Van de Noort, Robert. 1995. 'West Furze: The Reconstruction of a Monumental Wetland Landscape'. In *Wetland Heritage of Holderness: An Archaeological Survey*, edited by Stephen Ellis and Robert Van de Noort, 323–34. Kingston upon Hull: Humber Wetlands Project, University of Hull.

Varndell, Gillian, and Peter Topping. 2002. *Causewayed Enclosures in Neolithic Europe*. Oxford: Oxbow.

Viner, Sarah, Jane Evans, Umberto Albarella, and Mike Parker Pearson. 2010. 'Cattle Mobility in Prehistoric Britain: Strontium Isotope Analysis of Cattle Teeth from Durrington Walls (Wiltshire, Britain)'. *Journal of Archaeological Science* 37 (11): 2812–20. https://doi.org/10.1016/j.jas.2010.06.017.

Waddington, Clive, Geoff Bailey, Alex Bayliss, Ian Boomer, Nicky Milner, Kristian Pederson, Robert Shiel, and Tony Stevenson. 2003. 'A Mesolithic Settlement Site at Howick, Northumberland: A Preliminary Report'. *Archaeologia Aeliana*, 5th, 32: 1–12.

Wainwright, Geoffrey. 1971. *Durrington Walls Excavations, 1966-1968*. Reports of the Research Committee of the Society of Antiquaries of London; No. 29. London: Society of Antiquaries of London.

Watkin, J R. 1983. "Two Prehistoric Finds from North Humberside Stone Axe-Hammer; Bronze Flat Axe." *East Riding Archaeologist* 7: 91–92.

Watson, James. 1955. 'Geography: A Discipline in Distance'. *Scottish Geographical Magazine* 71 (1): 1–13. https://doi.org/10.1080/00369225508735583.

Whallon, Robert. 1974. 'Spatial Analysis of Occupation Floors II: The Application of Nearest Neighbor Analysis'. *American Antiquity* 39 (1): 16. https://doi.org/10.2307/279216.

Wheatley, David. 1996. 'Between the Lines: The Role of GIS-Based Predictive Modelling in the Interpretation of Extensive Survey Data'. In *Interfacing the Past: Computer Applications and Quantitative Methods in Archaeology, CAA95*, edited by Hans Kamermans and Kelly Fennema, 2:275–92. Analecta Praehistorica Leidensia 28. Leiden: University of Leiden. https://proceedings.caaconference.org/paper/32_wheatley_caa_1995/.

Wheatley, David, and Mark Gillings. 2002. *Spatial Technology and Archaeology: The Archaeological Applications of GIS*. New York: Taylor & Francis.

Whitehouse, Nicki, Rick Schulting, Meriel McClatchie, Phil Barratt, T. Rowan McLaughlin, Amy Bogaard, Sue Colledge, Rob Marchant, Joanne Gaffrey, and M. Jane Bunting. 2014. 'Neolithic Agriculture on the European Western Frontier: The Boom and Bust of Early Farming in Ireland'. *Journal of Archaeological Science*, The world reshaped: practices and impacts of early agrarian societies, 51 (November): 181–205. https://doi.org/10.1016/j.jas.2013.08.009.

Whittaker, John. 1994. *Flintknapping: Making and Understanding Stone Tools*. Austin: University of Texas Press.

Whittle, Alasdair, Jessica Davies, Ian Dennis, Andrew Fairbairn, Michael Hamilton, and Joshua Pollard. 2000. 'Neolithic Activity and Occupation Outside Windmill Hill Causewayed Enclosure, Wiltshire: Survey and Excavation'. *The Wiltshire Archaeological and Natural History Magazine* 93: 131–80.

Whittle, Alasdair, Frances Healy, and Alex Bayliss. 2011. *Gathering Time: Dating the Early Neolithic Enclosures of Southern Britain and Ireland*. Oxford: Oxbow Books.

Wickham-Jones, Caroline. 1990. *Rhum: Mesolithic and Later Sites at Kinloch, Excavations 1984-86*. Edinburgh: Society of Antiquaries of Scotland.

Wickham-Jones, Caroline, and John Pouncett. 2000. 'Flaked Stone'. In *From Barra to Berneray: Archaeological Survey and Excavation in the Southern Isles of the Outer Hebrides*, edited by Keith Branigan and Patrick Foster, 181–83. Sheffield: Sheffield Academic Press.

Wood, Jo. 1996. 'Scale-Based Characterisation of Digital Elevation Models'. In *Innovations in GIS 3: Selected Papers from the Third National Conference on GIS Research UK (GISRUK)*, edited by David Parker, 163–75. London: Taylor & Francis.

Woodward, Peter. 1978. ‘Flint Distribution, Ring Ditches and Bronze Age Settlement Patterns in the Great Ouse Valley’. *Archaeological Journal* 135: 32–56. https://doi.org/10.1080/00665983.1978.11077643.

Worboys, Michael. 1995. *GIS, a Computing Perspective*. London: Taylor & Francis.

Wright, Elizabeth, Sarah Viner-Daniels, Mike Parker Pearson, and Umberto Albarella. 2014. ‘Age and Season of Pig Slaughter at Late Neolithic Durrington Walls (Wiltshire, UK) as Detected through a New System for Recording Tooth Wear’. *Journal of Archaeological Science* 52 (December): 497–514. https://doi.org/10.1016/j.jas.2014.09.009.

Wunder, Michael. 2010. ‘Using Isoscapes to Model Probability Surfaces for Determining Geographic Origins’. In *Isoscapes: Understanding Movement, Pattern, and Process on Earth through Isotope Mapping*, edited by Jason West, Gabriel Bowen, Todd Dawson, and Kevin Tu, 251–70. Dordrecht: Springer.

Wunder, Michael, Cynthia Kester, Fritz Knopf, and Robert Rye. 2005. ‘A Test of Geographic Assignment Using Isotope Tracers in Feathers of Known Origin’. *Oecologia* 144 (4): 607–17. https://doi.org/10.1007/s00442-005-0071-y.

Wymer, John, and Clive Bonsall. 1977. *Gazetteer of Mesolithic Sites in England and Wales*. Abramson, Philip. 1996. ‘Excavations along the Caythorpe Gas Pipeline’. *Yorkshire Archaeological Journal* 68: 1–88.

Yorkshire Philosophical Society. 1853. “Donations to the Museum.” *Yorkshire Philosophical Society Annual Report* 1853, 20–24.

Catalogue of lithic scatters and stray finds from the Wolds study area

North Yorkshire

Acklam

None

Birdsall

Site	Location	n	Period	Details	Notes
1	NGR: SE 80 63 Locality: Aldro	1	Mesolithic	Stray find: perforated macehead (quartzite fragment) Source(s): Roe and Radley 1968, p.176 (3); Keen and Radley 1971, p.37 (275); Wymer and Bonsall 1977, p.349	Also listed as Thixendale NMR: SE 86 SW 31 SMR: NY 12467
2	NGR: SE 81 62 Locality: Aldro	1	Mesolithic	Stray find: perforated macehead (quartzite) Source(s): Roe and Radley 1968, p.176 (2); Keen and Radley 1971, p.37 (326); Wymer and Bonsall 1977, p.349	Also listed as Thixendale NMR: SE 86 SW 31 SMR: NY 12467
3	NGR: SE 80 62 Locality: Aldro	1	Neolithic	Stray find: stone axe (greenstone – unfinished?) Source(s): Evans 1897, p.205	Also listed as Thixendale NMR: SE 86 SW 35 SMR: NY 12469
4	NGR: SE 82 65 Locality: Coke Fields	1	Neolithic	Stray find: polished stone axe (quartzite) Source(s): Keen and Radley 1971, p.33 (117); Radley 1974, p.15	NMR: SE 86 NW 8 SMR: NY 4180
5	NGR: SE 79 63 Locality: Mount Ferrant	1	Neolithic	Stray find: polished flint axe Source(s): Rutter 1965	Listed as Burythorpe NMR: SE 76 SE 9 SMR: NY 2105

Burythorpe

Site	Location	n	Period	Details	Notes
1	NGR: SE 782 657	6*	Neolithic to Bronze Age	Lithic scatter (multi-period): including 5 scrapers and 1 flake from a polished stone axe (greenstone – Group VI?) Source(s): Phillips et al. 1988, p.216 (697)	NMR: SE 76 NE 19

Site	Location	n	Period	Details	Notes
2	NGR: SE 76 67 Locality: Menethorpe	1	Neolithic	Stray find: polished stone axe Source(s): Evans 1897, p.136	Also listed as Huttons Ambo NMR: SE 76 NE 18 SMR: NY 12261

Foxholes

Site	Location	n	Period	Details	Notes
1	NGR: TA 00 72	1	Neolithic	Stray find: stone axe (dolerite)	NMR: TA 07 SW 18
2	NGR: TA 010 718 Locality: Grantham	7*	Mesolithic	Lithic scatter (single period): 3 cores, 3 scrapers, 1 microlith and an unspecified number of blades/flakes Source(s): Wymer and Bonsall 1977, p.351	Collection: Grantham NMR: TA 07 SW 19
3	NGR: TA 99 71 Locality: Butterwick	1	Neolithic	Stray find: arrowhead (leaf-shaped) Source(s): Evans 1897, p.374	NMR: SE 97 SE 31 SMR: NY 3759

Howsham

None

Huttons Ambo

None

Kirby Grindalythe

Site	Location	n	Period	Details	Notes
1	NGR: SE 87 67	1	Mesolithic	Stray find: perforated macehead (fragment) Sources(s): Roe and Radley 1968, p.177 (20)	BM 331 NMR: SE 86 NE 20 SMR: NY 12462
2	NGR: SE 87 67 Locality: Duggleby	1	Neolithic	Stray find: greenstone axe Sources(s): Evans 1897, p.14	NMR: SE 86 NE 19 SMR: NY 12461
3	NGR: SE 88 68 Locality: High Mowthorpe	16	Neolithic	Lithic scatter (single period): 12 stone axes and 4 flint axes	NMR: SE 86 NE 6
4	NGR: SE 86 66 Locality: Wharram	1	Neolithic	Stray find: stone axe (medium grained tuff fragment) Sources(s): Keen and Radley 1971, p.35 (226)	NMR: SE 86 NE 31 SMR: NY 12464
5	NGR: SE 87 67 Locality: Duggleby	1	Neolithic	Stray find: stone axe (Group VI fragment) Sources(s): Keen and Radley 1971, p.31 (37)	NMR: SE 86 NE 31 SMR: NY 12465

Site	Location	n	Period	Details	Notes
6	NGR: SE 88 69 Locality: Fridaythorpe	1	Neolithic	Stray find: Group VI axe (fragment) Sources(s): Keen and Radley 1971, p.34 (215)	NMR: SE 86 NE 31 SMR: NY 12465

Langton

None

Leavening

None

Luttons

Site	Location	n	Period	Details	Notes
1	NGR: SE 93 69	2	Bronze Age	Lithic scatter (single period): 2 battle axes (fragments) Sources(s): Roe 1966, p.239 (271 and 272)	BM 323/344 NMR: SE 96 NW 17 SMR: NY 9079 and NY9080
2	NGR: SE 93 69 Locality: West Lutton	1	Mesolithic	Stray find: flint axe Sources(s): Wymer and Bonsall 1977, p.353	NMR: SE 96 NW 18 SMR: NY 9081
3	NGR: SE 978 674 Locality: Burrow Nook	7	Mesolithic	Lithic scatter (single period): 3 microliths (2 separate entries) and 4 scrapers Sources(s): Wymer and Bonsall 1977, p.352	Collection: Grantham NMR: SE 96 NE 27 SMR: NY 9084
4	NGR: SE 94 70	4	Neolithic	Lithic scatter (single period): 4 stone axes (1 foraminiferal limestone, 1 coarse tuff fragment, 1 coarse tuff and 1 Group VI) Sources(s): Keen and Radley 1971, pp.32 and 35 (112, 225, 230 and 233)	NMR: SE 96 NW 16 SMR: NY 9066, NY9070 and 9072
5	NGR: SE 95 70	4	Neolithic	Lithic scatter (single period): 3 stone axes (1 Group VI fragment and 2 tuff fragments) and 1 stone macehead (greywacke) Sources(s): Keen and Radley 1971, pp.34 (210, 212, 217 and 220)	NMR: SE 96 NW 16 SMR: NY 9067 to NY 9069
6	NGR: SE 95 69	1	Neolithic	Stray find: stone adze Sources(s): Keen and Radley 1971, pp.35 (238)	NMR: SE 96 NW 16 SMR: NY 9073
7	NGR: SE 93 69	1	Neolithic	Stray find: stone axe (Group VII) Sources(s): Keen and Radley 1971, pp.35 (258)	NMR: SE 96 NW 16 SMR: NY 9074
8	NGR: SE 93 69	4	Neolithic	Lithic scatter (single period): 2 edge polished chisels (1 Group VI and 1 flint), a flint chisel and a 'Duggleby-type' flint adze Sources(s): Manby 1974, pp.118-128	NMR: SE 96 NW 16 SMR: NY 9075 to NY9078

Site	Location	n	Period	Details	Notes
9	NGR: SE 95 70 Locality: Helperthorpe	1	Neolithic	Stray find: flint axe Sources(s): Evans 1897, p.89	NMR: SE 97 SE 28 SMR: NY 3756
10	NGR: SE 95 70 Locality: Helperthorpe	1	Neolithic	Stray find: stone axe (greenstone fragment) Sources(s): Keen and Radley 1971, p.33 (132)	NMR: SE 97 SE 26 SMR: NY 3754
11	NGR: SE 95 70 Locality: Helperthorpe	1	Neolithic	Stray find: flint chisel (worn at both ends) Sources(s): Evans 1897, p.177	NMR: SE 97 SE 27 SMR: NY 3755
12	NGR: SE 95 70 Locality: Helperthorpe	6	Mesolithic	Lithic scatter (single period): 6 cores Sources(s): Wymer and Bonsall 1977, p.352	NMR: SE 97 SE 37 SMR: NY 12485

Norton-on-Derwent

None

Scrayingham

None

Settrington

None

Thixendale

Site	Location	n	Period	Details	Notes
1	NGR: SE 84 61	1	Neolithic	Stray Find: stone axe (schist – narrow chisel-like) Source(s): Evans 1897, p.128	Collection: Mortimer NMR: SE 86 SW 38 SMR: NY 12472
2	NGR: SE 8055 6200 Locality: 400 yards east of Acklam Wold 123	1	Neolithic	Stray find: polished stone axe with two circular hollows Source(s): Mortimer 1905, p.85	NMR: SE 86 SW 34 SMR: NY 6655 / NY 12468
3	NGR: SE 84 61	3	Uncertain	Lithic scatter (unknown): 3 arrowheads Source(s): Smith 1931, p.133}	Collection: Sturge NMR: SE 86 SW 42 SMR: NY 12476

Weaverthorpe

Site	Location	n	Period	Details	Notes
1	NGR: SE 97 67 Locality: Weaverthorpe Pasture	10*	Mesolithic	Lithic scatter (single period): 8 cores, 1 scraper, 1 microlith and an unspecified number of blades/flakes Source(s): Wymer and Bonsall 1977, p.355	Collection: Grantham NMR: SE 96 NE 25 SMR: NY 9082

Site	Location	n	Period	Details	Notes
2	NGR: SE 96 70	1	Neolithic	Stray Find: core Source(s): Evans 1897, p.277	NMR: SE 97 SE 29 SMR: NY 3757
3	NGR: SE 96 70	1	Neolithic	Stray Find: conical nodule of flint (reused as rubber) Source(s): Evans 1897, p.266	NMR: SE 97 SE 30 SMR: NY 3758
4	NGR: SE 96 70	1	Neolithic	Stray Find: discoidal knife Source(s): Manby 1974, p.113	NMR: SE 97 SE 36 SMR: NY 12484
5	NGR: SE 96 72 Locality: High Dales Farm	2	Neolithic	Lithic Scatter (single period): 2 polished stone axes (1 greenstone and 1 andesite) Source(s): Rutter 1966, p.564	NMR: SE 97 SE 22 SMR: NY 3750
6	NGR: SE 96 70	2	Mesolithic	Lithic Scatter (single period): perforated macehead (dolerite) and microlith Source(s): Roe and Radley 1968, p.177 (31); Wymer and Bonsall 1977, p.355	Collection: Microlith ex. Sturge NMR: SE 97 SE 25 SMR: NY 3753
7	NGR: SE 96 70	2	Neolithic to Early Bronze Age	Lithic Scatter (multi-period): 2 battle axes (fragments) Source(s): Roe 1966, p.239 (282 and 283)	BM 334 NMR: SE 97 SE 24 SMR: NY 3752

Westow

None

Wharram

Site	Location	n	Period	Details	Notes
1	NGR: SE 85 64 Locality: Wharram	1	Uncertain	Stray find: scraper Source(s): Smith 1931, p.134	Collection: Sturge NMR: SE 86 SE 28 SMR: NY 12684

Wintringham

None

East Riding of Yorkshire

Allerthorpe

None

Bainton

None

Barmby Moor

Site	Location	n	Period	Details	Notes
1	NGR: SE 77 48 Locality: Barmby Moor	1	Neolithic	Stray find: arrowhead (leaf-shaped) Source(s): Sheppard 1940, p.57	NMR: SE 74 NE 15
2	NGR: SE 77 48 Locality: Barmby Moor	1	Prehistoric	Stray find: flint knife Source(s): Sheppard 1920, pp.44-46	NMR: SE 74 NE 16

Beswick

Site	Location	n	Period	Details	Notes
1	NGR: TA 01 48	2	Neolithic	Lithic scatter (single period): 2 stone axes Source(s): Smith 1931, p.132	Collection: Sturge NMR: TA 04 NW 16

Bishop Wilton

None

Bugthorpe

Site	Location	n	Period	Details	Notes
1	NGR: SE 77 57	1	Prehistoric	Stray find: perforated macehead (Borrowdale volcanic ash) Sources(s): Sheppard 1920, pp.44-46	NMR: SE 75 NE 13

Cottam

Site	Location	n	Period	Details	Notes
1	NGR: SE 996 617 Locality: Elmswell Wold Farm	4*	Mesolithic	Lithic scatter (single period): 2 scrapers, 1 microlith, 1 other artefact and an unspecified number of cores and blades/flakes Source(s): Wymer and Bonsall 1977, p.350	Collection: Grantham NMR: SE 96 SE 14
2	NGR: SE 995 625 Locality: Cottam Warren	5*	Mesolithic	Lithic scatter (single period): 2 scrapers, 1 other artefact, 2 cores and an unspecified number of blades/flakes Source(s): Wymer and Bonsall 1977, p.350	Collection: Grantham NMR: SE 96 SE 15
3	NGR: SE 99 65	1	Neolithic	Stray find: stone axe (Group VI fragment) Source(s): Sheppard 1920, p.48; Keen and Radley 1971, p.32 (70)	NMR: SE 96 NE 34
4	NGR: SE 97 65	1	Neolithic	Stray find: stone axe (near Group I) Source(s): Sheppard 1920, p.48; Keen and Radley 1971, p.32 (103)	NMR: SE 96 NE 34

Site	Location	n	Period	Details	Notes
5	NGR: SE 99 62 Locality: Cottam Warren	1	Neolithic	Stray find: discoidal knife Source(s): Manby 1974, p. 112	Collection: Grantham NMR: SE 96 SE 17
6	NGR: SE 99 65	2	Neolithic	Lithic scatter (single period): 2 stone axes (greywacke) Source(s): Keen and Radley 1971, pp.32 and 33 (113 and 135)	NMR: SE 96 SE 16
7	NGR: SE 98 64	2	Neolithic	Lithic scatter (single period): 2 stone axes (1 quartz dolerite and 1 micaceous sandstone) Source(s): Keen and Radley 1971, p.36 (318 and 319)	NMR: SE 96 SE 16

Driffield

Site	Location	n	Period	Details	Notes
1	NGR: TA 03 58	1	Neolithic	Stray find: stone axe (coarse tuff fragment) Source(s): Keen and Radley 1971, p.35 (231)	NMR: TA 05 NW 43
2	NGR: TA 02 58	1	Neolithic	Stray find: stone axe (devitrified tuff) Source(s): Keen and Radley 1971, p.35 (262)	NMR: TA 05 NW 42
3	NGR: TA 02 57	1	Neolithic	Stray find: stone axe (dolerite) possible battle axe Source(s): Sheppard 1920, p.44	NMR: TA 05 NW 46
4	NGR: TA 02 57	1	Neolithic	Stray find: arrowhead (barbed) Source(s): Sheppard 1930, p.43	NMR: TA 05 NW 15

Fangfoss

None

Fimber

Site	Location	n	Period	Details	Notes
1	NGR: SE 89 60	2	Bronze Age	Lithic scatter (single period): 2 battle axes (fragments) Source(s): Roe 1966, p.239 (253 and 254)	NMR: SE 86 SE 27
2	NGR: SE 895 464 Locality: Towthorpe Wold	1*	Bronze Age	Lithic scatter (single period) Source(s): Meirion-Jones 1979, p.20	NMR: SE 86 SE 33
3	NGR: SE 898 641 Locality: Towthorpe Wold	1*	Bronze Age	Lithic scatter (single period) Source(s): Meirion-Jones 1979, p.20	NMR: SE 86 SE 33

Site	Location	n	Period	Details	Notes
4	NGR: SE 89 61 Locality: Lady Graves	9*	Neolithic to Bronze Age	Lithic scatter (multi-period): including 3 flint chisels, axes and arrowheads Source(s): Evans 1897, pp.91, 105, 140, 266, 337, 341, 380, 390 and 393; Sheppard 1920, p.38; Manby 1974, p.118	NMR: SE 86 SE 20
5	NGR: SE 90 63 Locality: Towthorpe	1	Mesolithic	Stray find: tranchet axe Source(s): Wymer and Bonsall 1977, p.350	NMR: SE 96 SW 17
6	NGR: SE 89 60	4	Mesolithic	Lithic scatter (single period): 3 perforated maceheads and 1 tranchet axe Source(s): Wymer and Bonsall 1977, p.350	NMR: SE 86 SE 34
7	NGR: SE 90 62 Locality: Towthorpe	4	Neolithic	Lithic scatter (single period): 4 polished arrowheads (including 3 leaf-shaped) Source(s): Radley 1975, p.47	NMR: SE 96 SW 18
8	NGR: SE 89 60	1	Uncertain	Stray find: fabricator Source(s): Smith 1931, p.132	Collection: Sturge NMR: SE 86 SE 30

Foston

Site	Location	n	Period	Details	Notes
1	NGR: TA 10 57 Locality: Gembling	2	Neolithic	Lithic scatter (single period): stone axe and polished stone chisel Source(s): Smith 1931, p.132; Manby 1974, p.118	Collection: Sturge NMR: TA 15 NW 26

Fridaythorpe

Site	Location	n	Period	Details	Notes
1	NGR: SE 87 59	2	Prehistoric	Lithic scatter (unknown): flint axe and flint 'lancehead' Source(s): Rutter 1971, p.53	NMR: SE 85 NE 29

Garton

Site	Location	n	Period	Details	Notes
1	NGR: SE 9175 6138	1	Bronze Age	Stray find: arrowhead (barbed and tanged)	NMR: SE 96 SW 13
2	NGR: SE 97 58 Locality: Garton Slack	1	Mesolithic or Bronze Age	Stray find: perforated macehead (quartzite) Source(s): Roe and Radley 1968, p.176 (16); Wymer and Bonsall 1977, p.352	NMR: SE 95 NE 44

Site	Location	n	Period	Details	Notes
3	NGR: SE 95 59	1	Neolithic or Bronze Age	Stray find: axe hammer (basalt) Source(s): Sheppard 1920, p.48	NMR: SE 95 NE 48
4	NGR: SE 981 619 Locality: Garton Grange	6	Mesolithic	Lithic scatter (single period): 5 cores and 1 scraper Source(s): Wymer and Bonsall 1977, p.352	Collection: Grantham NMR: SE 96 SE 11
5	NGR: SE 987 615 Locality: Garton Fields	3	Mesolithic	Lithic scatter (single period): 2 scrapers and 1 microlith Source(s): Wymer and Bonsall 1977, p.352	Collection: Grantham NMR: SE 96 SE 12
6	NGR: SE 95 58 Locality: Elmswell Wold	1	Neolithic	Stray find: stone axe (Group VI) Source(s): Keen and Radley 1971, pp.33 (142)	NMR: SE 95 NE 49 Listed at SE 98 58
7	NGR: SE 959 596 Locality: Garton Slack	2	Mesolithic	Lithic scatter (single period): 2 perforated maceheads Source(s): Wymer and Bonsall 1977, p.352	Collection: Grantham
8	NGR: SE 98 59 Locality: Garton Wold	1	Mesolithic	Stray find: blade/flake Source(s): Wymer and Bonsall 1977, p.352	Pitt Rivers Museum

Harpham

Site	Location	n	Period	Details	Notes
1	NGR: TA 0902 5855 Locality: Lowthorpe	3	Neolithic	Lithic scatter (single period): 2 flint knives and 1 polished stone axe Source(s): McInnes 1966, p.558	NMR: TA 05 NE 7
2	NGR: TA 09 61	1	Neolithic	Stray find: axe hammer (sub greywacke) Source(s): Keen and Radley 1971, p.37 (328)	NMR: TA 06 SE 31
3	NGR: TA 08 60 Locality: Lowthorpe	1	Prehistoric	Stray find: arrowhead Source(s): Smith 1931, p.133	Collection: Sturge NMR: TA 06 SE 36

Hayton

None

Huggate

Site	Location	n	Period	Details	Notes
1	NGR: SE 86 57 Locality: Huggate Wold	1	Neolithic	Stray find: perforated macehead Source(s): Roe and Radley 1968, p.177 (18); Wymer and Bonsall 1977, p.353	NMR: SE 85 NE 22

Site	Location	n	Period	Details	Notes
2	NGR: SE 86 57 Locality: Huggate Wold	2	Neolithic	Lithic scatter (single period): 2 stone axes (1 tuff and 1 banded tuff part) Source(s): Keen and Radley 1971, pp.34-35 (221 and 255)	NMR: SE 85 NE 30
3	NGR: SE 88 55	1	Neolithic	Stray find: flint chisel Source(s): Manby 1974, p.118	NMR: SE 85 NE 31

Hutton Cranswick

Site	Location	n	Period	Details	Notes
1	NGR: TA 02 52	1	Mesolithic	Stray find: perforated macehead Sources(s): Roe and Radley 1968, p.177 (19); Wymer and Bonsall 1977, p.353	NMR: TA 05 SW 16
2	NGR: TA 02 52 Locality: Cranswick Carr	1	Neolithic	Stray find: flint axe Sources(s): Sheppard 1920, p.38	NMR: TA 05 SW 14
3	NGR: TA 03 53	1	Neolithic	Stray find: stone axe (dolerite) Sources(s): Keen and Radley 1971, p.35 (245)	NMR: TA 05 SW 18
4	NGR: TA 02 52	1	Neolithic	Stray find: stone axe (Group VI) Sources(s): Keen and Radley 1971, p.35 (266)	NMR: TA 05 SW 17
5	NGR: TA 02 52	1	Neolithic	Stray find: stone axe (Group XVII?) Sources(s): Sheppard 1910, p.7; Phillips et al. 1988, p.213 (418)	NMR: TA 05 SW 20

Kilham

Site	Location	n	Period	Details	Notes
1	NGR: TA 06 64	4	Mesolithic to Prehistoric	Lithic scatter (multi-period): stone axe (greenstone), 1 flint axe, 1 tranchet axe and 1 flint chisel Source(s): Evans 1897, p.91; Keen and Radley 1971, p.32 (109); Wymer and Bonsall 1977, p.353; Manby 1974, p.118	NMR: TA 06 SE 32
2	NGR: TA 07 66 Locality: north of Kilham Lane	1	Mesolithic	Stray find: tranchet axe (Thames pick) Source(s): Wymer and Bonsall 1977, p.353	NMR: TA 06 NE 40

Kirby Underdale

Site	Location	n	Period	Details	Notes
1	NGR: SE 80 58	13	Neolithic	Lithic scatter (single period): 7 axes (including 1 Seamer Type flint), 4 arrowheads, 1 point/blade and 1 core Source(s): Smith 1931, p.133; Manby 1974, p.129	Collection: Sturge NMR: SE 85 NW 50

Kirkburn

Site	Location	n	Period	Details	Notes
1	NGR: TA 016 562 Locality: between Kelleythorpe and Sunderlandwick	1	Neolithic or Bronze Age	Stray find: axe hammer Source(s): Watkin 1983, p.91	NMR: TA 05 NW 59

Langtoft

None

Leven

Site	Location	n	Period	Details	Notes
1	NGR: TA 10 45	1	Neolithic	Stray find: ground flint axe Source(s): Elgee and Elgee 1933, p.241	Found with bronze swords and a looped palstave NMR: TA 14 NW 23
2	NGR: TA 10 45	1	Neolithic	Stray find: flint axe Source(s): Sheppard 1907, p.52	NMR: TA 14 NW 16

Lockington

Site	Location	n	Period	Details	Notes
1	NGR: TA 05 46 Locality: Aike	1	Mesolithic	Stray find: tranchet axe Source(s): Wymer and Bonsall 1977, p.353	Listed at TA 050 640 NMR: TA 04 NW 24

Londesborough

Site	Location	n	Period	Details	Notes
1	NGR: SE 875 570 Locality: Londesborough Park	4	Mesolithic	Lithic scatter (single period): 3 microliths and 1 other artefact Source(s): Wymer and Bonsall 1977, p.353	NMR: SE 84 NE 28

Site	Location	n	Period	Details	Notes
2	NGR: SE 84 44 Locality: Londesborough Moor Farm	1	Neolithic	Stray find: polished axe Source(s): Sheppard 1940, p.53	Collection: Featherstone NMR: SE 84 SW 9

Lund

Site	Location	n	Period	Details	Notes
1	NGR: SE 9342 4579 Locality: south of Lairhill House	1	Neolithic	Stray find: stone axe (greenstone)	NMR: SE 94 NW 7
2	NGR: SE 9167 4659 Locality: field above Enthorpe House	1	Bronze Age	Stray find: arrowhead (barbed and tanged)	NMR: SE 94 NW 4
3	NGR: SE 49 46 Locality: Kipling Cotes Racecourse	1	Neolithic	Stray find: scraper	NMR: SE 94 NW 10

Middleton

None

Millington

None

Nafferton

Site	Location	n	Period	Details	Notes
1	NGR: TA 04 63 Locality: Pockthorpe	2	Mesolithic	Lithic scatter (single period): 2 microliths Source(s): Wymer and Bonsall 1977, p.350	Listed as Driffield Collection: Grantham NMR: TA 06 SW 14
2	NGR: TA 00 61 Locality: Tenents Wold Farm	1	Mesolithic	Stray find: unspecified Source(s): Wymer and Bonsall 1977, p.350	Listed as Driffield Collection: Grantham NMR: TA 06 SW 15
3	NGR: TA 05 59	2	Mesolithic	Lithic scatter (single period): perforated macehead and axe Source(s): Wymer and Bonsall 1977, p.353	NMR: TA 05 NE 15
4	NGR: TA 04 61 Locality: Nafferton Wold	2	Neolithic	Lithic scatter (single period): 2 stone axes (including 1 quartzite) Source(s): Sheppard 1920, p.46	NMR: TA 06 SW 11
5	NGR: TA 02 61 Locality: Driffield Wold	1	Prehistoric	Stray find: stone axe (greywacke fragment) Source(s): Keen and Radley 1971, pp.32 (93)	NMR: TA 06 SW 12

Site	Location	n	Period	Details	Notes
6	NGR: TA 02 62 Locality: Driffield Wold	2	Prehistoric	Lithic scatter (unknown): 2 stone axes (including 1 Group VI part) Source(s): Keen and Radley 1971, pp.34 (219 and 222)	NMR: TA 06 SW 12
7	NGR: TA 01 61 Locality: Driffield Wold	1	Prehistoric	Stray find: stone axe (Group VI) Source(s): Keen and Radley 1971, p.35 (260); Phillips et al. 1988, p.213 (404)	Duplicate (also listed at TA 02 62) NMR: TA 06 SW 12

North Dalton

None

Nunburnholme

Site	Location	n	Period	Details	Notes
1	NGR: SE 820 492 Locality: Area 1	22	Neolithic to Later Prehistoric	Lithic scatter (multi-period): 1 stone axe (Group VI fragment), 15 scrapers (7 horseshoe, 4 side, 1 triangular, 1 core, 2 side/end and 1 double-end) , a retouched fragment, 4 other implements and a flake (Group VI) Source(s):Mackay 1979, pp.137-139	NMR: SE 84 NW 36

Pocklington

Site	Location	n	Period	Details	Notes
1	NGR: SE 796 496 Locality: Area 2	9	Neolithic to Later Prehistoric	Lithic scatter (multi-period): 9 scrapers (4 horseshoe, 2 side, 1 end and 2 oval) Source(s): Mackay 1979, pp.139	NMR: SE 74 NE 17
2	NGR: SE 796 487 Locality: Area 3	4*	Neolithic to Later Prehistoric	Lithic scatter (multi-period): 1 stone axe (dolerite fragment), 2 arrowheads (1 leaf-shaped and 1 transverse), 1 sickle (edge-retouched flake knife) and an unspecified number of flakes Source(s): Mackay 1979, pp.139	NMR: SE 74 NE 17
3	NGR: SE 799 485 Locality: 2nd field to south-west of Pocklington School	1	Neolithic	Stray find: polished stone axe Source(s): Radley 1974, p.16 (139)	NMR: SE 74 NE 18
4	NGR: SE 800 490	1	Prehistoric	Stray find: stone axe Source(s): Yorkshire Philosophical Society Annual Report, 1853, p.21	NMR: SE 84 NW 40
5	NGR: SE 807 474	1	Neolithic	Stray find: stone axe (Group I) Source(s): Keen and Radley 1971, p.34 (187)	NMR: SE 84 NW 30

Site	Location	n	Period	Details	Notes
6	NGR: SE 808 467 Locality: near Southmoor House	1	Neolithic	Stray find: polished stone axe Source(s): Radley 1974, p.16 (176)	NMR: SE 84 NW 30

Rudston

Site	Location	n	Period	Details	Notes
1	NGR: TA 06 68 Locality: Rudston Grange	1	Neolithic	Stray find: stone axe (Group VII) Source(s): Keen and Radley 1971, p.32 (74)	NMR: TA 06 NE 43
2	NGR: TA 11 67 Locality: Low Caythorpe	1	Prehistoric	Stray find: lancehead Source(s): Smith 1931, Plate 114	Collection: Sturge NMR: TA 16 NW 55
3	NGR: TA 09 67	1	Neolithic	Stray find: curved sickle blade Source(s): Clark 1932b, p.74	NMR: TA 06 NE 38
4	NGR: TA 117 667 Locality: South of Low Caythorpe	1	Neolithic	Stray find: stone axe (greywacke fragment) Source(s): Keen and Radley 1971, p.34 (188)	NMR: TA 16 NW 54
5	NGR: TA 09 67	5	Neolithic	Lithic scatter (single period): 1 polished stone chisel, 1 edge-polished stone chisel, 2 stone axes (1 Group VI fragment and 1 Group VI part) and 1 stone rubber (Group VI) Source(s): Evans 1897, p.176; Smith 1931, pp.112 and 114; Manby 1974, p.118; Keen and Radley 1971, pp.31-32 (22, 72 and 73)	NMR: TA 06 NE 42
6	NGR: TA 10 67	1	Neolithic	Stray find: stone axe (quartz dolerite) Source(s): Keen and Radley 1971, p.33 (133)	NMR: TA 06 NE 42
7	NGR: TA 08 67	1	Neolithic	Stray find: stone axe (Group VI) Source(s): Keen and Radley 1971, p.33 (165)	NMR: TA 06 NE 42

Skerne and Wansford

Site	Location	n	Period	Details	Notes
1	NGR: TA 053 547 Locality: Pick Hills	1	Neolithic	Stray find: polished flint axe Source(s): Moorhouse 1977, p.4	Collection: Grantham NMR: TA 05 SE 25

Sledmere

Site	Location	n	Period	Details	Notes
1	NGR: SE 93 64	4	Mesolithic to Neolithic	Lithic scatter (multi-period): 2 stone axes (1 Group XVIII fragment and 1 fragment), 1 tranchet axe and 1 discoidal knife Source(s): Clark 1929, p.49; Keen and Radley 1971, p.34 (209 and 211); Wymer and Bonsall 1977, p.354; Manby 1974, p.112	NMR: SE 96 SW 16

Thwing

Site	Location	n	Period	Details	Notes
1	NGR: TA 03 69 Locality: Octon	2	Prehistoric	Lithic scatter (unknown): 2 arrowheads Source(s): Smith 1931, p.133	Collection: Sturge NMR: TA 06 NW 21
2	NGR: TA 05 70	3	Prehistoric	Lithic scatter (unknown): 3 perforated maceheads (1 igneous, 1 greenstone and 1 quartzite fragment) Source(s): Roe and Radley 1968, p.177 (27, 28 and 29); Wymer and Bonsall 1977, p.355	Collection: Boynton NMR: TA 07 SE 14
3	NGR: TA 0276 7084 Locality: Paddock Hill	1	Prehistoric	Stray find: flake (Group VI) Source(s): Thorp 1976, p.3	NMR: TA 07 SW 31
4	NGR: TA 05 71	22	Neolithic to Prehistoric	Lithic scatter (multi-period): 16 arrowheads (including 5 leaf-shaped, 7 barbed and tanged and 1 hollow-base), a fabricator, a point, 1 flint chisel (fragment) and 3 edge-polished flint chisels Source(s): Smith 1931, p.33; Manby 1974, p.118; Radley 1975, pp.46-47	Collection: Sturge NMR: TA 07 SE 22
5	NGR: TA 0257 7065 Locality: Old Hill	1	Neolithic	Stray find: polished stone axe (Group VI flake) Source(s): Thorp 1976, p.3	NMR: TA 07 SW 28
6	NGR: TA 05 70	5	Mesolithic	Lithic scatter (single period): 1 tranchet axe, 1 core and 3 microliths Source(s): Wymer and Bonsall 1977, p.355	Collection: Harland /Grantham NMR: TA 07 SE 16
7	NGR: TA 0230 7048 Locality: Ringlands	1	Prehistoric	Stray find: stone axe (Group VI fragment) Source(s): Thorp 1976, p.3	NMR: TA 07 SW 29
8	NGR: TA 0254 7056 Locality: Old Hill	1	Bronze Age	Stray find: arrowhead (barbed and tanged) Source(s): Moorhouse 1977, p.5	NMR: TA 07 SW 30
9	NGR: TA 04 71	1	Neolithic	Stray find: stone axe Source(s): Keen and Radley 1971, p.34 (205)	NMR: TA 07 SW 33

Tibthorpe

None

Warter

None

Watton

Site	Locality	n	Period	Details	Notes
1	NGR: TA 01 50	1	Bronze Age	Stray find: arrowhead (barbed and tanged) Source(s): Radley 1975, p.47	NMR: TA 05 SW 23

Wetwang

None

Yapham

None

Catalogue of the lithic assemblage from Wharram-le-Street

ID	Unit	Sub Division	Class	Type	Sub Type	Date
1	01/01	Low	Lithic Debitage	Flake	Broken	-
2	03/03	Background	Lithic Debitage	Flake	Non-cortical	-
3	04/02	Background	Lithic Debitage	Flake	Non-cortical	-
4	04/03	Background	Stone Tool	Other	Retouched Flake	-
5	05/03	Background	Lithic Debitage	Flake	Fragment	-
6	05/03	Background	Lithic Debitage	Blade	Non-cortical	Mesolithic
7	05/05	Background	Lithic Debitage	Flake	Non-cortical	-
8	05/05	Background	Lithic Debitage	Flake	Broken	-
9	05/05	Background	Stone Tool	Scraper	End	-
10	05/07	Background	Lithic Debitage	Flake	Cortical	-
11	05/07	Background	Lithic Debitage	Flake	Cortical	-
12	06/04	Background	Stone Tool	Scraper	Broad Hafted	Bronze Age
13	06/05	Background	Lithic Debitage	Flake	Non-cortical	-
14	06/06	Background	Lithic Debitage	Flake	Cortical	-
15	06/06	Background	Lithic Debitage	Flake	Non-cortical	-
16	07/05	Background	Stone Tool	Other	Retouched Debris	-
17	07/06	Background	Lithic Debitage	Core	Opposed Platform	Early Neolithic
18	07/07	Background	Lithic Debitage	Flake	Non-cortical	-
19	07/07	Background	Lithic Debitage	Flake	Cortical (rejuvenation)	-
20	07/09	Background	Stone Tool	Arrowhead	Leaf-shaped	Early Neolithic
21	07/09	Background	Stone Tool	Other	Awl	Early Neolithic
22	08/04	Background	Stone Tool	Other	Retouched Flake	-
23	08/05	Background	Stone Tool	Arrowhead	Transverse	Late Neolithic
24	08/05	Background	Lithic Debitage	Flake	Non-cortical	-
25	08/05	Background	Lithic Debitage	Debris	Shatter	-
26	08/06	East	Lithic Debitage	Debris	Shatter	-
27	08/07	East	Lithic Debitage	Blade	Fragment	-
28	08/07	East	Stone Tool	Scraper	Side	-
29	08/08	East	Lithic Debitage	Debris	Shatter	-
30	08/08	East	Lithic Debitage	Flake	Cortical	-
31	08/08	East	Lithic Debitage	Core	Other	-

ID	Unit	Sub Division	Class	Type	Sub Type	Date
32	08/09	East	Lithic Debitage	Debris	Shatter	-
33	08/09	East	Lithic Debitage	Flake	Fragment	-
34	08/09	East	Lithic Debitage	Flake	Fragment	-
35	08/09	East	Stone Tool	Other	Retouched Flake	-
36	08/09	East	Stone Tool	Scraper	Double-sided	-
37	08/10	East	Lithic Debitage	Flake	Fragment	-
38	08/10	East	Lithic Debitage	Flake	Cortical	-
39	08/10	East	Lithic Debitage	Flake	Cortical	-
40	08/10	East	Lithic Debitage	Flake	Non-cortical	-
41	08/10	East	Stone Tool	Other	Retouched Flake	-
42	08/11	Background	Stone Tool	Scraper	Side	-
43	09/04	Background	Lithic Debitage	Core	Single Platform	Early Neolithic
44	09/05	Background	Lithic Debitage	Flake	Cortical	-
45	09/05	Background	Lithic Debitage	Flake	Fragment	-
46	09/05	Background	Stone Tool	Scraper	Disc	Bronze Age
47	09/06	East	Lithic Debitage	Flake	Non-cortical (rejuvenation)	-
48	09/06	East	Lithic Debitage	Flake	Cortical	-
49	09/06	East	Lithic Debitage	Flake	Non-cortical	-
50	09/07	East	Lithic Debitage	Core	Polyhedral	Bronze Age
51	09/07	East	Stone Tool	Other	Retouched Flake	-
52	09/07	East	Lithic Debitage	Flake	Cortical	-
53	09/07	East	Lithic Debitage	Blade	Segment	-
54	09/07	East	Lithic Debitage	Flake	Non-cortical	-
55	09/08	East	Lithic Debitage	Flake	Cortical (rejuvenation)	Early Neolithic
56	09/08	East	Lithic Debitage	Flake	Cortical	-
57	09/08	East	Stone Tool	Scraper	End	-
58	09/09	East	Lithic Debitage	Flake	Non-cortical	-
59	09/09	East	Lithic Debitage	Flake	Non-cortical	-
60	09/09	East	Lithic Debitage	Flake	Non-cortical	-
61	09/09	East	Lithic Debitage	Flake	Non-cortical	-
62	09/09	East	Stone Tool	Other	Retouched Flake	-
63	09/10	East	Lithic Debitage	Flake	Cortical	-
64	09/10	East	Lithic Debitage	Flake	Non-cortical	-
65	09/10	East	Stone Tool	Scraper	End	-
66	09/11	Background	Lithic Debitage	Flake	Cortical	-
67	10/05	Background	Lithic Debitage	Flake	Non-cortical	-
68	10/07	East	Stone Tool	Scraper	End	-
69	10/08	East	Lithic Debitage	Debris	Shatter	-
70	10/09	East	Lithic Debitage	Flake	Cortical	-

ID	Unit	Sub Division	Class	Type	Sub Type	Date
71	10/09	East	Lithic Debitage	Core	Other	-
72	10/09	East	Stone Tool	Other	Retouched Flake	-
73	10/10	East	Lithic Debitage	Flake	Cortical	-
74	10/10	East	Lithic Debitage	Flake	Cortical	-
75	10/10	East	Lithic Debitage	Flake	Non-cortical	-
76	10/11	Background	Stone Tool	Other	Retouched Flake	-
77	11/06	Background	Lithic Debitage	Flake	Non-cortical	-
78	11/06	Background	Stone Tool	Other	Serrated Blade	-
79	11/07	East	Lithic Debitage	Flake	Cortical	-
80	11/07	East	Lithic Debitage	Blade	Fragment	-
81	11/07	East	Lithic Debitage	Flake	Cortical	-
82	11/07	East	Lithic Debitage	Flake	Cortical	-
83	11/07	East	Lithic Debitage	Flake	Cortical	-
84	11/08	East	Lithic Debitage	Core	Simple	Bronze Age
85	11/08	East	Lithic Debitage	Core	Single Platform	Early Neolithic
86	11/09	East	Lithic Debitage	Core	Single Platform	Mesolithic
87	11/10	East	Lithic Debitage	Flake	Cortical	-
88	11/10	East	Stone Tool	Other	Retouched Flake	-
89	11/12	Background	Lithic Debitage	Debris	Shatter	-
90	11/13	Background	Lithic Debitage	Flake	Fragment	-
91	11/14	Background	Lithic Debitage	Core	Simple	Bronze Age
92	12/06	Background	Lithic Debitage	Core	Single Platform	Early Neolithic
93	12/06	Background	Lithic Debitage	Flake	Cortical	-
94	12/07	East	Lithic Debitage	Blade	Non-cortical	-
95	12/07	East	Lithic Debitage	Flake	Broken	-
96	12/08	East	Lithic Debitage	Debris	Shatter	-
97	12/09	East	Stone Tool	Other	Awl	-
98	12/09	East	Lithic Debitage	Flake	Non-cortical	-
99	12/09	East	Stone Tool	Scraper	Disc	-
100	12/10	Background	Lithic Debitage	Debris	Shatter	-
101	12/10	Background	Lithic Debitage	Flake	Cortical	-
102	12/10	Background	Lithic Debitage	Flake	Non-cortical	-
103	12/14	West	Stone Tool	Other	Microlith	Mesolithic
104	12/14	West	Lithic Debitage	Blade	Fragment	-
105	12/14	West	Lithic Debitage	Debris	Shatter	-
106	12/14	West	Stone Tool	Other	Retouched Flake	-
107	12/15	Background	Lithic Debitage	Flake	Non-cortical	-
108	12/15	Background	Stone Tool	Other	Retouched Flake	-
109	13/06	Background	Lithic Debitage	Flake	Cortical	-

ID	Unit	Sub Division	Class	Type	Sub Type	Date
110	13/06	Background	Stone Tool	Other	Retouched Blade	-
111	13/07	East	Lithic Debitage	Flake	Cortical	-
112	13/08	East	Lithic Debitage	Flake	Non-cortical	-
113	13/08	East	Stone Tool	Other	Serrated Blade	Early Neolithic
114	13/08	East	Lithic Debitage	Flake	Non-cortical	-
115	13/08	East	Lithic Debitage	Core	Opposed Platform	Early Neolithic
116	13/08	East	Lithic Debitage	Flake	Fragment	-
117	13/09	East	Lithic Debitage	Flake	Cortical	-
118	13/09	East	Lithic Debitage	Flake	Non-cortical	-
119	13/09	East	Stone Tool	Other	Retouched Flake	-
120	13/10	Background	Lithic Debitage	Debris	Shatter	-
121	13/10	Background	Lithic Debitage	Flake	Broken	-
122	13/13	West	Lithic Debitage	Flake	Non-cortical	-
123	13/13	West	Lithic Debitage	Flake	Fragment	-
124	13/13	West	Lithic Debitage	Flake	Fragment	-
125	13/13	West	Lithic Debitage	Blade	Broken	-
126	13/13	West	Lithic Debitage	Flake	Fragment	-
127	13/13	West	Stone Tool	Other	Retouched Flake	-
128	13/13	West	Lithic Debitage	Flake	Cortical	-
129	13/14	West	Lithic Debitage	Debris	Shatter	-
130	13/15	West	Lithic Debitage	Debris	Shatter	-
131	13/15	West	Stone Tool	Knife	Edge-retouched	-
132	13/15	West	Lithic Debitage	Blade	Broken	-
133	13/15	West	Stone Tool	Other	Retouched Flake	-
134	13/16	Background	Lithic Debitage	Flake	Non-cortical	-
135	13/17	Background	Lithic Debitage	Flake	Fragment	-
136	14/06	Background	Lithic Debitage	Flake	Non-cortical	-
137	14/06	Background	Stone Tool	Other	Retouched Flake	-
138	14/08	East	Lithic Debitage	Blade	Fragment	-
139	14/08	East	Lithic Debitage	Flake	Fragment	-
140	14/08	East	Lithic Debitage	Flake	Non-cortical	-
141	14/08	East	Lithic Debitage	Flake	Cortical	-
142	14/09	East	Lithic Debitage	Debris	Shatter	-
143	14/10	Background	Lithic Debitage	Core	Discoidal	Late Neolithic
144	14/11	Background	Stone Tool	Other	Awl	-
145	14/12	Background	Lithic Debitage	Debris	Shatter	-
146	14/14	West	Lithic Debitage	Debris	Shatter	-
147	14/15	West	Lithic Debitage	Flake	Fragment	-
148	14/19	Background	Lithic Debitage	Flake	Cortical	-

ID	Unit	Sub Division	Class	Type	Sub Type	Date
149	15/07	Background	Lithic Debitage	Flake	Non-cortical	-
150	15/07	Background	Lithic Debitage	Flake	Non-cortical	-
151	15/08	East	Lithic Debitage	Flake	Cortical	-
152	15/08	East	Lithic Debitage	Flake	Non-cortical	-
153	15/08	East	Lithic Debitage	Flake	Fragment	-
154	15/09	East	Lithic Debitage	Flake	Non-cortical	-
155	15/09	East	Stone Tool	Other	Retouched Blade	Mesolithic
156	15/10	Background	Lithic Debitage	Flake	Non-cortical	-
157	15/10	Background	Lithic Debitage	Flake	Fragment	-
158	15/10	Background	Stone Tool	Scraper	Disc	Bronze Age
159	15/11	Single	Lithic Debitage	Flake	Cortical	-
160	15/11	Single	Lithic Debitage	Flake	Non-cortical	-
161	15/11	Single	Stone Tool	Scraper	Side	-
162	15/12	Background	Lithic Debitage	Flake	Non-cortical	-
163	15/12	Background	Lithic Debitage	Flake	Non-cortical	-
164	15/12	Background	Lithic Debitage	Flake	Cortical	-
165	15/12	Background	Lithic Debitage	Debris	Shatter	-
166	15/12	Background	Lithic Debitage	Core	Polyhedral	Bronze Age
167	15/14	West	Lithic Debitage	Flake	Non-cortical	-
168	15/14	West	Lithic Debitage	Flake	Fragment	-
169	15/14	West	Lithic Debitage	Flake	Non-cortical	-
170	15/14	West	Lithic Debitage	Blade	Fragment	-
171	15/14	West	Lithic Debitage	Debris	Shatter	-
172	15/14	West	Lithic Debitage	Core	Opposed Platform	Mesolithic
173	15/15	West	Lithic Debitage	Flake	Non-cortical	-
174	15/15	West	Stone Tool	Other	Retouched Flake	-
175	15/15	West	Stone Tool	Scraper	Broken	-
176	15/17	Background	Lithic Debitage	Blade	Broken	-
177	15/17	Background	Lithic Debitage	Flake	Cortical	-
178	15/18	Background	Stone Tool	Other	Retouched Flake	-
179	16/08	Background	Stone Tool	Other	Serrated Blade	Mesolithic
180	16/08	Background	Lithic Debitage	Flake	Non-cortical	-
181	16/08	Background	Stone Tool	Other	Retouched Flake	-
182	16/10	Background	Lithic Debitage	Flake	Cortical	-
183	16/13	West	Lithic Debitage	Flake	Non-cortical	-
184	16/13	West	Lithic Debitage	Flake	Non-cortical	-
185	16/13	West	Lithic Debitage	Flake	Cortical	-
186	16/14	West	Lithic Debitage	Flake	Non-cortical	-
187	16/15	West	Lithic Debitage	Flake	Cortical	-

ID	Unit	Sub Division	Class	Type	Sub Type	Date
188	16/15	West	Lithic Debitage	Flake	Broken	-
189	16/15	West	Lithic Debitage	Core	Discoidal	Bronze Age
190	16/16	Background	Lithic Debitage	Debris	Shatter	-
191	16/16	Background	Stone Tool	Scraper	Broken	Bronze Age
192	16/17	Background	Stone Tool	Other	Serrated Blade	Early Neolithic
193	16/19	Background	Lithic Debitage	Flake	Non-cortical	-
194	16/20	Background	Lithic Debitage	Flake	Cortical	-
195	16/21	Background	Lithic Debitage	Debris	Shatter	-
196	16/22	Background	Lithic Debitage	Debris	Shatter	-
197	17/08	Background	Lithic Debitage	Flake	Non-cortical	-
198	17/11	Background	Lithic Debitage	Flake	Non-cortical	-
199	17/12	Background	Lithic Debitage	Flake	Non-cortical	-
200	17/13	West	Lithic Debitage	Flake	Broken	-
201	17/13	West	Stone Tool	Other	Retouched Flake	-
202	17/14	West	Lithic Debitage	Flake	Cortical	-
203	17/14	West	Lithic Debitage	Flake	Cortical	-
204	17/14	West	Lithic Debitage	Flake	Cortical	-
205	17/14	West	Lithic Debitage	Flake	Fragment	-
206	17/16	West	Lithic Debitage	Flake	Fragment	-
207	17/19	Background	Lithic Debitage	Flake	Non-cortical	-
208	17/20	Background	Lithic Debitage	Core	Polyhedral	-
209	18/08	Background	Lithic Debitage	Debris	Shatter	-
210	18/09	Background	Lithic Debitage	Debris	Shatter	-
211	18/09	Background	Stone Tool	Other	Retouched Flake	-
212	18/09	Background	Lithic Debitage	Flake	Non-cortical	-
213	18/10	Background	Stone Tool	Scraper	Broken	-
214	18/12	Background	Lithic Debitage	Flake	Non-cortical	-
215	18/13	West	Stone Tool	Other	Burin	-
216	18/13	West	Lithic Debitage	Blade	Broken	-
217	18/13	West	Lithic Debitage	Core	Discoidal	Bronze Age
218	18/14	West	Lithic Debitage	Flake	Cortical	-
219	18/14	West	Lithic Debitage	Flake	Non-cortical	-
220	18/14	West	Lithic Debitage	Flake	Non-cortical	-
221	18/14	West	Stone Tool	Other	Retouched Blade	Neolithic
222	18/15	West	Lithic Debitage	Flake	Non-cortical	-
223	18/15	West	Lithic Debitage	Flake	Non-cortical	-
224	18/15	West	Stone Tool	Scraper	Double-ended	Neolithic
225	18/15	West	Stone Tool	Other	Retouched Blade	Early Neolithic
226	18/18	Background	Lithic Debitage	Blade	Broken	-

ID	Unit	Sub Division	Class	Type	Sub Type	Date
227	18/18	Background	Stone Tool	Scraper	End	-
228	18/19	Background	Stone Tool	Other	Retouched Flake	Bronze Age
229	18/19	Background	Lithic Debitage	Flake	Non-cortical	-
230	18/23	Background	Lithic Debitage	Debris	Shatter	-
231	19/09	Background	Stone Tool	Other	Retouched Flake	-
232	19/10	Background	Lithic Debitage	Flake	Non-cortical	-
233	19/13	West	Stone Tool	Other	Retouched Flake	Late Neolithic
234	19/13	West	Stone Tool	Other	Retouched Flake	-
235	19/13	West	Lithic Debitage	Flake	Non-cortical	-
236	19/14	West	Lithic Debitage	Flake	Cortical	-
237	19/14	West	Lithic Debitage	Flake	Fragment	-
238	19/14	West	Lithic Debitage	Flake	Non-cortical	-
239	19/14	West	Lithic Debitage	Flake	Cortical	-
240	19/14	West	Lithic Debitage	Flake	Fragment	-
241	19/15	West	Lithic Debitage	Blade	Non-cortical	Mesolithic
242	19/15	West	Lithic Debitage	Flake	Non-cortical	-
243	19/18	Background	Stone Tool	Other	Retouched Flake	-
244	20/11	Background	Lithic Debitage	Flake	Non-cortical	-
245	20/13	Background	Stone Tool	Other	Retouched Flake	-
246	20/15	Background	Lithic Debitage	Core	Single Platform	Early Neolithic
247	20/17	Background	Lithic Debitage	Flake	Non-cortical	-
248	20/18	Background	Stone Tool	Other	Retouched Flake	-
249	20/21	Background	Stone Tool	Other	Retouched Flake	-
250	20/23	Background	Lithic Debitage	Flake	Cortical	-
251	21/14	Background	Stone Tool	Other	Retouched Flake	-
252	21/14	Background	Lithic Debitage	Core	Polyhedral	Bronze Age
253	21/15	Background	Lithic Debitage	Flake	Non-cortical	-
254	21/16	Background	Lithic Debitage	Flake	Non-cortical	-
255	21/18	Background	Stone Tool	Other	Retouched Flake	Late Neolithic
256	21/18	Background	Stone Tool	Arrowhead	Transverse	Late Neolithic
257	21/21	Background	Lithic Debitage	Debris	Shatter	-
258	21/24	Low	Lithic Debitage	Blade	Fragment	-
259	22/12	Background	Lithic Debitage	Flake	Non-cortical	-
260	22/13	Background	Stone Tool	Other	Retouched Flake	-
261	22/14	Background	Stone Tool	Other	Awl	-
262	22/14	Background	Stone Tool	Other	Retouched Flake	-
263	22/16	Background	Lithic Debitage	Flake	Cortical	-
264	22/17	Background	Lithic Debitage	Flake	Non-cortical	-
265	22/22	Background	Lithic Debitage	Flake	Cortical	-

ID	Unit	Sub Division	Class	Type	Sub Type	Date
266	23/12	Background	Lithic Debitage	Flake	Cortical	-
267	23/12	Background	Lithic Debitage	Flake	Fragment	-
268	23/12	Background	Lithic Debitage	Flake	Cortical	-
269	23/12	Background	Stone Tool	Other	Retouched Flake	-
270	23/13	Background	Lithic Debitage	Flake	Non-cortical	-
271	23/14	Background	Lithic Debitage	Flake	Non-cortical (crested)	-
272	23/19	Background	Stone Tool	Scraper	Disc	Bronze Age
273	23/21	Background	Stone Tool	Other	Retouched Flake	-
274	24/12	Background	Lithic Debitage	Debris	Shatter	-
275	24/12	Background	Lithic Debitage	Flake	Cortical	-
276	24/12	Background	Lithic Debitage	Flake	Fragment	-
277	24/14	Background	Lithic Debitage	Debris	Shatter	-
278	24/14	Background	Lithic Debitage	Debris	Shatter	-
279	24/14	Background	Stone Tool	Scraper	End	Early Neolithic
280	24/15	Background	Lithic Debitage	Debris	Shatter	-
281	24/15	Background	Lithic Debitage	Debris	Shatter	-
282	24/15	Background	Lithic Debitage	Flake	Cortical	-
283	24/16	Background	Lithic Debitage	Core	Discoidal	Bronze Age
284	24/17	Background	Lithic Debitage	Debris	Shatter	-
285	24/17	Background	Lithic Debitage	Debris	Shatter	-
286	24/17	Background	Stone Tool	Scraper	End	Early Neolithic
287	24/18	Background	Lithic Debitage	Debris	Shatter	-
288	24/18	Background	Lithic Debitage	Debris	Shatter	-
289	24/19	Background	Stone Tool	Scraper	Disc	Bronze Age
290	24/23	Background	Lithic Debitage	Debris	Shatter	-
291	25/13	Background	Stone Tool	Other	Retouched Flake	-
292	25/15	Background	Stone Tool	Other	Retouched Flake	-
293	25/16	Background	Stone Tool	Other	Retouched Flake	-
294	25/17	Background	Stone Tool	Other	Retouched Flake	-
295	25/18	Background	Stone Tool	Other	Serrated Blade	-
296	25/23	Background	Stone Tool	Scraper	Horseshoe	Late Neolithic
297	26/12	Background	Lithic Debitage	Core	Other	Bronze Age
298	26/12	Background	Lithic Debitage	Debris	Shatter	-
299	26/12	Background	Stone Tool	Other	Retouched Core Fragment	-
300	26/13	Background	Stone Tool	Other	Serrated Flake	Early Neolithic
301	26/14	Background	Lithic Debitage	Debris	Shatter	-
302	26/14	Background	Lithic Debitage	Flake	Cortical	-
303	26/18	Background	Lithic Debitage	Debris	Shatter	-
304	26/19	Background	Lithic Debitage	Flake	Cortical	-

ID	Unit	Sub Division	Class	Type	Sub Type	Date
305	26/20	Background	Lithic Debitage	Flake	Non-cortical	-
306	26/20	Background	Stone Tool	Other	Retouched Flake	-
307	26/21	Background	Stone Tool	Other	Retouched Flake	-
308	26/22	Background	Lithic Debitage	Flake	Non-cortical	-
309	26/22	Background	Lithic Debitage	Flake	Cortical	-
310	26/22	Background	Lithic Debitage	Flake	Non-cortical	-
311	26/23	Background	Lithic Debitage	Debris	Shatter	-
312	27/17	Background	Stone Tool	Scraper	Horseshoe	Late Neolithic
313	27/17	Background	Stone Tool	Other	Retouched Debris	-
314	27/18	Background	Lithic Debitage	Debris	Shatter	-
315	27/19	Background	Lithic Debitage	Debris	Shatter	-
316	27/21	Background	Stone Tool	Other	Retouched Core Fragment	-
317	27/23	Background	Stone Tool	Scraper	End	Late Neolithic
318	27/23	Background	Lithic Debitage	Flake	Cortical	-
319	28/18	Background	Lithic Debitage	Flake	Cortical	-
320	29/22	Background	Stone Tool	Other	Retouched Flake	-
321	30/17	Low	Lithic Debitage	Debris	Shatter	-
322	30/21	Background	Lithic Debitage	Debris	Shatter	-
323	30/22	Background	Lithic Debitage	Flake	Cortical	-
324	31/19	Background	Lithic Debitage	Flake	Non-cortical	-
325	31/21	Background	Lithic Debitage	Debris	Shatter	-
326	31/22	Background	Lithic Debitage	Core	Other	Bronze Age
327	32/19	Background	Stone Tool	Scraper	Side	-
328	32/22	Background	Stone Tool	Scraper	Side	-
329	32/24	Background	Lithic Debitage	Flake	Fragment	-
330	33/18	Background	Lithic Debitage	Flake	Fragment	-
331	33/23	Background	Stone Tool	Arrowhead	Barb and Tang	Bronze Age
332	33/24	Background	Lithic Debitage	Flake	Non-cortical	-
333	34/21	Background	Stone Tool	Other	Retouched Flake	-
334	35/20	Background	Lithic Debitage	Flake	Fragment	-
335	35/24	Background	Stone Tool	Other	Retouched Flake	-
336	36/24	Background	Lithic Debitage	Core	Pyramidal	Mesolithic
337	37/21	Background	Lithic Debitage	Flake	Non-cortical	-
338	37/21	Background	Lithic Debitage	Debris	Shatter	-
339	37/23	Background	Lithic Debitage	Flake	Broken	-
340	37/23	Background	Lithic Debitage	Debris	Shatter	-

Gazetteer of the burial mounds excavated on the Yorkshire Wolds

Mortimer Barrows

Barrow	Group	Source	NGR	Parish	Notes
1	Towthorpe	Tumulus	SE 880 637	Fimber	
1a	Driffield	Tumulus	TA 023 582	Driffield	
2	Blanch	Historic	SE 892 561	Huggate	
2b	Calais Wold	Historic (site of)	SE 834 544	Millington	
3	Towthorpe	Cropmark	SE 852 624	Wharram	Long barrow
4	Painsthorpe Wold	Tumulus	SE 822 593	Kirby Underdale	
5	Fimber	Historic	SE 890 609	Fimber	
6	Towthorpe	Tumulus	SE 889 639	Fimber	
7	Towthorpe	Historic	SE 892 646	Kirby Grindalythe	
7a	Towthorpe &c.	Tumulus	SE 839 615	Thixendale	Detached
8	Hanging Grimston	Tumulus	SE 816 603	Thixendale	
9	Hanging Grimston	Tumulus	SE 814 604	Thixendale	
10	Hanging Grimston	Cropmark	SE 814 603	Thixendale	
11	Hanging Grimston	Cropmark	SE 814 604	Thixendale	
12	Hanging Grimston	Tumulus	SE 812 606	Thixendale	
13	Calais Wold	Tumulus	SE 828 562	Bishop Wilton	
14	Calais Wold	Tumulus	SE 831 556	Bishop Wilton	Mortuary house
15	Calais Wold	Cropmark	SE 823 565	Bishop Wilton	
16	Riggs	Historic (site of)	SE 851 587	Thixendale	
17	Riggs	Tumulus	SE 852 589	Thixendale	
18	Towthorpe	Cropmark	SE 898 649	Kirby Grindalythe	
19	Riggs	Historic (site of)	SE 852 589	Thixendale	
20	Riggs	Tumulus	SE 848 590	Thixendale	
21	Towthorpe	Historic	SE 906 653	Kirby Grindalythe	
22	Towthorpe	Historic (site of)	SE 902 648	Kirby Grindalythe	
23	Calais Wold	Cropmark	SE 829 556	Bishop Wilton	
24	Calais Wold	Historic	SE 830 554	Bishop Wilton	
25	Calais Wold	Historic	SE 829 554	Bishop Wilton	
26	Hanging Grimston	Tumulus	SE 817 600	Thixendale	
27	Hanging Grimston	Cropmark	SE 818 600	Thixendale	
28	Life Hill	Historic	SE 936 618	Sledmere	
29	Riggs	Cropmark	SE 853 577	Thixendale	
30	Aldro (Division B)	Cropmark	SE 825 617	Thixendale	
31	Garrowby Wold	Tumulus	SE 810 560	Bishop Wilton	
32	Garrowby Wold	Historic	SE 810 558	Bishop Wilton	

Barrow	Group	Source	NGR	Parish	Notes
33	Riggs	Tumulus	SE 849 592	Thixendale	
34	Riggs	Cropmark	SE 855 581	Thixendale	Mortuary house
35	Riggs	Cropmark	SE 855 581	Thixendale	
36	Riggs	Historic	SE 849 597	Thixendale	
37	Garton Slack	Historic (site of)	SE 957 597	Garton	Long barrow
38	Calais Wold	Historic	SE 839 560	Millington	
39	Garrowby Wold	Cropmark	SE 807 567	Bishop Wilton	
40	Garton Slack	Historic (site of)	SE 965 580	Garton	
41	Riggs	Tumulus	SE 854 582	Thixendale	
42	Garrowby Wold	Cropmark	SE 806 565	Bishop Wilton	
43	Towthorpe	Cropmark	SE 872 637	Wharram	
44	Towthorpe	Tumulus	SE 862 633	Wharram	
45	Wharram Percy	Cropmark	SE 841 637	Wharram	
46	Wharram Percy	Cropmark	SE 839 636	Wharram	
47	Wharram Percy	Cropmark	SE 838 635	Wharram	
48	Wharram Percy	Cropmark	SE 837 635	Wharram	
49	Aldro (Division D)	Tumulus (site of)	SE 798 630	Leavening	
50	Aldro (Division D)	Historic	SE 800 630	Leavening	
51	Aldro (Division D)	Cropmark	SE 800 629	Leavening	
52	Aldro (Division A)	Cropmark	SE 817 629	Birdsall	
53	Aldro (Division A)	Cropmark	SE 817 629	Birdsall	
54	Aldro (Division A)	Tumulus	SE 815 629	Birdsall	
55	Hanging Grimston	Historic	SE 806 612	Thixendale	
56	Hanging Grimston	Tumulus	SE 805 613	Thixendale	
57	Hanging Grimston	Historic	SE 806 612	Thixendale	
58	Hanging Grimston	Historic	SE 806 611	Thixendale	
59	Hanging Grimston	Historic (site of)	SE 809 612	Thixendale	Square barrow
60	Painsthorpe Wold	Historic	SE 831 577	Kirby Underdale	
61	Hanging Grimston	Tumulus	SE 800 606	Thixendale	
62	Garrowby Wold	Tumulus	SE 808 567	Kirby Underdale	
63	Garrowby Wold	Historic	SE 808 569	Kirby Underdale	
64	Garrowby Wold	Cropmark	SE 814 567	Bishop Wilton	
65	Wharram Percy	Tumulus	SE 835 637	Birdsall	
66	Wharram Percy	Tumulus	SE 839 639	Birdsall	
67	Wharram Percy	Tumulus	SE 831 635	Birdsall	
68	Garrowby Wold	Historic	SE 808 570	Kirby Underdale	Square barrow
69	Garrowby Wold	Historic	SE 812 563	Bishop Wilton	
70	Wharram Percy	Tumulus	SE 837 634	Birdsall	
71	Wharram Percy	Cropmark	SE 836 634	Birdsall	
72	Towthorpe	Cropmark	SE 869 638	Wharram	
73	Towthorpe	Historic (site of)	SE 869 640	Wharram	
74	Garton Slack	Historic (site of)	SE 962 579	Garton	
75	Garton Slack	Tumulus	SE 961 580	Garton	
76	Garton Slack	Historic (site of)	SE 963 582	Garton	
77	Garton Slack	Historic (site of)	SE 956 581	Wetwang	
78	Painsthorpe Wold	Historic	SE 841 573	Kirby Underdale	

Barrow	Group	Source	NGR	Parish	Notes
79	Garton Slack	Tumulus	SE 979 577	Kirkburn	
80	Garton Slack	Tumulus	SE 978 577	Kirkburn	Long barrow
81	Garton Slack	Historic (site of)	SE 979 575	Kirkburn	Long barrow
82	Garton Slack	Historic (site of)	SE 974 579	Garton	
83	Painsthorpe Wold	Tumulus	SE 826 588	Kirby Underdale	
84	Painsthorpe Wold	Historic	SE 828 590	Kirby Underdale	
85	Painsthorpe Wold	Historic	SE 827 591	Kirby Underdale	
86	Calais Wold	Historic	SE 832 569	Kirby Underdale	
87	Aldro (Division A)	Tumulus	SE 816 628	Birdsall	
88	Aldro (Division A)	Historic	SE 820 628	Birdsall	
89	Hanging Grimston	Cropmark	SE 801 608	Thixendale	
90	Hanging Grimston	Tumulus	SE 804 610	Thixendale	
91	Hanging Grimston	Historic (site of)	SE 810 610	Thixendale	Square barrow
92	Acklam Wold	Historic	SE 807 616	Thixendale	
93	Painsthorpe Wold	Cropmark	SE 842 577	Kirby Underdale	
93a	Painsthorpe Wold	Historic	SE 838 583	Thixendale	
94	Aldro (Division E)	Historic	SE 800 625	Leavening	
95	Painsthorpe Wold	Historic	SE 825 576	Kirby Underdale	
96	Calais Wold	Cropmark	SE 825 570	Kirby Underdale	
97	Aldro (Division D)	Tumulus	SE 800 629	Leavening	
98	Painsthorpe Wold	Cropmark	SE 842 577	Kirby Underdale	
99	Painsthorpe Wold	Historic	SE 826 584	Kirby Underdale	
100	Calais Wold	Tumulus	SE 834 559	Bishop Wilton	
101	Garrowby Wold	Cropmark	SE 814 569	Kirby Underdale	
102	Painsthorpe Wold	Historic	SE 824 582	Kirby Underdale	
103	Calais Wold	Cropmark	SE 825 563	Bishop Wilton	
104	Garrowby Wold	Historic	SE 816 568	Kirby Underdale	
104a	Garrowby Wold &c.	Cropmark	SE 814 551	Bishop Wilton	Detached
105	Calais Wold	Cropmark	SE 824 564	Bishop Wilton	
106	Towthorpe	Cropmark	SE 876 639	Wharram	
107	Garton Slack	Historic (site of)	SE 969 579	Garton	
108	Aldro (Division A)	Cropmark	SE 823 629	Birdsall	
109	Aldro (Division A)	Cropmark	SE 822 629	Birdsall	
110	Hanging Grimston	Tumulus	SE 808 608	Thixendale	Long barrow
111	Painsthorpe Wold	Cropmark	SE 838 591	Thixendale	
112	Garton Slack	Historic (site of)	SE 986 575	Kirkburn	
113	Aldro (Division D)	Historic	SE 800 630	Birdsall	
114	Calais Wold	Historic	SE 824 569	Bishop Wilton	
115	Painsthorpe Wold	Historic	SE 830 589	Kirby Underdale	
116	Aldro (Division A)	Cropmark	SE 829 627	Birdsall	
117	Aldro (Division E)	Historic	SE 806 624	Thixendale	
118	Painsthorpe Wold	Tumulus	SE 833 583	Thixendale	
119	Aldro (Division B)	Historic	SE 821 621	Birdsall	
120	Garrowby Wold	Cropmark	SE 812 554	Bishop Wilton	
121	Painsthorpe Wold	Cropmark	SE 835 584	Thixendale	
122	Life Hill &c.	Historic (site of)	SE 939 592	Wetwang	Detached

Barrow	Group	Source	NGR	Parish	Notes
123	Acklam Wold	Cropmark	SE 801 620	Thixendale	
124	Acklam Wold	Tumulus (site of)	SE 793 623	Acklam	
124a	Acklam Wold	Tumulus (site of)	SE 792 622	Acklam	
125	Aldro (Division E)	Historic	SE 805 625	Thixendale	
126	Aldro (Division E)	Historic	SE 805 626	Thixendale	
127	Wharram Percy	Historic	SE 836 627	Wharram	
128	Aldro (Division B)	Historic	SE 816 623	Birdsall	Indexed as C28
129	Aldro (Division B)	Historic	SE 816 624	Birdsall	Indexed as C29
130	Aldro (Division B)	Historic	SE 820 624	Birdsall	Indexed as C30
131	Hanging Grimston	Cropmark	SE 818 601	Thixendale	
132	Hanging Grimston	Cropmark	SE 819 600	Thixendale	
C33	Fimber	Other	SE 894 606	Fimber	Fimber Church
C34	Garton Slack	Historic (site of)	SE 988 576	Garton	Long barrow
C35	Garton Slack	Tumulus (site of)	SE 991 558	Kirkburn	
C36	Garton Slack	Historic (site of)	TA 003 562	Kirkburn	
C37	Garton Slack	Historic (site of)	TA 001 562	Kirkburn	
C38	Driffield	Historic (site of)	TA 017 566	Kirkburn	
C39	Towthorpe	Tumulus	SE 881 639	Fimber	
C40	Garton Slack	Historic (site of)	SE 982 572	Kirkburn	
C41	Garton Slack	Historic (site of)	SE 988 572	Kirkburn	
C42	Garton Slack	Historic (site of)	SE 979 575	Kirkburn	
C42a	Riggs	Historic	SE 851 597	Thixendale	
C43	Garrowby Wold	Tumulus	SE 812 551	Bishop Wilton	
C44	Driffield	Tumulus	TA 042 578	Driffield	
C45	Garton Slack	Historic	SE 983 577	Garton	
C46	Garton Slack	Historic (site of)	SE 971 575	Kirkburn	
C47	Aldro (Division D)	Tumulus (site of)	SE 799 629	Leavening	Square barrow
C48	Aldro (Division E)	Historic	SE 805 626	Thixendale	
C49	Riggs	Cropmark	SE 848 603	Thixendale	
C50	Driffield	Tumulus	TA 015 572	Garton	
C51	Garton Slack	Historic (site of)	SE 966 583	Garton	
C52	Garton Slack	Historic (site of)	SE 966 584	Garton	
C53	Garton Slack	Historic (site of)	SE 960 584	Garton	
C54	Garton Slack	Historic (site of)	SE 959 585	Garton	
C55	Garton Slack	Historic (site of)	SE 960 583	Garton	
C56	Garton Slack	Historic (site of)	SE 961 583	Garton	
C57	Garton Slack	Historic (site of)	SE 988 568	Kirkburn	
C58	Garton Slack	Historic (site of)	SE 996 565	Kirkburn	
C58	Garton Slack	Tumulus	SE 999 580	Garton	
C58a	Garton Slack	Tumulus	SE 999 580	Garton	
C59	Aldro (Division B)	Tumulus	SE 816 622	Birdsall	
159a	Garton Slack	Historic (site of)	TA 001 585	Garton	
159b	Garton Slack &c.	Not found	TA 001 608	Garton	Detached

Barrow	Group	Source	NGR	Parish	Notes
C61	Garton Slack	Historic (site of)	SE 962 588	Garton	
C62	Garton Slack	Historic (site of)	SE 962 587	Garton	
C63	Garton Slack	Historic (site of)	SE 958 588	Garton	
C64	Garton Slack	Historic (site of)	SE 959 579	Tibthorpe	
C67	Garton Slack	Historic (site of)	SE 980 574	Kirkburn	
C68	Garrowby Wold	Tumulus	SE 813 567	Bishop Wilton	
C69	Garrowby Wold	Tumulus	SE 813 567	Bishop Wilton	
C70	Calais Wold	Cropmark	SE 821 567	Bishop Wilton	
C71	Garton Slack	Historic (site of)	SE 956 582	Garton	
C72	Calais Wold	Historic	SE 830 559	Bishop Wilton	
C73	Towthorpe	Tumulus	SE 883 640	Fimber	
C74	Aldro (Division C)	Historic	SE 809 629	Birdsall	
C75	Aldro (Division C)	Cropmark	SE 811 629	Birdsall	
C76	Aldro (Division C)	Tumulus	SE 808 631	Birdsall	
C77	Aldro (Division C)	Tumulus	SE 811 630	Birdsall	
C78	Aldro (Division C)	Tumulus	SE 811 630	Birdsall	
C79	Aldro (Division C)	Historic	SE 809 629	Birdsall	
C80	Aldro (Division C)	Tumulus	SE 811 630	Birdsall	
C81	Aldro (Division C)	Cropmark	SE 809 631	Birdsall	
C82	Fimber	Historic	SE 909 612	Fimber	
C83	Riggs	Tumulus	SE 854 583	Thixendale	
C84	Riggs	Cropmark	SE 855 583	Thixendale	
C86	Driffield	Tumulus	TA 025 563	Hutton Cranswick	
C88	Blanch	Historic (site of)	SE 922 557	Huggate	
C89	Blanch	Tumulus (site of)	SE 902 545	Huggate	
C90	Blanch	Tumulus (site of)	SE 902 545	Huggate	
C91	Blanch	Tumulus (site of)	SE 901 545	Huggate	
C92	Blanch	Tumulus (site of)	SE 901 545	Huggate	
C93	Blanch	Tumulus (site of)	SE 899 546	Huggate	
C94	Blanch	Tumulus (site of)	SE 900 546	Huggate	
C95	Blanch	Tumulus (site of)	SE 900 547	Huggate	
C96	Blanch	Tumulus (site of)	SE 900 549	Huggate	
C97	Blanch	Tumulus (site of)	SE 900 549	Huggate	
C97	Garrowby Wold	Tumulus	SE 804 568	Kirby Underdale	Duplicate
C98	Garrowby Wold	Tumulus	SE 805 568	Kirby Underdale	
C99	Garrowby Wold &c.	Tumulus	SE 779 565	Bishop Wilton	Detached
200	Painsthorpe Wold	Tumulus	SE 829 585	Kirby Underdale	
201	Painsthorpe Wold	Tumulus	SE 827 585	Kirby Underdale	
202	Acklam Wold	Tumulus (site of)	SE 799 619	Acklam	
203	Acklam Wold	Tumulus (site of)	SE 797 620	Acklam	
204	Acklam Wold	Tumulus (site of)	SE 796 621	Acklam	
205	Acklam Wold	Tumulus (site of)	SE 796 621	Acklam	
206	Acklam Wold	Tumulus (site of)	SE 796 619	Acklam	
207	Acklam Wold	Tumulus (site of)	SE 792 622	Acklam	
208	Acklam Wold	Tumulus	SE 796 623	Acklam	
209	Ungrouped	Historic	SE 961 662	Cottam	Long barrow
209	Acklam Wold	Tumulus	SE 795 623	Acklam	Duplicate

Barrow	Group	Source	NGR	Parish	Notes
210	Ungrouped	Historic	SE 967 665	Cottam	
210	Acklam Wold	Not found	SE 797 622	Acklam	Duplicate
211	Acklam Wold	Tumulus (site of)	SE 795 618	Acklam	
211½	Towthorpe	Historic	SE 833 621	Thixendale	
212	Acklam Wold	Tumulus (site of)	SE 797 617	Acklam	
212a	Driffield	Tumulus (site of)	TA 035 568	Driffield	
212b	Driffield	Tumulus (site of)	TA 035 568	Driffield	
213	Towthorpe	Historic	SE 861 632	Wharram	
214	Towthorpe	Historic (site of)	SE 850 626	Wharram	
214½	Towthorpe	Historic (site of)	SE 849 624	Wharram	
215	Huggate Wold	Historic	SE 842 571	Huggate	
216	Huggate Wold	Cropmark	SE 840 569	Huggate	
217	Painsthorpe Wold	Other	SE 842 577	Kirby Underdale	Offset from text
218	Huggate Wold	Historic	SE 848 571	Huggate	
219	Huggate Wold	Cropmark	SE 840 570	Huggate	
220	Huggate Wold	Cropmark	SE 857 570	Huggate	
221	Huggate Wold	Cropmark	SE 873 576	Huggate	
222	Huggate Wold	Cropmark	SE 873 576	Huggate	
223	Huggate Wold	Cropmark	SE 870 574	Huggate	
224	Huggate Wold	Historic	SE 871 576	Huggate	
225	Huggate Wold	Cropmark	SE 872 577	Huggate	
226	Huggate Wold	Cropmark	SE 872 577	Huggate	
227	Huggate Wold	Cropmark	SE 870 573	Huggate	
228	Huggate Wold	Historic	SE 869 570	Huggate	
229	Huggate Wold	Cropmark	SE 864 572	Huggate	
230	Huggate Wold	Cropmark	SE 857 573	Huggate	
231	Huggate Wold	Cropmark	SE 858 571	Huggate	
232	Blanch	Historic (site of)	SE 914 550	Huggate	
233	Towthorpe	Tumulus	SE 885 640	Fimber	
234	Towthorpe	Tumulus	SE 891 643	Fimber	
235	Huggate Wold	Historic	SE 850 571	Huggate	
236	Blanch	Tumulus (site of)	SE 900 545	Warter	
237	Blanch	Historic	SE 899 537	Warter	
238	Blanch	Historic (site of)	SE 898 537	Warter	
240	Blanch	Tumulus (site of)	SE 902 533	North Dalton	
241	Blanch	Historic (site of)	SE 899 532	Warter	
242	Huggate and Warter Wold	Cropmark	SE 861 555	Huggate	
243	Huggate and Warter Wold	Cropmark	SE 863 553	Huggate	
244	Huggate and Warter Wold	Historic	SE 856 541	Huggate	
245	Huggate Wold	Historic	SE 866 570	Huggate	
246	Huggate and Warter Wold	Historic	SE 859 538	Huggate	
247	Huggate and Warter Wold	Historic	SE 859 539	Huggate	
248	Huggate and Warter Wold	Historic	SE 858 538	Huggate	
249	Huggate and Warter Wold	Historic	SE 860 539	Huggate	
250	Huggate and Warter Wold	Tumulus	SE 858 539	Huggate	
251	Huggate and Warter Wold	Tumulus	SE 858 539	Huggate	

Barrow	Group	Source	NGR	Parish	Notes
252	Huggate and Warter Wold	Tumulus	SE 851 534	Warter	
253	Huggate and Warter Wold	Tumulus	SE 854 531	Warter	
254	Huggate and Warter Wold	Historic (site of)	SE 850 530	Warter	
255	Huggate and Warter Wold	Historic (site of)	SE 849 531	Warter	
256	Aldro (Division A)	Tumulus	SE 819 629	Birdsall	
257	Blanch	Historic	SE 898 531	Warter	
258	Blanch	Tumulus	SE 899 532	Warter	
259	Blanch	Historic	SE 898 531	Warter	
260	Blanch	Historic	SE 898 530	Warter	
261	Blanch	Historic	SE 899 530	Warter	
262	Blanch	Tumulus (site of)	SE 896 521	Warter	
263	Huggate and Warter Wold	Cropmark	SE 863 554	Huggate	
264	Huggate and Warter Wold	Tumulus	SE 859 537	Huggate	
265	Blanch	Tumulus (site of)	SE 902 532	North Dalton	
266	Blanch	Tumulus (site of)	SE 902 531	North Dalton	
268	Garton Slack	Tumulus	SE 985 552	Kirkburn	
268	Life Hill	Historic	SE 926 621	Sledmere	Duplicate
269	Blanch	Tumulus (site of)	SE 901 533	Warter	
270	Life Hill	Historic (site of)	SE 924 621	Sledmere	
271	Life Hill	Historic (site of)	SE 925 621	Sledmere	
272	Ungrouped	Historic (site of)	TA 058 612	Nafferton	
273	Towthorpe &c.	Tumulus	SE 880 668	Kirby Grindalythe	Detached
274	Garton Slack &c.	Not found	SE 956 627	Sledmere	Detached
275	Calais Wold	Cropmark	SE 831 559	Bishop Wilton	Mortuary enclosure
276	Towthorpe	Not found	SE 917 651	Sledmere	
277	Ungrouped	Tumulus	SE 958 663	Cottam	Long barrow
278	Driffield	Tumulus	TA 011 551	Hutton Cranswick	
279	Driffield	Not found	TA 019 562	Kirkburn	
279a	Driffield	Not found	TA 021 561	Hutton Cranswick	
280	Ungrouped	Tumulus (site of)	TA 201 695	Bridlington	
281	Ungrouped	Tumulus	SE 784 665	Burythorpe	
284	Ungrouped	Tumulus	TA 048 726	Wold Newton	
291	Towthorpe &c.	Cropmark	SE 882 669	Kirby Grindalythe	Detached
292	Towthorpe &c.	Cropmark	SE 882 668	Kirby Grindalythe	Detached
293	Towthorpe &c.	Cropmark	SE 882 669	Kirby Grindalythe	Detached
294	Life Hill	Tumulus	SE 944 620	Sledmere	
295	Life Hill	Historic (site of)	SE 944 621	Sledmere	
296	Ungrouped	Historic	SE 983 667	Cottam	YAJ 20
297	Ungrouped	Historic	SE 978 674	Luttons	YAJ 21
298	Ungrouped	Historic	SE 979 675	Weaverthorpe	YAJ 21
A	Ungrouped	Historic	SE 963 679	Luttons	Long barrow
B	Garrowby Wold &c.	Not found	SE 779 565	Bishop Wilton	Detached
X	Painsthorpe Wold	Tumulus	SE 821 594	Kirby Underdale	
Z	Painsthorpe Wold	Historic	SE 821 594	Kirby Underdale	

Compiled from Ordnance Survey Land Line Plus data, Ordnance Survey Country Series maps, Historic England NMP data and Mortimer 1905.

Greenwell Barrows

Barrow	Name	Source	NGR	Parish	Notes
1	Uncleby I	British Museum	SE 821 594	Kirby Underdale	
2	-	British Museum	SE 820 685	Langton	
3	Duggleby Wold I	British Museum	SE 875 696	Kirby Grindalyth	
4	-	British Museum	SE 900 740	Heslerton	
5	Hall II	British Museum	SE 900 740	Heslerton	Oval barrow
6	Cordner	British Museum	SE 910 740	Heslerton	
7	Duggleby I	British Museum	SE 960 741	Sherburn	
8	Duggleby II	British Museum	SE 960 741	Sherburn	
9	Prodham I	British Museum	SE 960 741	Sherburn	
10	Binning	British Museum	SE 962 740	Sherburn	Oval barrow
11	Lamplough I	British Museum	SE 960 740	Sherburn	
12	Lovel	British Museum	SE 940 730	Sherburn	
13	Lamplough II	British Museum	SE 970 750	Sherburn	
16	Brough V	British Museum	SE 970 750	Ganton	
17	Brough II	British Museum	SE 970 750	Ganton	Oval barrow
18	Brough I	British Museum	SE 970 750	Ganton	
19	Brough IV	British Museum	SE 986 760	Ganton	
20	Brough VI	British Museum	SE 986 760	Ganton	
21	Brough II	British Museum	SE 985 760	Ganton	
22	Brough VII	British Museum	SE 985 762	Ganton	
23	Southwell	British Museum	SE 990 760	Ganton	
24	Southwell V	British Museum	TA 000 760	Ganton	
25	Southwell IV	British Museum	TA 000 760	Ganton	
26	Southwell III	British Museum	TA 000 760	Ganton	
27	Southwell I	British Museum	TA 000 760	Ganton	
28	Southwell II	British Museum	TA 000 760	Ganton	
29	Southwell VI	British Museum	TA 010 760	Ganton	
30	Southwell VII	British Museum	TA 010 760	Ganton	
31	Puckering	British Museum	TA 010 760	Binnington	
32	Marr III	British Museum	TA 030 760	Willerby	
33	Marr IV	British Museum	TA 030 760	Willerby	
34	Marr II	British Museum	TA 030 760	Willerby	
35	Marr I	British Museum	TA 030 760	Willerby	
36	-	British Museum	TA 030 760	Willerby	
37	-	British Museum	TA 030 760	Willerby	
38	Marr V	British Museum	TA 030 760	Willerby	
39	-	British Museum	SE 978 732	Butterwick	
40	Grundon I	British Museum	SE 940 720	Helperthorpe	
41	Grundon II	British Museum	SE 940 720	Helperthorpe	
42	Ford	British Museum	SE 979 689	Weaverthorpe	
43	Anderson	British Museum	SE 987 686	Weaverthorpe	
44	Smith III	British Museum	SE 995 685	Weaverthorpe	
45	Smith I	British Museum	TA 000 680	Weaverthorpe	
46	Smith II	British Museum	TA 000 680	Weaverthorpe	
47	Octon Wold I	British Museum	TA 004 691	Weaverthorpe	

Barrow	Name	Source	NGR	Parish	Notes
48	Lamplough	British Museum	TA 000 680	Langtoft	
49	Esh II	British Museum	SE 959 689	Helperthorpe	Long barrow
50	Cowlam IV	British Museum	SE 984 667	Cowlam	Square barrow
51	Cowlam II	British Museum	SE 984 667	Cowlam	Square barrow
52	Cowlam III	British Museum	SE 984 667	Cowlam	Square barrow
53	Cowlam VIII	British Museum	SE 984 667	Cowlam	Square barrow
54	Cowlam I	British Museum	SE 984 667	Cowlam	Square barrow
55	Cowlam V	British Museum	SE 986 675	Cowlam	
56	Cowlam VI	British Museum	SE 986 675	Cowlam	
57	Cowlam VII	British Museum	SE 970 670	Cowlam	
58	Cowlam IX	British Museum	SE 960 660	Cowlam	
59	Cowlam X	British Museum	SE 960 660	Cowlam	
60	-	British Museum	TA 005 720	Thwing	
61	Rudstone I	British Museum	TA 098 658	Rudston	
62	Rudstone IV	British Museum	TA 098 658	Rudston	
63	Rudstone V	British Museum	TA 098 658	Rudston	
64	Rudstone VI	British Museum	TA 094 655	Rudston	
65	Rudstone X	British Museum	TA 090 650	Rudston	
66	Rudstone VII-IX	British Museum	TA 099 658	Rudston	Cursus
67	Cranswick I	British Museum	TA 107 666	Rudston	
68	Cranswick II	British Museum	TA 080 650	Rudston	
69	Jordan	British Museum	TA 110 650	Rudston	
70	Flixton II	British Museum	TA 040 768	Folkton	
71	Flixton III	British Museum	TA 043 767	Folkton	
72	Gardham I	British Museum	SE 942 405	Cherry Burton	
73	Gardham II	British Museum	SE 942 405	Cherry Burton	
74	Gardham IV	British Museum	SE 942 405	Cherry Burton	
75	Gardham VII	British Museum	SE 943 406	Cherry Burton	
76	Paulinus IX	British Museum	SE 990 440	Etton	
77	Paulinus X	British Museum	SE 990 440	Etton	
78	Paulinus XI	British Museum	SE 990 440	Etton	
79	Etton Wold	British Museum	SE 935 438	Etton	
80	Etton I	British Museum	SE 935 438	Etton	Oval barrow
81	Etton II	British Museum	SE 935 438	Etton	
82	Riley	British Museum	SE 930 450	Etton	
83	Enthorpe I	British Museum	SE 910 450	Goodmanham	
84	Enthorpe II	British Museum	SE 910 450	Goodmanham	
85	Enthorpe III	British Museum	SE 910 450	Goodmanham	
86	Enthorpe IV	British Museum	SE 910 450	Goodmanham	
87	Enthorpe VI	British Museum	SE 910 450	Goodmanham	
88	Enthorpe V	British Museum	SE 910 450	Goodmanham	
89	Enthorpe IX	British Museum	SE 910 450	Goodmanham	
90	Paulinus V	British Museum	SE 915 455	Goodmanham	
91	Goodmanham I	British Museum	SE 910 460	Goodmanham	
92	Goodmanham XIII	British Museum	SE 910 460	Goodmanham	
93	Goodmanham X	British Museum	SE 910 460	Goodmanham	
94	Goodmanham XII	British Museum	SE 910 460	Goodmanham	

Barrow	Name	Source	NGR	Parish	Notes
95	Goodmanham IV	British Museum	SE 910 460	Goodmanham	
96	Goodmanham III	British Museum	SE 910 460	Goodmanham	
97	Goodmanham VII	British Museum	SE 910 460	Goodmanham	
98	Goodmanham II	British Museum	SE 910 460	Goodmanham	
99	Goodmanham VIII	British Museum	SE 910 460	Goodmanham	
100	Goodmanham V	British Museum	SE 910 460	Goodmanham	
101	Goodmanham XIV	British Museum	SE 910 460	Goodmanham	
102	Jarrett VIII	British Museum	SE 910 460	Goodmanham	
103	Jarrett II	British Museum	SE 910 460	Goodmanham	
104	Jarrett I	British Museum	SE 910 460	Goodmanham	
105	Jarrett III	British Museum	SE 910 460	Goodmanham	
106	Jarrett IV	British Museum	SE 910 460	Goodmanham	
107	Jarrett VI	British Museum	SE 910 460	Goodmanham	
108	Jarrett VII	British Museum	SE 910 460	Goodmanham	
109	Jarrett V	British Museum	SE 910 460	Goodmanham	
110	Paulinus I	British Museum	SE 910 460	Goodmanham	
111	Paulinus II	British Museum	SE 910 460	Goodmanham	
112	Paulinus III	British Museum	SE 910 460	Goodmanham	
113	Paulinus IV	British Museum	SE 910 460	Goodmanham	
114	Paulinus VI	British Museum	SE 910 460	Goodmanham	
115	Paulinus VIII	British Museum	SE 910 460	Goodmanham	
116	Goodmanham IX	British Museum	SE 900 460	Goodmanham	
117	Goodmanham VII	British Museum	SE 900 460	Goodmanham	
118	Jarrett IX	British Museum	SE 900 460	Goodmanham	
119	Jarrett X	British Museum	SE 900 460	Goodmanham	
120	Enthorpe X	British Museum	SE 900 460	Goodmanham	
121	Goodmanham XI	British Museum	SE 921 455	Goodmanham	Oval barrow
122	-	British Museum	SE 890 490	Londesborough	
123	Benjamin I	British Museum	SE 890 490	Londesborough	
162	-	British Museum	SE 971 569	Rylston	
222	Willerby Wold	British Museum	TA 029 761	Willerby	Long barrow
223	-	British Museum	SE 759 652	Westow	Long barrow
224	-	British Museum	TA 076 678	Rudston	Long barrow
226	-	British Museum	SE 906 410	Market Weighton	Long barrow
234	Ruston II	British Museum	TA 056 673	Kilham	Long barrow
235	Folkton VI	British Museum	TA 010 760	Willerby	
236	Folkton VII	British Museum	TA 010 760	Willerby	
237	Sharp Howe I	British Museum	TA 050 777	Folkton	
238	Sharp Howe III	British Museum	TA 049 778	Folkton	
239	Sharp III	British Museum	TA 048 776	Folkton	
240	Sharp Howes II	British Museum	TA 049 778	Folkton	
241	Sharp V;Sharpe Howes I	British Museum	TA 049 778	Folkton	
242	Sharp VI	British Museum	TA 051 770	Folkton	
243	Sharp VII	British Museum	TA 049 771	Folkton	
244	Folkton I	British Museum	TA 050 736	Folkton	
245	Folkton II;'Bording Dale'	British Museum	TA 059 778	Folkton	
246	Folkton III	British Museum	TA 055 777	Folkton	

Barrow	Name	Source	NGR	Parish	Notes
247	Flotmanby	British Museum	TA 065 785	Folkton	
248	Folkton IV	British Museum	TA 065 785	Folkton	
249	Folkton V	British Museum	TA 065 785	Folkton	
250	Folkton VIII	British Museum	TA 075 742	Hunmanby	
251	Folkton IX	British Museum	TA 080 750	Hunmanby	
252	Willie Howe	British Museum	TA 062 724	Wold Newton	
253	Metlow Hill	British Museum	TA 219 720	Bempton	
254	Little Kelk	British Museum	TA 112 612	Harpham	
255	Littlewood I	British Museum	SE 955 377	Bishop Burton	
256	Littlewood II	British Museum	SE 954 377	Bishop Burton	
257	Littlewood III	British Museum	SE 950 370	Bishop Burton	
258	LIttlewood IV	British Museum	SE 950 370	Bishop Burton	
259	Littlewood V	British Museum	SE 950 370	Bishop Burton	
260	Littlewood VIII	British Museum	SE 950 370	Bishop Burton	
261	Littlewood VI	British Museum	SE 950 370	Bishop Burton	
262	Littlewood VII	British Museum	SE 950 370	Bishop Burton	
263	Littlewood IX	British Museum	SE 950 370	Bishop Burton	
264	Littlewood X	British Museum	SE 950 370	Bishop Burton	
265	Littlewood XI	British Museum	SE 950 370	Bishop Burton	
U64	Arras	British Museum	SE 930 413	Market Weighton	Lady's Barrow
U65	Beverley I	British Museum	TA 020 390	Beverley	
U66	Beverley II	British Museum	TA 020 390	Beverley	
U67	Bishop Burton	British Museum	SE 950 380	Bishop Burton	
U68	Blanch Farm	British Museum	SE 890 530	Huggate	
U69	Brough	British Museum	SE 933 282	Brough	Unknown
U70	Danes Graves 15	British Museum	TA 018 633	Kilham	
U71	Danes Graves 16	British Museum	TA 018 633	Kilham	
U72	Danes Graves 17	British Museum	TA 018 633	Kilham	
U73	Danes Graves 18	British Museum	TA 018 633	Kilham	
U74	Danes Graves 19	British Museum	TA 018 633	Kilham	
U75	Danes Graves 20	British Museum	TA 018 633	Kilham	
U76	Danes Graves 21	British Museum	TA 018 633	Kilham	
U77	Danes Graves 22	British Museum	TA 018 633	Kilham	
U78	Danes Graves 23	British Museum	TA 018 633	Kilham	
U79	Danes Graves 24	British Museum	TA 018 633	Kilham	
U80	Danes Graves 25	British Museum	TA 018 633	Kilham	
U81	Danes Graves 26	British Museum	TA 018 633	Kilham	
U82	Danes Graves 27	British Museum	TA 018 633	Kilham	
U83	Danes Graves 28	British Museum	TA 018 633	Kilham	
U84	Danes Graves 48	British Museum	TA 018 633	Kilham	
U85	Danes Graves 53	British Museum	TA 018 633	Kilham	
U86	Danes Graves 54	British Museum	TA 018 633	Kilham	
U87	Danes Graves 65	British Museum	TA 018 633	Kilham	
U88	Danes Graves 70	British Museum	TA 018 633	Kilham	
U89	Danes Graves 79	British Museum	TA 018 633	Kilham	
U90	Elf Howe	British Museum	TA 042 772	Folkton	

Barrow	Name	Source	NGR	Parish	Notes
U91	Ganton Wold	British Museum	TA 000 760	Ganton	
U92	Goodmanham	British Museum	TA 000 760	Goodmanham	
U93	Goodmanham Wold I	British Museum	SE 910 450	Goodmanham	
U94	Goodmanham II	British Museum	SE 910 450	Goodmanham	
U95	Helperthorpe	British Museum	SE 963 679	Helperthorpe	Long barrow
U96	Helperthorpe Cross	British Museum	SE 960 680	Helperthorpe	Unknown
U97	Heslerton Wold	British Museum	SE 950 750	Heslerton	
U98	Huggate Wold I	British Museum	SE 850 540	Huggate	Unknown
U99	Huggate Wold II	British Museum	SE 850 540	Huggate	
U100	Kellythorpe I	British Museum	TA 015 573	Kellythorpe	Driffield C50
U101	Kellythorpe II	British Museum	TA 017 567	Kellythorpe	Driffield C38
U102	Lund Warren	British Museum	SE 910 460	Middleton	
U103	Maiden's Grave	British Museum	TA 090 710	Rudston	?Long barrow
U104	Rudston/Burton Agnes	British Museum	TA 010 650	Rudston	
U105	Sherburn	British Museum	SE 960 740	Sherburn	
U106	Sherburn/Heslerton	British Museum	SE 950 750	Sherburn	
U107	Sherburn Wold	British Museum	SE 960 750	Sherburn	
U108	Warter Wold I	British Museum	SE 899 532	Warter	Blanch 259
U109	Warter Wold II	British Museum	SE 899 532	Warter	
U110	Westow	British Museum	SE 770 650	Westow	
U111	Wintringham	British Museum	SE 890 720	Wintringham	

Compiled from Ordnance Survey Land Line Plus data, Ordnance Survey Country Series maps, Historic England NMP data, Greenwell 1877, Greenwell 1892 and Kinnes and Longworth 1985.

Ceramic phasing of the burial mounds from the Wolds study area

Group I Towthorpe

Barrow	Grimston	Towthorpe	Ebbsfleet	Mortlake	Fengate	Rudston	Grooved	Step 1[1]	Step 2	Step 3	Step 4	Step 5	Step 6	Step 7	Food Vessel	Collared Urn	Bucket Urn	Early Mediaeval
Raisthorpe (Towthorpe 3)	●							●										
Towthorpe 7	●																	
Duggleby Howe (Towthorpe 273)	●	●																●
Towthorpe 72	●		●															
Towthorpe 18		●																
Towthorpe 291 (Greenwell III)		●																
Towthorpe 211½											●							
Towthorpe 21												●						
	Neolithic									Bronze Age								

Other barrows:
1, 6, 22, 43, 44, 73, 106, C39, C73, 213, 214, 214½, 233, 234, 276
Detached barrows:
7a, 292, 293

Compiled from Meaney, 1964, Clarke 1970, Lanting and van der Waals 1972, Cowie 1978, Manby 1980, Longworth 1983 and Manby 1988.

[1]Red dots indicate unspecified types of Beaker pottery.

Group II Wharram Percy

Barrow	Grimston	Towthorpe	Ebbsfleet	Mortlake	Fengate	Rudston	Grooved	Step 1	Step 2	Step 3	Step 4	Step 5	Step 6	Step 7	Food Vessel	Collared Urn	Bucket Urn	Early Mediaeval
Wharram Percy 46		●																
Wharram Percy 48																●		
Wharram Percy 71																●		
Wharram Percy 127																		●
	Neolithic									Bronze Age								

Other barrows:
45, 47, 65, 66, 67, 70

Group III Aldro

Barrow	Grimston	Towthorpe	Ebbsfleet	Mortlake	Fengate	Rudston	Grooved	Step 1	Step 2	Step 3	Step 4	Step 5	Step 6	Step 7	Food Vessel	Collared Urn	Bucket Urn	Early Mediaeval
Aldro (Division A) 88		●																
Aldro (Division E) 94		●																
Aldro (Division A) 116		●						●	●		●	●	●					
Aldro (Division D) 49			●															
Aldro (Division B) 30						●												
Aldro (Division A) 54											●							
Aldro (Division A) 87																●		
Aldro (Division A) 256																●		
Aldro (Division B) 129																●		
Aldro (Division B) 130																●		
Aldro (Division C) 179																●		
Aldro (Division E) 126																●		
Aldro (Division A) 108																	●	
	Neolithic									Bronze Age								

Other barrows:
Division A: 52, 53, 109
Division B: 119, 128, 159
Division C: C74, C75, C76, C77, C78, C80, C81
Division D: 50, 51, 97, 113, C47, C59
Division E: 117, 125, C48

Group IV Acklam Wold

Barrow	Grimston	Towthorpe	Ebbsfleet	Mortlake	Fengate	Rudston	Grooved	Step 1	Step 2	Step 3	Step 4	Step 5	Step 6	Step 7	Food Vessel	Collared Urn	Bucket Urn	Early Mediaeval
Acklam Wold 92	●															●		
Acklam Wold 211					●													
Acklam Wold 124												●						
Acklam Wold 204														●				
Acklam Wold 202																●		
	Neolithic									Bronze Age								

Other barrows:
123, 124a, 203, 205, 206, 207, 208, 209, 210, 212

Group V Hanging Grimston

Barrow	Grimston	Towthorpe	Ebbsfleet	Mortlake	Fengate	Rudston	Grooved	Step 1	Step 2	Step 3	Step 4	Step 5	Step 6	Step 7	Food Vessel	Collared Urn	Bucket Urn	Early Mediaeval
Hanging Grimston (110)	●																	
Hanging Grimston 131								●										
Hanging Grimston 56								●				●						
Hanging Grimston 55											●	●	●					
Hanging Grimston 61																●		
	Neolithic									Bronze Age								

Other barrows:
8, 9, 10, 11, 12, 26, 27 57, 58, 59, 89, 90, 91, 132

Group VI Painsthorpe Wold

Barrow	Grimston	Towthorpe	Ebbsfleet	Mortlake	Fengate	Rudston	Grooved	Step 1	Step 2	Step 3	Step 4	Step 5	Step 6	Step 7	Food Vessel	Collared Urn	Bucket Urn	Early Mediaeval
Painsthorpe Wold 83	●											●						
Painsthorpe Wold 98				●				●										
Painsthorpe Wold 118								●			●						●	
Painsthorpe Wold 4								●				●	●					●
Painsthorpe Wold 111																	●	
Painsthorpe Wold 102																		●
Painsthorpe Wold 200																		●
Painsthorpe Wold Z																		●
	Neolithic									Bronze Age								

Other barrows:
60, 78, 84, 85, 93, 93a, 95, 99, 115, 121, 201, 217, X

Group VII Garrowby Wold

Barrow	Grimston	Towthorpe	Ebbsfleet	Mortlake	Fengate	Rudston	Grooved	Step 1	Step 2	Step 3	Step 4	Step 5	Step 6	Step 7	Food Vessel	Collared Urn	Bucket Urn	Early Mediaeval
Garrowby Wold 39								●										
Garrowby Wold 32								●										
Garrowby Wold 42								●										
Garrowby Wold C43								●										
Garrowby Wold 104								●					●		●			
Garrowby Wold C99								●										●
Garrowby Wold 69																		●
	Neolithic									Bronze Age								

Other barrows:
31, 62, 63, 64, 68, 101, 120, C68, C69, C97, C98
Detached barrows:
104a, B

Group VIII Calais Wold

Barrow	Grimston	Towthorpe	Ebbsfleet	Mortlake	Fengate	Rudston	Grooved	Step 1	Step 2	Step 3	Step 4	Step 5	Step 6	Step 7	Food Vessel	Collared Urn	Bucket Urn	Early Mediaeval
Calais Wold 275		●														●		
Calais Wold C70							●											
Calais Wold 100							●	●							●			
Calais Wold 86								●										
	Neolithic									Bronze Age								

Other barrows:
13, 14, 15, 23, 24, 25, 38, 96, 103, 105, 114, C72
Detached barrows:
2b

Group IX Riggs

Barrow	Grimston	Towthorpe	Ebbsfleet	Mortlake	Fengate	Rudston	Grooved	Step 1	Step 2	Step 3	Step 4	Step 5	Step 6	Step 7	Food Vessel	Collared Urn	Bucket Urn	Early Mediaeval
Riggs 20			●															
Riggs 36								●										
Riggs 17																●		
Riggs 19																●		
Riggs 34																●		
Riggs C49																●		
Riggs 33																●	●	
	Neolithic									Bronze Age								

Other barrows:
16, 29, 35, 41, C42a, C83, C84

Group X Fimber

Barrow	Grimston Towthorpe	Ebbsfleet Mortlake Fengate Rudston	Grooved	Step 1 Step 2	Step 3 Step 4 Step 5 Step 6 Step 7	Food Vessel Collared Urn Bucket Urn	Early Mediaeval
Fimber C82			•				
Fimber C33							•
	Neolithic				Bronze Age		

Other barrows:
5

Group Xa Life Hill

Barrow	Grimston Towthorpe	Ebbsfleet Mortlake Fengate Rudston	Grooved	Step 1 Step 2	Step 3 Step 4 Step 5 Step 6 Step 7	Food Vessel Collared Urn Bucket Urn	Early Mediaeval
None							
	Neolithic				Bronze Age		

Other barrows:
28, 268, 270, 271, 294, 295
Detached barrows:
122

Group XI Garton Slack

Barrow	Grimston	Towthorpe	Ebbsfleet	Mortlake	Fengate	Rudston	Grooved	Step 1	Step 2	Step 3	Step 4	Step 5	Step 6	Step 7	Food Vessel	Collared Urn	Bucket Urn	Early Mediaeval
Garton Slack 81	●							●			●							
Garton Slack C37	●																	●
Garton Slack 112						●												●
Garton Slack 75								●										
Garton Slack C41								●										
Garton Slack 80								●		●								
Garton Slack C63											●	●						
Garton Slack C61												●						
Garton Slack 37								●					●					
Garton Slack C58															●			
Garton Slack 268																		●
	Neolithic									Bronze Age								

Other barrows:
40, 74, 76, 77, 79, 82, 107, C34, C35, C36, C40, C42, C45, C46, C51, C52, C53, C54, C55, C56, C57, C58, C58a, 159a, C62, C64, C67, C71

Detached barrows:
159b, 274

Group XII Driffield

Barrow	Grimston	Towthorpe	Ebbsfleet	Mortlake	Fengate	Rudston	Grooved	Step 1	Step 2	Step 3	Step 4	Step 5	Step 6	Step 7	Food Vessel	Collared Urn	Bucket Urn	Early Mediaeval
Driffield 1a																	●	
Driffield C38																		●
Cheesecake Hill (Driffield C44)																		●
	Neolithic									Bronze Age								

Other barrows:
C50, 186, 212a, 212b, 278, 279, 279a

Group XIII Huggate Wold

Barrow	Grimston	Towthorpe	Ebbsfleet	Mortlake	Fengate	Rudston	Grooved	Step 1	Step 2	Step 3	Step 4	Step 5	Step 6	Step 7	Food Vessel	Collared Urn	Bucket Urn	Early Mediaeval
Huggate Wold 230	●																	
Huggate Wold 216								●				●						
Huggate Wold 225															●			
	Neolithic									Bronze Age								

Other barrows:
215, 218, 219, 220, 221, 222, 223, 224, 226, 227, 228, 229, 231, 235, 245

Group XIV Huggate and Warter Wold

Barrow	Grimston	Towthorpe	Ebbsfleet	Mortlake	Fengate	Rudston	Grooved	Step 1	Step 2	Step 3	Step 4	Step 5	Step 6	Step 7	Food Vessel	Collared Urn	Bucket Urn	Early Mediaeval
Huggate and Warter Wold 249	●																	
Huggate and Warter Wold 252	●																	
Huggate and Warter Wold 254	●										●							
Huggate and Warter Wold 263								●										
Huggate and Warter Wold 264								●										
	Neolithic									Bronze Age								

Other barrows:
242, 243, 244, 246, 247, 248, 250, 251, 253, 255

Group XV Blanch

Barrow	Grimston	Towthorpe	Ebbsfleet	Mortlake	Fengate	Rudston	Grooved	Step 1	Step 2	Step 3	Step 4	Step 5	Step 6	Step 7	Food Vessel	Collared Urn	Bucket Urn	Early Mediaeval
Blanch C90															•			
	Neolithic									Bronze Age								

Other barrows:
2, C88, C89, C91, C92, C93, C94, C95, C96, C97, 232, 236, 237, 238, 240, 241, 257, 258, 259, 260, 261, 262, 265, 266, 269

Stratigraphic and structural sequences for the Neolithic burial mounds

Towthorpe 18

Kinnes 1979, Cc5; SE 8981 6495 (Centroid); Kirby Grindalythe, North Yorkshire

Towthorpe 18 was demolished in 1887 (Mortimer 1905, 11). Mortimer recorded that the barrow was completely levelled and spread over the surface of the adjoining land. The associated ring ditch, however, is visible as a crop mark and was recorded as part of the former Royal Commission survey of the Yorkshire Wolds (Stoertz 1997). Prior to its demolition, the barrow was shown on the 1st edition County Series 6" Ordnance Survey map (1850-54). The site of the barrow lies approximately 440m to the west north-west of Kirby Grange. It is situated on a narrow, north-east facing peninsular between Crowtree Slack and Hog Walk, at a height of 198mOD. The barrow was part of the Towthorpe Group, a dispersed barrow cemetery that followed the Towthorpe Ridge. This ridge has long been recognised as a major 'prehistoric' route between the Pennines and the lithic resources of the East Yorkshire coastline (Cole 1892).

The barrow, excavated in August 1864, consisted predominantly of Kimmeridge Clay interspersed with layers of soil (Mortimer 1905, 9). It was approximately 3 feet high and was encircled by a ditch with an external bank constructed from chalk rubble. A secondary cremation was identified within the upper levels of the mound, only a few inches below the surface. Six flexed inhumations were found to the south-west of the centre of the barrow. These inhumations were interred within an area 5½ feet square which has been interpreted as a possible non-megalithic chamber (Kinnes 1979). The distribution of grave goods around the edges of the burials was thought to be indicative of deposition against the chamber walls. Two Towthorpe bowls were found with the inhumations in the putative non-megalithic chamber (Manby 1988, 80). Towthorpe 18 is the type-site for Towthorpe Ware.

A pit filled with Kimmeridge Clay was encountered to the north of the centre of the mound during the course of the re-opening of the barrow in September 1864 (Mortimer 1905, 11). Part of the antler of a red deer was found within the fill of the pit at a depth of 2 feet below

the old land surface. A crouched inhumation was identified further to the north-east during the course of the second re-opening in June 1868. It was placed within an oval grave, 1 foot deep, on its right-hand side with the head to the north. A second inhumation was found to the west of the centre of the barrow within the body of the mound. This inhumation lay close to the surface and had been damaged by ploughing. Both inhumations were associated with incomplete food vessels. A pit cut through the body of the mound was also identified to the north of the centre of the barrow. Several pieces of burnt wood and decayed bone were found within the fill of the pit.

Non-Megalithic Chamber

A 'beautiful spear-head' of black flint was recorded on the north side of the inhumations associated with the non-megalithic chamber at Towthorpe 18 (Mortimer 1905, 9). Four 'leaf-shaped arrow-heads of fine workmanship' were found nearby. A second 'spear-head' was found 'close under the thigh bone' of one of the inhumations within the non-megalithic chamber. These artefacts, six leaf-shaped arrowheads [6 and A to E], were illustrated in *Forty Years' Researches* (Mortimer 1905, Figures 16 to 21) and were listed in both the *Descriptive Catalogue of the Mortimer Museum* (Sheppard 1900, 27) and the *Illustrated Catalogue of the Mortimer Collection* (Sheppard 1929, 3). They were associated with two Towthorpe bowls which were also found within the non-megalithic chamber (Manby 1988, 80).

Three deposits of 'flint-flakes', some of which were serrated, were recorded close to the sides of the non-megalithic chamber (Mortimer 1905, 10). The total number of pieces of worked flint within these deposits is not specified. None of the 'flakes' were illustrated by Mortimer or listed in the *Descriptive Catalogue of the Mortimer Museum* (Sheppard 1900). Five finely serrated flints and two flint 'knives' found 'adjoining interments' in Towthorpe 18 were listed in the *Illustrated Catalogue of the Mortimer Collection* (Sheppard 1929, 4). These pieces of worked flint corresponded to four serrated blades [7 to 10], two serrated flakes [11 and 13] and a cortical flake [12] held in the *Mortimer Collection* at the Hull and East Riding Museum. Three stone pounders were also found within the non-megalithic chamber (Mortimer 1905, 10). These pounders or hammerstones [1 to 3] were illustrated in *Forty Years' Researches* and listed in both of the catalogues compiled by Tom Sheppard (1900, 1929).

Burial Mound

No lithic artefacts were recovered from the oval-shaped mass of clay found beneath the old land surface during the course of the first re-opening of Towthorpe 18. A few 'splinters' of flint, however, were found during the course of the second re-opening of the barrow. None of these 'splinters' were illustrated by Mortimer or listed in either of the catalogues of the *Mortimer Collection* compiled by Tom Sheppard (1900, 1929). A serrated flake [4] and a cortical flake [5] attributed to the barrow, however, were held in the *Mortimer Collection* at the Hull and East Riding Museum. No pieces of worked flint were found in association with the grave or inhumations encountered during the course of the second re-opening.

Towthorpe 273 (Duggleby Howe)

Kinnes 1979, Cf2, Db4, Eb1 and Fc1; SE 8804 6689 (Centroid); Kirby Grindalythe, North Yorkshire

Towthorpe 273, more commonly known as Duggleby Howe, lies approximately 300m to the south-east of the village of Duggleby. It is situated on the lower slopes of a narrow spur below Towthorpe Ridge, at a height of 128mOD, close to the head of the Great Wolds Valley. The barrow lies at the centre of a circular enclosure, with a diameter of approximately 370m, which has been interpreted as either a causewayed enclosure or a henge monument (Riley 1980; Kinnes et al. 1983; Manby, Moorhouse, and Ottaway 2003; Gibson and Bayliss 2009; Gibson et al. 2011). This enclosure is defined by a double interrupted ditch visible as a crop mark. It is located at the confluence of a series of linear features recorded as part of the former Royal Commission survey of the Yorkshire Wolds (Stoertz 1997). Towthorpe 273 was one of several detached barrows associated with the Towthorpe Group.

The barrow was partially excavated during the late eighteenth century by the Reverend Christopher Sykes. No record of this excavation exists. Duggleby Howe was later re-opened during July and August 1890 (Cole 1901; Mortimer 1892, 1893, 1905, 22–30). A trench 40m square was excavated through the centre and eastern portion of the barrow. The barrow consisted of an earthen core (Deposit W) overlain by a bed of chalk grit (Deposit X). These deposits, sealed by a layer of Kimmeridge Clay (Deposit Y), formed an inner mound, approximately 75 feet in diameter and 10 feet high. A substantial mound of earth and chalk rubble (Deposit Z), 125 feet in diameter and over 22 feet high, had been erected over the inner

mound. Two hundred and fifty pieces of pottery were recovered from the outer mound, including a single sherd of Grimston Ware (Manby 1988, 76).

A mediaeval post mill had been built on the top of Towthorpe 273, the foundation trenches of which were encountered within the upper levels of the barrow. Several early mediaeval inhumations were also found within the outer mound (Meaney 1964). A total of thirteen inhumations and fifty-three cremation deposits were found within the inner mound. Three separate chronological sequences have been suggested on the basis of stratigraphic relationships and artefact associations (Piggott 1954; Kinnes et al. 1983; Manby 1988). The most significant differences between these sequences relate to the relationship between the inhumations and the cremation deposits. Duggleby Howe is considered pivotal in understanding the transition between inhumation and cremation as the dominant funerary rite during the late Neolithic (Loveday 2002).

The earliest burials, according to all three chronologies, are a series of inhumations associated with a large shaft grave (Grave B) at the centre of the barrow. A flexed inhumation (Burial K) was encountered at the bottom of this grave, at a depth of 9 feet below the old land surface. Several grave goods, including a Towthorpe bowl, had been placed at the knees of this burial. A crouched inhumation (Burial I) and a cranium (Burial J) were found above the basal inhumation. Two further interments (Burials G and H) were also encountered within the shaft grave, the second of which was placed in the bottom of a boat-shaped mass of clay. The relationship between these interments and those in the lower levels of the grave is ambiguous. One of the inhumations (Burial G) was associated with prestige goods, including a perforated antler macehead.

A flexed inhumation (Burial C) was found in a shallow grave (Grave A), several feet to the east of Grave B. This burial was placed on its left-hand side, with the head to the north north-east. It was associated with a wide range of grave goods, including twelve boar tusk blades and two beaver incisors. A second inhumation (Burial D) was encountered immediately to the east, overlaying the edge of the grave. This inhumation was also associated with prestige grave goods. Burial D and Burial G, the uppermost burial within the shaft grave, lie close to the old land surface. They are comparable to the simple burials at Aldro C75 which are considered to be a later development in the Neolithic of Eastern Yorkshire (Kinnes 1979 Stage D). Both of

these burials are ascribed to the second phase of activity in each of the chronologies for the barrow.

Six further inhumations (Burials A, B, E, F, L and M) were found in the inner mound, all within the earthen core of the barrow. These inhumations are generally considered to be later than those within the graves or close to the old land surface (Kinnes et al. 1983; Manby 1988). Fifty-three cremation deposits (Cremations 1 to 53) were also found within the inner mound, the majority of which were found within the layer of chalk grit which overlaid the earthen core of the barrow. Two possibilities have been suggested: either the cremations were contemporary with the inhumations in the fabric of the mound (Piggott 1954; Manby 1988), or they were associated with a separate phase of activity (Kinnes et al. 1983). Regardless, the sequence of burials at Duggleby Howe was thought to have taken place over a relatively short period of time (Loveday 2002).

Grave A

Two assemblages of worked flint were found close to the burial (Burial C) in Grave A at Towthorpe 273: one 'close to the shoulders' and the other 'a few inches behind the hips' (Mortimer 1905, 27–28). These assemblages comprised thirteen 'flint flakes' and six 'worked flints' in total. The 'flint flakes' found with the burial could not be accounted for. Five of the 'worked flints' associated with Burial C, four chisel-shaped transverse arrowheads [F to I] and an oblique transverse arrowhead [J], were illustrated in *Forty Years' Researches* (Mortimer 1905, Figures 47 to 50 and 52). A fifth chisel-shaped transverse arrowhead [N] was also illustrated (Mortimer 1905, Figure 51). The figure corresponding to this arrowhead was referred to twice in the account of the opening of the barrow: first, in relation to one of the cremation deposits (Cremation 3) in the inner mound and, secondly, in the description of Burial C. This arrowhead is attributed to the cremation deposit in another account of the opening of the barrow (Mortimer 1892).

Six arrowheads were listed in the *Illustrated Catalogue of the Mortimer Collection* (Sheppard 1929, 7). Whilst all of these arrowheads were attributed to Burial C, this catalogue was compiled from the material illustrated by Mortimer. A broken scraper [17] from Grave A was held in the *Mortimer Collection* at the Hull and East Riding Museum. The box (KINCM 1772.1984.1) that contained this scraper was labelled 'at the back of body C'. Two possibilities arise: either this scraper was one of the 'flint flakes' described by Mortimer, or it was one of

the six 'worked flints'. The fact that the scraper was boxed and labelled would appear to suggest the latter; in which case, the transverse arrowhead illustrated in Fig. 52 is associated with Cremation 3, and not Burial C (Kinnes et al. 1983, 94).

Grave B

Nine 'flint flakes' and two 'flint cores' were found close to the crushed Towthorpe bowl placed 'at the knees of' the burial (Burial K) at the base of Grave B (Mortimer 1905, 29). An assemblage of seven pieces of worked flint [18 to 24] was attributed to this burial in the Hull and East Riding Museum. This assemblage included a broken scraper [21], a disc scraper [23], a serrated blade [18] and the medial segment of a blade [22], both edges of which were serrated. Two of the 'flint flakes' and both of the 'flint cores' recorded by Mortimer could not be accounted for. None of these artefacts were illustrated in *Forty Years' Researches* or listed in either of the catalogues compiled by Tom Sheppard (1900, 1929). Furthermore, neither of the cores is listed in the entry for Burial K in the Table of Barrows, Interments and Articles deposited with Interments (Mortimer 1905, 401). No worked flint was recovered from any of the other burials (Burials H, I and J) in Grave B.

Simple Burials (Burials D and G)

A rectangular polished discoidal knife [K] was found 'in front of the face' of the burial (Burial D) overlying the eastern edge of Grave B (Mortimer 1905, 28). This knife was illustrated by Mortimer (1905, Figure 58) and was listed in the *Illustrated Catalogue of the Mortimer Collection* (Sheppard 1929, 7). It was similar to one found 'in front of the face' of Burial 2 at Aldro C75. A 'diamond-shaped arrowhead', a kite-shaped arrowhead [L], was found close to the antler macehead placed 'close to the chest' of the burial (Burial G) inserted into the upper levels of Grave B (Mortimer 1905, 27) An 'axe', a Duggleby type polished flint adze [M], was also described in the account of this burial. Both of these objects were illustrated in *Forty Years' Researches* (Mortimer 1905, Figures 64 and 56 respectively) and were listed in the *Illustrated Catalogue of the Mortimer Collection* (Sheppard 1929, 7–8).

Inner Mound

No lithic artefacts were found with any of the other inhumations (Burials A, B, E, F, L and M) interred within the barrow. 'An instrument of flint chipped to a point', however, was found approximately 3 feet to the north of one of the cremation deposits (Cremation 3) within the inner mound (Mortimer 1905, 26). This instrument, a chisel-shaped transverse arrowhead

[N], was illustrated by Mortimer (1905, Figure 52). The ambiguity regarding the figure corresponding to this arrowhead has already been noted (Grave A). None of the cremation deposits would appear to have been directly associated with worked flint. Only three bone pins are listed in the entry for the cremation deposits from Towthorpe 273 in the Table of Barrows, Interments and Articles deposited with Interments (Mortimer 1905, 401).

Outer Mound

In addition to the artefacts associated with burials and cremation deposits, twenty five 'flint flakes' were recovered from the upper levels of the mound (Mortimer 1905, 25). These 'flakes' included a large core, a 'punch-like tool', a portion of a double-edged 'flake saw' and a 'triangular knife'. The flint core [14] was illustrated in *Forty Years' Researches* (Mortimer 1905, Figure 46). A further twelve 'chips' of flint were found in the backfill of the earlier excavation and the disturbed portion of the arms of the cross associated with the post mill (Mortimer 1905, 26). With the exception of the flint core illustrated by Mortimer, none of the 'flint flakes' or 'chips' recovered from the upper levels of the mound were listed in either of the catalogues compiled by Tom Sheppard (1900, 1929). The majority of these artefacts could not be accounted for at the Hull and East Riding Museum. An oblique transverse arrowhead [15] and a fabricator [16] attributed to Towthorpe 273, however, were held in the *Mortimer Collection*. These presumably correspond to the 'triangular knife' and 'punch-like' tool described by Mortimer.

Towthorpe 291

Kirby Grindalyth (sic.) III; SE 8823 6690 (Centroid); Kirby Grindalythe, North Yorkshire

Towthorpe 291, also referred to as Kirby Grindalyth (sic.) III, was not shown on the 1st edition County Series 6" Ordnance Survey map (1854). The height of the barrow, however, was recorded at 6 feet in 1866 (Greenwell 1877, 140). By 1895, it had been greatly reduced by ploughing (Mortimer 1905, 43). Whilst the barrow is no longer visible, the associated ring ditch survives as a crop mark and was recorded as part of the former Royal Commission survey of the Yorkshire Wolds (Stoertz 1997). The site of the barrow lies approximately 190m to the east of Towthorpe 273. It is situated on the lower slopes of a narrow spur below Towthorpe Ridge at a height of 131mOD. Towthorpe 291 was one of several detached barrows associated with the Towthorpe Group, a dispersed barrow cemetery along the line of a putative 'prehistoric' trackway.

The barrow was excavated in 1866 by Canon William Greenwell (1877, 140). An inhumation, laid upon a layer of charcoal (possibly wooden planking), was encountered close to the centre of the barrow. This inhumation was placed on top of a mound of chalk rubble, 4 feet in diameter and 1½ feet high. Two similar mounds were noted nearby. Four stake holes were identified close to the skull of the burial. An oblong grave and circular pit were also encountered during the course of the excavation of the barrow. Neither of these features contained an inhumation or cremation deposit. Several pieces of pottery, including a few sherds of Towthorpe Ware, were recovered from the body of the mound. Towthorpe 291 was re-excavated in August 1895 (Mortimer 1905, 42–43). A possible interment was identified a little to the north of the centre of the mound.

Burial Mound

Four 'flint' chippings and three water-worn flint pebbles were found close to the inhumation on the surface of the clay core of Towthorpe 291 during the course of the excavation carried out by Greenwell (1877, 140). Several flint 'chippings' and a 'well-formed flake' were also recovered from the body of the mound. None of these artefacts were held in the *Mortimer Collection* at the Hull and East Riding Museum. A flint 'knife', three 'scrapers' many 'flakes and rudely chipped flints' were also recovered from the body of the mound when the barrow was re-opened by Mortimer (Mortimer 1905, 43). None of these artefacts were illustrated in *Forty Years' Researches* or listed in either of the catalogues of the *Mortimer Collection* compiled by Tom Sheppard (1900, 1929). Twenty-eight pieces of worked flint [26 to 53] attributed to the barrow, however, were held in the Hull and East Riding Museum. These included two polyhedral cores [26 and 31], a short end scraper [33], a broken scraper [36], a possible awl or dihedral burin [41], a double microburin [44] and a burin [46]. One of the polyhedral cores [31] was thought to have been a re-used platform core.

Old Land Surface

A flint 'spear-head' and stone pounder were found on the old land surface when the barrow was re-opened by Mortimer (1905, 43). The 'spear-head', a leaf point [25], was illustrated in *Forty Years' Researches* (Mortimer 1905, Figure 41b) and listed in the *Illustrated Catalogue of the Mortimer Collection* (Sheppard 1929). Several stone pounders are listed in the entry for the Towthorpe group in the *Descriptive Catalogue of the Mortimer Museum* (Sheppard 1900, 27). The stone pounder from Towthorpe 291, however, could not be accounted for in the Hull and East Riding Museum. Neither of the artefacts found on the old land surface were

associated with a cremation deposit or an inhumation. Six 'flakes' associated with an inhumation, however, were listed in the entry for the barrow in the *Table of Barrows, Interments, and Articles deposited with Interments* (Mortimer 1905, 401). These flakes were not mentioned in the body of the text and could not be accounted for in the *Mortimer Collection* at the Hull and East Riding Museum.

Wharram Percy 46

None; SE 8390 6360 (Centroid); Wharram, North Yorkshire

Wharram Percy 46 was shown on the 1st edition County Series 6" Ordnance Survey map (1850-1855). The height of the barrow was recorded at 2 feet in 1866 (Mortimer 1905, 44). Whilst it has since been ploughed out, the associated ring ditch survives as a crop mark and was recorded as part of the former Royal Commission survey of the Yorkshire Wolds (Stoertz 1997). The site of the barrow lies approximately 780m to the west north-west of Wharram Percy Farm. It is situated on a narrow peninsula, between Wharram Percy Plantation and Birdsall Brow, at a height of approximately 225mOD. The barrow was part of the Wharram Percy Group. It is one of five contiguous barrows which, together, form the Greenlands barrow cemetery. Two of the barrows in this cemetery (Wharram Percy 48 and 71) were associated with Collared Urns (Longworth 1984).

The barrow was excavated in February and March 1866 (Mortimer 1905, 44–45). A trench, 17 feet square, was excavated through the centre of the mound. Two smaller trenches were also excavated. No inhumations or cremation deposits were identified during the course of the excavation of the barrow. Residual occupational debris, however, was recovered from the fabric of the mound and the old land surface beneath the barrow. This material included a sherd of Towthorpe Ware found within the central excavation (Manby 1988, 80). Wharram Percy 46 was re-excavated in April 1883. A grave was encountered during the course of the re-opening of the barrow. No inhumation was found within this grave. A cremation deposit, however, was found at the west end of the feature. This cremation was associated with a small Beaker.

Burial Mound

Five small 'hand struck flakes' were recovered from the trench excavated through the centre of Wharram Percy 46 (Mortimer 1905, 44). Twelve more 'flakes' were found on the old land

surface in the other trenches excavated by Mortimer. None of these artefacts were illustrated in *Forty Years' Researches* or listed in the catalogues of the *Mortimer Collection* compiled by Tom Sheppard (1900, 1929). Two polyhedral cores [66 and 67], a crude flake core [68] and eighteen 'flint flakes and knives' [69 to 86], however, attributed to the barrow were held in the Hull and East Riding Museum. The cores are not mentioned in the account of the excavation of the barrow. Their provenance is, therefore, uncertain. The 'flint flakes and knives' presumably correspond to the material recovered from both the centre of the barrow and the old land surface. They included an edge-retouched flake knife [69], a possible polyhedral core [71], a broken scraper possibly re-used as an awl [74], a long end scraper [76] and two retouched flakes [80 and 86]. No lithic artefacts were recovered from the grave or cremation deposit encountered during the course of the re-opening of the barrow.

Aldro 88

Division A; Kinnes 1979, Cc3; SE 8201 6283 (Centroid); Birdsall, North Yorkshire

Aldro 88 was shown on the 1st edition County Series 6" Ordnance Survey map (1850-1855). In 1867, the height of the barrow was recorded at 49 inches (Mortimer 1905, 68). The barrow lies approximately 580m to the west north-west of Vessey Pasture farmhouse. It is situated a little to the south of Birdsall Brow at a height of 230mOD. The barrow was part of Division A of the Aldro Group, a dispersed group of barrows to the west of Toisland Wold. It was incorporated into the western edge of a later linear earthwork, a triple dyke, forming part of a 'clothes line enclosure'. This enclosure has been tentatively interpreted as a 'prehistoric' estate (Hayfield and Manby 1996). Several of the barrows in Aldro Division A, including Barrow 88, were arranged in a manner resembling the constellation of Charles' Wain (Mortimer 1891).

The barrow, excavated in April 1867, was encircled by a ditch approximately 60 feet in diameter (Mortimer 1905, 58–60). It consisted of a chalk rubble core, 16 inches high, capped with clay overlain by a layer of soil. Four inhumations (Burials A to D) were encountered on the old land surface, to the south-west of the centre of the barrow. These inhumations were laid on a clay floor, 6 feet long and 3 feet wide, aligned from east to west. This floor was thought to have formed part of a non-megalithic chamber (Kinnes 1979). Traces of light walling, either free standing or constructed in trench chamber style, were identified at the south-west corner of the clay floor. A Towthorpe bowl was found with one of the inhumations

(Burial C) in the non-megalithic chamber (Manby 1988, 78–79). Another of the burials (Burial A) was associated with a boar tusk blade.

A circular pit was identified at the centre of the mound. This pit contained a cremation deposit (Cremation a) which appeared to have been burnt in situ (Mortimer 1905, 59). A second cremation deposit (Cremation b) was found immediately to the east of the pit. Two crouched inhumations (Burials E and F) were also encountered on the old land surface beneath the barrow. Neither of these inhumations were associated with any grave goods. Residual occupational debris, however, was recovered from the body of the mound.

Non-Megalithic Chamber

Three small 'flakes' of flint were recorded near to the plain food vase found near the head of Burial C in the non-megalithic chamber at Aldro 88 (Mortimer 1905, 58). These 'flakes', two blades [94 and 95] and the distal end of a broken crested blade [96], were illustrated in *Forty Years' Researches* (Mortimer 1905, Figures 112 to 114) and were listed in the *Illustrated Catalogue of the Mortimer Collection* (Sheppard 1900, 15). They were associated with a Towthorpe bowl placed at the head of Burial C (Manby 1988, 78–79). A broken 'diamond-shaped arrowhead' was also found 'under the middle of the thigh bone' of Burial D (Mortimer 1905, 59). The remains of the tip of the shaft of this arrowhead, a leaf-shaped arrowhead [93], were noted at the time of excavation and were illustrated by Mortimer (Mortimer 1905, Figure 117).

Burial Mound

No lithic artefacts were recovered from the circular pit, cremation deposit and inhumations encountered at the centre of the barrow. Five worked flints, however, were listed in the entry corresponding to Burial E at Aldro 88 in the *Table of Barrows, Interments, and Articles deposited with Interments* (Mortimer 1905, 403). These 'worked' flints are not mentioned in the body of the text. Five 'splinters' of flint and a flint 'slingstone' were found within the body of the mound. None of these pieces of worked flint were illustrated by Mortimer or listed in either of the catalogues of the *Mortimer Collection* compiled by Tom Sheppard (1900, 1929). Three pieces of worked flint [97 to 99] attributed to the barrow, however, were held in the Hull and East Riding Museum. These artefacts included a retouched piece of angular shatter or crude flake core [97]. They presumably correspond to two of the flint 'splinters' and the 'slingstone' recorded by Mortimer.

Aldro 116

Division A; Clarke 1970, 1215-1220F; SE 8290 6278 (Centroid); Birdsall, North Yorkshire

Aldro 116 was partially demolished between 1853 and 1856 (Mortimer 1905, 54). The central area and eastern side of the mound had been largely removed in order to obtain flint for road repairing. Two inhumations were reportedly found during the course of this operation. The barrow was shown on the 1st edition County Series 6" Ordnance Survey map (1850-1855). In 1867, the height of the barrow was recorded at 49 inches (Mortimer 1905, 54). It lies approximately 370m to the east north-east of Vessey Pasture farmhouse and is situated on a narrow ridge between Birdsall Brow and Vessey Pasture Dale, the continuation of the Towthorpe Ridge, at a height of 230mOD. The barrow was part of Division A of the Aldro Group, a dispersed group of barrows to the west of Toisland Wold. It lies within a 'clothes line enclosure' which has been tentatively interpreted as a 'prehistoric' estate (Hayfield and Manby 1996).

The barrow, excavated in June 1868, was encircled by a ditch 90 feet in diameter (Mortimer 1905, 54). It was comprised of a clay loam core, capped with chalk rubble overlain by a layer of soil. The upper surface of the chalk rubble showed signs of burning. A keeled food vessel was found within the body of the mound, approximately 12 inches above the old land surface. Residual occupational debris, including a moderately large assemblage of worked flint, was recovered from the layer of chalk rubble. A crouched inhumation (Burial 1) was found in an oval grave (Grave A) close to the south-west edge of the mound. This inhumation was placed on its right-hand side, facing east south-east towards Wharram Percy 127. A crushed Beaker was found behind the shoulders of the burial (Clarke 1970, 1217 S2(W); Lanting and van der Waals 1972, Step 5).

An oval grave (Grave B) was encountered immediately to the north-west. A flexed inhumation (Burial 2), place on its left-hand side with the head to the north-east, was found in this grave. Several grave goods were found with the burial, including a Bronze dagger and a Beaker (Clarke 1970, 1218 S2(W)). Four inhumations (Burials 3 to 6) were found in a shallow rectangular grave (Grave C) just to the west of the centre of the mound. Three of these inhumations (Burials 3, 4 and 5) were placed on their right-hand sides, facing west north-west to Aldro 108 and 109. The fourth (Burial 6) was laid on its left-hand side with the head to the north. Three Beakers were found within the grave, one behind the head of Burial 3 (Clarke

1970, AOC), another behind the hips of Burial 4 (Clarke 1970, 1219 SH3(C)) and a third in front of the face of Burial 5 (Clarke 1970, 1216 S1).

Graves A, B and C

A flint 'flake' was recorded close to the pelvis of Burial 1 in Grave A of Aldro 116 (Mortimer 1905, 54). The oxidised point of a bronze awl was placed on the upper surface of the 'flake'. This flake [109] was illustrated in *Forty Years' Researches* (Mortimer 1905, Figure 96) and was listed in the *Illustrated Catalogue of the Mortimer Collection* (Sheppard 1929, 13). It was associated with a crushed Beaker found behind the shoulders of Burial 1 (Clarke 1970, 505). No lithic artefacts were recovered from Graves B and C.

Burial Mound

One hundred and five flint 'chippings', six 'cores or slingstones', two 'leaf-shaped arrow points', a 'spearhead', a 'circular disc' and a 'greenstone flake knife' were recovered from the undisturbed portion of the mound (Mortimer 1905, 56). The 'greenstone flake knife', a blunted-back edge-retouched flake knife [108] manufactured from a flake from the roughing out of a Group VI axe, was illustrated by Mortimer (1905, Figure 106). None of the other artefacts from the body of the mound were illustrated by Mortimer or listed in either of the catalogues of the *Mortimer Collection* compiled by Tom Sheppard (1900, 1929). A plano-convex knife [110], disc scraper [111], a flint flake and a small flint [106 and 107 respectively] attributed to Aldro 116, however, were held in the Hull and East Riding Museum. The plano-convex knife and disc scraper presumably correspond respectively to the 'spearhead' and 'circular disc' mentioned by Mortimer. Only two of the flint 'chippings', the flint flake and small flint (both non-cortical flakes), were identified within the *Mortimer Collection* at the Hull and East Riding Museum. The remainder of the 'chippings', the cores and leaf-shaped arrowheads could not be accounted for.

Aldro 30

Division B; SE 8254 6178 (Centroid); Thixendale, North Yorkshire

Aldro 30 was shown on the 1st edition County Series 6” Ordnance Survey map (1850-1855). In 1865, the height of the barrow was recorded at 20 inches (Mortimer 1905, 68). Whilst the barrow is no longer visible, the associated ring ditch survives as a crop mark and was recorded as part of the former Royal Commission survey of the Yorkshire Wolds (Stoertz 1997). The

barrow lies approximately 860m to the south south-west of Vessey Pasture farmhouse. It is situated on a narrow ridge between Vessey Pasture Dale and Water Dale, at a height of 219mOD. The barrow was part of Division B of the Aldro Group, a dispersed group of barrows at the western end of Cow Dale. This group of barrows was arranged in a manner resembling the constellation of Charles' Wain (Mortimer 1891).

The barrow, excavated in May 1865, was comprised of material similar to the subsoil adjacent to the mound (Mortimer 1905, 68). A trench, 17 feet long and 13 feet wide, was excavated through the centre of the mound. No inhumations or cremation deposits were encountered during the course of the excavation of the barrow. A circular pit was encountered towards the southern extent of the mound. This pit was filled with burnt wood and unctuous earth. Several sherds of Rudston Style Peterborough Ware (Manby 1988, 80) were found within the fill of the pit, along with half a jet bead and several hazel nut shells. A solution hollow was also identified close to the centre of the mound.

Pit

A half 'disc' of flint was found in the deposit of burnt wood at the base of the circular pit to the south of the centre of Aldro 30 (Mortimer 1905, 68). This 'disc', a broken scraper, was not illustrated in *Forty Years' Researches* or illustrated in either of the catalogues of the *Mortimer Collection* compiled by Tom Sheppard (1900, 1929). It could not be accounted for in the Hull and East Riding Museum. The 'disc' was associated with sherds from a Rudston Ware vessel found in the fill of the pit (Manby 1988, 80).

Mound

A 'hand struck splinter' was recovered from the body of the mound (Mortimer 1905, 68). This splinter was not illustrated by Mortimer or listed in the *Descriptive Catalogue of the Mortimer Museum* (Sheppard 1900) or the *Illustrated Catalogue of the Mortimer Collection* (Sheppard 1929). A disc scraper [88] and a flint flake [87] were attributed to Aldro 30, however, in the Hull and East Riding Museum. Both of these flints were labelled 'Picked from the Material of the mound". The flint flake (a cortical flake) presumably corresponds to the 'hand struck splinter' mentioned by Mortimer.

Aldro C75

Division C; Kinnes 1979, Dc3; SE 8111 6298 (Centroid); Birdsall, North Yorkshire

Aldro C75 (also referred to as Barrow 175) was shown on the 1st edition County Series 6" Ordnance Survey map (1855). In 1874, the height of the barrow was recorded at 12 inches (Mortimer 1905, 74). Whilst the barrow is no longer visible, the associated ring ditch survives as a crop mark and was recorded as part of the former Royal Commission survey of the Yorkshire Wolds (Stoertz 1997). The barrow lies approximately 325m to the east north-east of Aldro Farm, just to the south of Birdsall Brow at a height of 233mOD. It was part of Division C of the Aldro Group. Several of the barrows in Division C were excavated in 1853 by the Yorkshire Antiquarian Club (Procter 1855). Three of these barrows lay along the line of a linear earthwork immediately to the north of Aldro C75. This earthwork could be traced further to the east, as far as the Greenlands barrow cemetery.

The barrow was excavated in 1874 (Mortimer 1905, 74). Two crouched inhumations (Burials 1 and 2) were encountered on the old land surface close to the centre of the mound. These inhumations, both simple burials, were associated with prestige goods, including a polished-edge knife and a rectangular polished discoidal knife (Kinnes 1979). A cache of worked flint (Deposit A) was found behind the skull of Burial 1. In an account of the opening of Duggleby Howe, the Reverend E Maule Cole observed that "it seems a common practice at the funeral for survivors to throw flint flakes into the grave, much the same as we throw earth" (Cole 1901, 60). The confined distribution of worked flint within the cache, however, is suggestive of deposition within a bag or pit. A cremation deposit (Deposit B) was also identified 8 feet to the north of the inhumations.

Burial 1

Two 'flake-knives' were recorded 'close behind the shoulders' of Burial 1 at Aldro C75 (Mortimer 1905, 74). One of these 'flake-knives', an edge-retouched flake knife [114], was illustrated in *Forty Years' Researches* (Mortimer 1905, Figure 159a and 159b) and was noted in the *Illustrated Catalogue of the Mortimer Collection* (Sheppard 1929, 20). The other could not be accounted for in the Hull and East Riding Museum. It was neither illustrated by Mortimer nor listed in the *Descriptive Catalogue of the Mortimer Museum* (Sheppard 1900). A 'knife' of white flint, a polished-edge blade [113], was listed in one of the entries for Barrow 175, however, in the *Illustrated Catalogue of the Mortimer Collection* (Sheppard 1929, 20).

Forty-six 'flint flakes' were recorded 'touching the crown of the head' of Burial 1, marked B on the plan of the barrow (Mortimer 1905, Figure 156). Two of these 'flakes', a marginal polished-edge blade [112] and a serrated blade [O], were illustrated in *Forty Years' Researches* (Mortimer 1905 Figure 157 and 158). Both were listed in the *Illustrated Catalogue of the Mortimer Collection* (Sheppard 1929, 20). The 'knife' of white flint noted above was also listed in the catalogue, in the first of two entries relating to a 'hoard' of forty-six 'flint flakes' found behind the skull of Burial 1.

There is a degree of uncertainty regarding the artefacts associated with Burial 1. The entry in the Table of Barrows, Interments and Articles deposited with Interments contradicts the account in the body of the text. Only forty-two 'flint flakes' were listed in this entry for the burial (Mortimer 1905, 406). This uncertainty is compounded when the material held in the Hull and East Riding Museum is considered. Excluding individual artefacts associated with specific burials, three assemblages of worked flint are attributed to the barrow. Two of these assemblages [115 to 128 and 129 to 154] are thought to relate to the 'flint flakes' found near the skull of Burial 1. They included a serrated blade [120], a serrated flake [133] and a single platform core [142].

Burial 2

A rectangular polished discoidal knife [P] was recorded 'close behind the shoulders' of Burial 2 (Mortimer 1905, 74). This knife was described as 'one of the finest examples of working in flint' in the *Descriptive Catalogue of the Mortimer Museum* (Sheppard 1900, 28). It was broken during the course of the excavation of the barrow and was later reconstructed. The reconstructed knife is illustrated in *Forty Years' Researches* (Mortimer 1905, Figure 160). A similar knife was recovered 'in front of the face' of Burial D at Towthorpe 273. Like both burials at Aldro C75, Burial D was placed on, or just below, the old land surface beneath the barrow.

Burial Mound

In addition to the material associated with Burials 1 and 2, Mortimer recorded that 'a few chippings of flint' were 'picked from the mound' (Mortimer 1905, 74). None of the 'chippings' were illustrated by Mortimer or listed in the catalogues compiled by Tom Sheppard (1900, 1929). Three assemblages of worked flint form Aldro C75 are currently held in the *Mortimer Collection* at the Hull and East Riding Museum. Two of these assemblages are thought to have been associated with Burial 1. The third [155 to 176], presumably, corresponds to the material

recovered from the mound. It included four retouched flakes [155, 167, 168 and 171], a retouched blade [172], a dihedral burin [158], a disc scraper [163], three short end scrapers [169, 170 and 174], a long end scraper [175], a broken scraper [173] and a fragment of a stone pounder or hammerstone [165]. No lithic artefacts were recovered from either the cremation deposit to the north-east of the burials or the old land surface beneath the barrow.

Aldro 49

Division D; SE 7984 6302 (Centroid); Leavening, North Yorkshire

Aldro 49 was shown on the 1st edition County Series 6" Ordnance Survey map (1854-1856). In 1866, the height of the barrow was recorded at just under 1 foot (Mortimer 1905, 79). The barrow lies approximately 1km to the west north-west of Aldro Farm. It is situated on a slight spur above Leavening Brow at a height of 219mOD. The barrow was part of Division D of the Aldro Group, a dispersed group of barrows to the north-west of a large earthwork enclosure on Aldro Wold. An Iron Age square was identified immediately to the north-east of the barrow as part of the former Royal Commission survey of the Yorkshire Wolds (Stoertz 1997). This square barrow, visible as a crop mark, was incorporated into or built along the southern edge of a linear earthwork to the west of the earthwork enclosure.

The barrow, excavated in March 1866, was encircled by a ditch 2½ feet deep (Mortimer 1905, 79). A trench, 18 feet long and 11 feet wide, was excavated through the centre of the mound. The southern edge of the barrow was also excavated. A flexed inhumation was encountered on the old land surface close to the centre of the barrow. This inhumation was covered by a layer of chalk rubble. No evidence of a grave was identified beneath the rubble. An area of burning tentatively interpreted as a hearth, however, was identified on the old land surface to the south-east of the burial. Several pieces of charcoal were recovered from the putative hearth. Residual occupational debris, including several sherds of Peterborough Ware and three pieces of worked flint (Manby 1988, 80), was also found to the north-west of the inhumation.

Old Land Surface

Three 'worked flints', including a 'spear' and an 'oval knife', were recorded 'near the skull' of the inhumation found on the old land surface at Aldro 49 (Mortimer 1905, 79). These 'worked flints', a cortical flake [91], an edge-retouched flake knife [92] and a plano-convex knife [89],

were illustrated in *Forty Years' Researches* (Mortimer 1905, Figures 176 to 178). Both of the flakes were listed in the *Illustrated Catalogue of the Mortimer Collection* (Sheppard 1929, 22). Although the plano-convex knife was not listed in either of the catalogues compiled by Tom Sheppard (1900, 1929), a 'worked flint' identical to that illustrated by Mortimer was held at the Hull and East Riding Museum. This knife presumably corresponds to the 'spear' mentioned by Mortimer. The 'worked flints' were associated with several sherds of Peterborough Ware and a possible hearth on the old land surface (Manby 1988, 80).

Burial Mound

A small end scraper [90] attributed to the barrow was also held in the *Mortimer Collection* at the Hull and East Riding Museum. This scraper was neither mentioned in the account of the excavation of Aldro 49, nor listed in the entry for the barrow in the *Table of Barrows, Interments, and Articles deposited with Interments* (Mortimer 1905, 407). Its provenance is uncertain.

Aldro 94

Division E; Kinnes 1979, Cb1; SE 8000 6250 (Centroid); Leavening, North Yorkshire

Aldro 94 was shown on the 1st edition County Series 6" Ordnance Survey map (1850-1855). In 1867, the height of the barrow was recorded at 18 inches (Mortimer 1905, 82). Whilst the barrow is no longer visible, the associated ring ditch survives as a crop mark and was recorded as part of the former Royal Commission survey of the Yorkshire Wolds (Stoertz 1997). The barrow lies approximately 330m to the north north-east of Acklam Wold House. It is situated on a narrow peninsula between Brownmoor Dale and Leavening Brow at a height of 225mOD. The barrow was part of Division E of the Aldro Group, a dispersed group of barrows largely within the large earthwork enclosure on Aldro Wold. Aldro 94 lies just beyond the western edge of the earthwork enclosure.

The barrow, excavated in May 1867, consisted predominantly of loamy earth inches (Mortimer 1905, 82). Two crouched inhumations were encountered on the old land surface close to the centre of the barrow. These inhumations were both laid on their right hands sides with the heads facing east towards Aldro 125. They were placed on a thin bed of clay which has been interpreted as a linear zone (Kinnes 1979). The eastern and western ends of the linear zone were defined by bracketing pits, filled with clay and chalk rubble. Ash was noted

in the fill of the western pit associated with the linear zone. Several grave goods were found with the burials, including a Towthorpe bowl and a polished edge knife (Manby 1988, 79). A small quantity of residual occupational debris was also found within the body of the mound.

Linear Zone

A 'knife' was recorded 'close behind the shoulders' of one of the inhumations on the clay floor found on the old land surface beneath Aldro 94 inches (Mortimer 1905, 82). This knife, a polished-edge knife [Q], was illustrated in *Forty Years' Researches* (Mortimer 1905, Figure 180) and was listed in both of the catalogues of the *Mortimer Collection* compiled by Tom Sheppard (1900, 28, 1929, 23). It was associated with a Towthorpe bowl, found between the two inhumations on the clay floor (Manby 1988, 79). No lithic artefacts were recovered from the slots that defined the edges of the linear zone.

Burial Mound

One 'lump' of flint and five 'splinters, two of which were serrated, were found within the body of the mound (Mortimer 1905, 82). None of these artefacts was illustrated by Mortimer or listed in either the *Descriptive Catalogue of the Mortimer Museum* (Sheppard 1900) or the *Illustrated Catalogue of the Mortimer Collection* (Sheppard 1929). Six pieces of worked flint [100 to 105] attributed to the barrow, however, were held in the Hull and East Riding Museum. This material included a single platform core [105] (presumably the 'lump' of flint mentioned by Mortimer), a crude barbed and tanged arrowhead [100], a serrated blade [101] and a crude awl [102].

Acklam Wold 211

None; SE 7954 6184 (Centroid); Acklam, North Yorkshire

Acklam Wold 211 was shown on the 1st edition County Series 6" Ordnance Survey map (1854-1856). Whilst the barrow is no longer visible, the associated ring ditch survives as a crop mark and was recorded as part of the former Royal Commission survey of the Yorkshire Wolds (Stoertz 1997). The barrow lies 470m to the south-west of Acklam Wold House. It is situated on a narrow peninsula between Deep Dale and Leavening Brow at a height of 221mOD. The barrow was part of the Acklam Wold Group. Several of the barrows in this group, including Acklam Wold 211, were opened by the Yorkshire Antiquarian Club in 1849. A trench, 7 feet

square, was cut through the centre of the mound. No inhumations or cremation deposits were encountered during the course of this excavation.

The barrow was re-excavated in October 1878 (Mortimer 1905, 92–93). A circular pit was encountered close to the centre of the mound. An assemblage of animal bone, several pieces of worked flint, an antler pick and a large number of sherds of Fengate Style Peterborough Ware were found within the fill of the pit (Manby 1988, 80). The pit was cut by a grave containing a crouched inhumation laid on its left-hand side with the head to the east. A small 'food vessel' was found close to the hands of this inhumation. Several grave goods were also found close to the skull, including the base of a large 'urn', a bone spatula and a leaf point.

Circular Pit

Three 'splinters' of flint were recovered from the fill of the circular pit cut by the grave at the centre of Acklam Wold 211 (Mortimer 1905, 92). None of these 'splinters' were illustrated in *Forty Years' Researches* or listed in either the *Descriptive Catalogue of the Mortimer Museum* (Sheppard 1900) or the *Illustrated Catalogue of the Mortimer Collection* (Sheppard 1929). Three assemblages of worked flint, however, were attributed to the barrow in the Hull and East Riding Museum. One of these assemblages comprised three artefacts [182 to 184] and presumably corresponds to the 'splinters' mentioned by Mortimer. It was associated with sherds of Fengate Style Peterborough Ware, also found within the fill of the pit (Manby 1988, 80).

Grave

A 'knife or spearhead' and two 'flakes' were recorded 'at the back of the skull' of the inhumation found in the central grave (Mortimer 1905, 92). The knife, a possible plano-convex knife [177], was illustrated in *Forty Years' Researches* (Mortimer 1905, Figure 220). Neither of the flakes was illustrated by Mortimer or listed in the either of the catalogues compiled by Tom Sheppard (1900, 1929). Two of the assemblages of worked flint attributed to Acklam Wold 211 in the Hull and East Riding Museum, however, comprised two artefacts. One of these assemblages [178 and 179] was designated an accession number in the same year as the plano-convex knife and presumably corresponds to the 'flakes' mentioned by Mortimer. The other [180 and 181] is of uncertain provenance. No further pieces of worked flint were recorded in the account of the excavation of the barrow.

Painsthorpe Wold 98

Clarke 1970, 1356F; SE 8428 5773 (Centroid); Kirby Underdale, East Riding of Yorkshire

Painsthorpe Wold 98 was shown on the 1st edition County Series 6" Ordnance Survey map (1850-1855). In 1867, the height of the barrow was recorded at 36 inches. The barrow lies approximately 820m to the north north-east of Wayrham Farm and is situated on a narrow spur between Wayrham Dale and Pluckham Dale at a height of 219mOD. It was one of several outliers which formed part of the Painsthorpe Wold Group. Painsthorpe Wold 98 lies approximately 200m to the east of the course of a linear earthwork, sections of which survive as a double dyke are visible as crop marks. The barrow was excavated in May 1867 (Mortimer 1905, 130–32). A trench, 20 feet square, was excavated through the centre of the mound. Three graves (Grave A to C) were encountered during the course of the excavation.

Grave A, to the south-west of the centre of the barrow, contained a crouched inhumation placed on its left-hand side with the head to the north. A second grave (Grave B) was identified immediately to the north. This grave was filled with chalk rubble overlain by a layer of clay. Two inhumations were found within Grave B: a crouched inhumation at the base of the grave and a child buried just below the layer of clay. An antler pick and a crushed 'food vessel' were found with the basal inhumation. Grave C was identified just to the east of the centre of the barrow. It contained a crouched inhumation laid on its right-hand side with the head to the north. Several grave goods were found with this inhumation, including a crushed 'food vessel' and a beaver tooth. Each of the graves was associated with a discrete mound of chalk rubble.

Five cremation deposits (Cremations 1 to 5) were encountered within the upper levels of the barrow, approximately 2 feet above the old land surface. One of the cremations (Cremation 1) was exposed on the surface of the mound. It was associated with a large cinerary 'urn'. The rim of an inverted Beaker (Clarke 1970, 1365F) and a crushed 'food vessel' were also found with two of the other cremations (Cremations 2 and 4 respectively). A cylindrical vessel thought to be associated with a sixth cremation deposit was found 9 inches above the old land surface. These cremation deposits are perhaps comparable to those associated with the putative cremation cemetery at Towthorpe 273 (Kinnes 1979). A small quantity of residual occupational debris, including a rim sherd of Mortlake Style Peterborough Ware, was found within the body of the mound.

Graves A, B and C

No lithic artefacts were found with the inhumation in Grave A at Painsthorpe Wold 98. An 'oval knife' was recorded a 'little above' the inhumation at the base of Grave B (Mortimer 1905, 131). This 'knife', a discoidal edge-retouched flake knife [194], was illustrated in *Forty Years' Researches* (Mortimer 1905, Figure 336) and was listed in the *Illustrated Catalogue of the Mortimer Collection* (Sheppard 1929). A 'sharp pointed tool' of 'glass-coloured' flint was found 'in front of the chest' of the inhumation in Grave C (Mortimer 1905, 132). This 'tool', a plano-convex knife [V], was illustrated by Mortimer (Mortimer 1905, Figure 339). A 'flint knife' was also found close by. This 'knife', a plano-convex knife [190], had been 'placed across a flake'. Both were illustrated in *Forty Years' Researches* (Mortimer 1905, Figures 341 and 343). All of the pieces of worked flint from Grave C were listed in the *Illustrated Catalogue of the Mortimer Collection* (Sheppard 1929). Only the plano-convex knife, however, could be accounted for in the Hull and East Riding Museum.

Cremation Cemetery

Two flint 'knives' were found at the 'southern margin' of Cremation 3 on the surface of the mound raised over Graves A, B and C (Mortimer 1905, 130). These 'knives', both plano-convex knives [188 and 189], were illustrated by Mortimer (Mortimer 1905, Figures 332 and 333) and were listed in the *Illustrated Catalogue of the Mortimer Collection* (Sheppard 1929). No lithic artefacts were recovered from any of the other cremation deposits in Painsthorpe Wold 98. One of the deposits (Cremation 2), however, was associated with the rim of a Beaker which had been inverted and placed over the cremated remains (Clarke 1970, 508).

Burial Mound

A 'flake' knife was found on the old land surface beneath the barrow, between Graves B and C (Mortimer 1905, 131). Twenty-eight 'splinters' of flint, a 'slingstone' and three 'irregularly-formed discs' were recovered from the fabric of the mound. An 'instrument' of 'native' flint was also found whilst back filling. None of these pieces of worked flint were illustrated in *Forty Years' Researches* or listed in either of the catalogues of the *Mortimer Collection* compiled by Tom Sheppard (1900, 1929). In addition to the material illustrated by Mortimer, eight pieces of worked flint [185 to 187, 191 to 193, 195 and 196] attributed to Painsthorpe Wold 98 were held in the Hull and East Riding Museum. This material included an edge-retouched flake knife [192], a polyhedral core [185], a thumbnail scraper [186], a short end scraper [187], a long end scraper [193] and a heavily patinated double side scraper [191] that

presumably corresponded respectively to the 'flake' knife, 'slingstone', 'discs' and 'instrument' mentioned by Mortimer. Twenty-four of the 'splinters' recovered from the fabric of the mound could not be accounted for in the Hull and East Riding Museum. Only twenty 'flint flakes' and five 'other flints', however, were listed in the entry for the barrow in the *Table of Barrows, Interments and, Articles deposited with Interments* (Mortimer 1905, 415).

Calais Wold C70

None; SE 8211 5677 (Centroid); Bishop Wilton, East Riding of Yorkshire

Calais Wold C70 (also referred to as Barrow 170) was shown on the 1st edition County Series 6" Ordnance Survey map (1850-1855). It lay within a plantation approximately 410m to the east of Cot Nab farmhouse. The plantation was cut down in 1874, at which time the height of the barrow was recorded at 2 feet (Mortimer 1905, 169). Whilst the barrow is no longer, the associated ring ditch survives as a crop mark and was recorded as part of the former Royal Commission survey of the Yorkshire Wolds (Stoertz 1997). The barrow was situated just below the summit of South Wold at a height of 243mOD. It was the most westerly barrow forming part of the Calais Wold Group. Four unexcavated barrows are shown approximately 225m to the north north-west on the current 1:10,000 Ordnance Survey map.

The barrow was excavated in June 1874, shortly after the clearance of the plantation (Mortimer 1905, 169–70). A flexed inhumation (Burial 3), with the head to the east, was encountered in an elliptical grave close to the centre of the mound. No grave goods were associated with this inhumation. A second flexed inhumation (Burial 2), also with the head to the east, was found on the old land surface. This inhumation extended over the north-eastern edge of the grave. Several sherds of Clacton Style Grooved Ware were found in front of the skull (Manby 1988, 83). A cremation deposit (Cremation 1) was also found above the grave. This cremation was found within a 'cinerary urn' which also contained a bronze knife blade and a pygmy cup. A second 'cinerary urn' was found within the body of the mound, approximately 9 feet from the centre of the barrow.

Simple Burial

No pieces of worked flint were recovered from either of the inhumations in the grave beneath the centre of Calais Wold C70. A small 'lump' of flint, however, was found 'near the face' of the inhumation placed on the old land surface, overlying the north-eastern edge of the grave

(Mortimer 1905, 170). This 'lump', a non-cortical flake [198], was illustrated in *Forty Years' Researches* (Mortimer 1905, Figure 428a) and listed in the *Illustrated Catalogue of the Mortimer Collection* (Sheppard 1929, 60). No lithic artefacts were found with the cremation deposit encountered within the body of the mound or elsewhere within the barrow. However, a second piece of worked flint, a 'crested' flake [197], was attributed to Calais Wold C70 in the *Mortimer Collection* at the Hull and East Riding Museum. This flake was neither listed in the *Table of Barrows, Interments and, Articles deposited with Interments* nor mentioned in the body of the text (Mortimer 1905) and its provenance is unknown.

Calais Wold 275

Kinnes 1979, Ba3; SE 8311 5594 (Centroid); Bishop Wilton, East Riding of Yorkshire

Calais Wold 275 was levelled in advance of the extension of the farm buildings at High Calais Wold (Coombs 1976b, 130–31). The site of the barrow, however, was shown on the 1st edition County Series 6" Ordnance Survey map (1850-1855). It lay within a narrow belt of coniferous woodland immediately to the east of the farm at High Calais Wold. Whilst this belt of woodland protected the barrow, the mound had been damaged by rabbit diggers and the burial of cattle by the tenant of the farm. In 1892, the height of the mound was recorded at 13 feet (Mortimer 1905, 161). The barrow was situated a little to the north-east of the highest point of Calais Wold at a height of 237mOD. It was one of the barrows which formed the southern part of the Calais Wold Group.

The barrow was initially excavated in August 1892 (Mortimer 1905, 161–63). A trench, 40 feet long and 24½ feet wide was excavated across the centre of the mound. The barrow comprised a chalk rubble core (Deposit A), capped by a layer of clay (Deposit B) which was in turn covered by a substantial earthen mound (Deposit C). Ten crouched inhumations (Burials 7 to 16) were found on the old land surface beneath the barrow. These inhumations had been placed on a limestone pavement, 12 feet long and 3 feet wide, aligned from east to west. This pavement has been interpreted as a linear zone, characteristic of earlier developments during the Neolithic (Kinnes 1979). Three leaf-shaped arrowheads were found with the inhumations in the linear zone. Cremated and disarticulated bone was also dispersed amongst the interments.

An oval bracketing pit was identified at the western end of the linear zone, close to the centre of the barrow. This pit contained a cremation deposit (Cremation 5) placed between two large

blocks of flint. A crouched inhumation (Burial 6) was found immediately to the south. This inhumation was placed on its right-hand side with the head facing north-east towards the linear zone. Two further inhumations (Burials 4 and 6) were encountered within the rubble core of the barrow, approximately 2 feet above the old land surface. Two cremation deposit were found within the body of the mound, one in the layer of clay capping the rubble core (Cremation 1) and the other in the upper levels of the barrow (Cremation 2). A 'cinerary urn' was also found just below the surface of the mound.

The barrow was re-excavated by the University of Manchester in 1974 and 1975 (Coombs 1976a, 1976b). This excavation was carried out on behalf of the Department of the Environment in advance of the extension of the farm. A second bracketing pit was identified at the eastern end of the linear zone. The linear zone lay within a mortuary enclosure defined by a façade trench at the front and a curved bedding trench at the rear. This enclosure was covered by an interim mound, the chalk rubble core mentioned by Mortimer. Charcoal from the façade trench was dated to 3710-3370 cal BC (BM-1170, 4083±71 BP) and 2470-2030 cal BC (BM-1167, 3794±70 BP). Several sherds of Towthorpe Ware were recovered from the mortuary enclosure and associated mound. Over 200 sherds of AOC (All Over Comb) and European Beaker pottery were also found on the surface of the interim mound, along with charcoal and knapping debris (Gibson 1982, 122–26).

Linear Zone

A 'leaf-shaped arrow-head' was recorded 'at the left hip' of one of the burials (Burial 12) on the limestone pavement beneath Calais Wold 275 (Mortimer 1905, 162). Two broken 'arrow-heads' were also found 'at the knees' of Burial 15. These 'arrow-heads', all leaf-shaped arrowheads [R to T], were illustrated in *Forty Years' Researches* (Mortimer 1905, Figure 410d to 410f). They were not listed in either of the catalogues of the *Mortimer Collection* compiled by Tom Sheppard (1900, 1929) and could not be accounted for in the Hull and East Riding Museum. No lithic artefacts were recovered from any of the other inhumations associated with the limestone pavement. Several sherds of Towthorpe Ware, however, were found within the fill of the pit (Kinnes 1979).

Interim Mound

No pieces of worked flint were recovered from Burial 3 on the old land surface or the bracketing pit at the western end of the limestone pavement. Five 'scrapers', a 'flake saw',

two 'slingstones' and eighty 'flakes and chips' of flint were found on the old land surface and within the rubble core of the barrow (Mortimer 1905, 163). None of these pieces of worked flint were illustrated by Mortimer or listed in either of the catalogues compiled by Tom Sheppard (1900, 1929). A large assemblage of worked flint attributed to Calais Wold 275, however, was held in the *Mortimer Collection* at the Hull and East Riding Museum. This assemblage comprised seventy-seven pieces of worked flint [199 to 275]. It included an opposed platform core [200], six polyhedral cores [199, 201 to 204 and 256], a broken leaf-shaped arrowhead [220], a petit-tranchet transverse arrowhead [221], two short end scrapers [222 and 224], two broken scrapers [223 and 251], a side scraper [214], a thumbnail scraper [229], a crude disc scraper [274], a possible awl [242], two dihedral burins [212 and 267], three burins [217, 227 and 231], two retouched flakes [226 and 248] and a serrated blade [211]. Two of the polyhedral cores [201 and 256], the scrapers and serrated flake presumably correspond to the 'slingstones', 'scrapers' and 'flake saw' mentioned by Mortimer. The other polyhedral cores were possibly thought to have been re-used platform cores. Several sherds of Towthorpe Ware were also found within the rubble core of the barrow (Manby 1988, 79).

Upper Levels

No lithic artefacts were found with any of the cremation deposits encountered within the barrow. A 'barbed arrow-head', however, was recovered from the upper levels of the burial mound. This 'arrow-head', a barbed and tanged arrowhead [U], was illustrated in *Forty Years' Researches* (Mortimer 1905, Figure 410c). It was not listed in either of the catalogues of the *Mortimer Collection* compiled by Tom Sheppard (1900, 1929) and could not be accounted for in the Hull and East Riding Museum. An unspecified number of pieces of worked flint was also found on the surface of the interim mound during the course of the re-excavation of the barrow in 1974 and 1975 (Coombs 1976b, 130). These pieces of worked flint, including a barb and tang arrowhead and a flaked axe, were associated with nearly two hundred sherds of Beaker pottery (Coombs 1976a, 143). None of this material could be accounted for in the *Mortimer Collection*.

Riggs 20

None; SE 8489 5905 (Centroid); Thixendale, North Yorkshire

Riggs 20 was shown on the 1st edition County Series 6" Ordnance Survey map (1850-1855) and is still visible today. In 1864, the height of the barrow was recorded at 5 feet 7 inches

(Mortimer 1905, 176). The barrow lies approximately 230m to the south south-west of Gills Farm. It is situated on a narrow ridge between Thixendale and Brubber Dale at a height of 213mOD. The barrow was part of the Riggs Group, a dispersed group of barrows on Thixendale Wold. Riggs 20 was excavated in 1864 (Mortimer 1905, 176–77). A trench, 14½ feet square, was excavated across the centre of the mound. Two smaller trenches were excavated through the northern and eastern edges of the barrow. The barrow was re-opened in July 1874. A trench, 18 feet wide, was excavated across the entire mound.

The barrow consisted predominantly of ferruginous clay, interspersed with lenses of ash and burnt soil. Evidence of burning was identified on the old land surface beneath the barrow. An area of burning, interpreted as a hearth, was identified on the old land surface beneath Aldro 49 (Mortimer 1905, 79). It is unclear whether the evidence of burning at Riggs 20 relates to a similar hearth or to the clearance of vegetation prior to the construction of the barrow. A crouched inhumation, on its right-hand side with the head to the south, was encountered within a grave close to the centre of the mound. This inhumation was placed on a thin layer of ash that contained burnt heather. A large quantity of residual occupation debris, including several sherds of Ebbsfleet Style Peterborough Ware, was found within the body of the mound (Manby 1988, 82).

Grave

Two 'slingstones', a 'hemispherical' flint and three 'splinters' were found in the fill of the grave close to the centre of Riggs 20 (Mortimer 1905, 176). None of these pieces of worked flint were illustrated in *Forty Years' Researches* or listed in either of the catalogues of the *Mortimer Collection* compiled by Tom Sheppard (1900, 1929). A hemispherical flint and three assemblages of worked flint attributed to the barrow, however, were held in the Hull and East Riding Museum. The hemispherical flint, a crude discoidal scraper [277], was labelled 'Tumulus No. 20 and found just above the skeleton laying at the base of the mound'. One of the assemblages of worked flint comprised a serrated blade [278], a blade, [279] and a burin or awl [280] which were thought to correspond to the 'splinters' mentioned by Mortimer. Neither of the 'slingstones' could be accounted for in the *Mortimer Collection* at the Hull and East Riding Museum. None of the pieces of worked flint within the grave were directly associated with the burial itself.

Burial Mound

Three 'nearly circular discs' of flint were recovered from the fabric of the mound (Mortimer 1905, 176). None of these 'discs' were illustrated by Mortimer or listed in either of the catalogues compiled by Tom Sheppard (1900, 1929). One of the assemblages of worked flint attributed to Riggs 20 in the Hull and East Riding Museum, however, consisted of a double side scraper [281] and two short end scrapers [282 and 283]. These scrapers presumably correspond to the 'discs' mentioned by Mortimer. They were associated with several sherds of Ebbsfleet Style Peterborough Ware, found within the central excavation (Manby 1988, 82). A few worked flints were also recovered from the trenches excavated at the northern and eastern margins of the mound and during the course of the re-opening of the barrow.

The entry corresponding to the barrow in the Table of Barrows, Interments and, Articles deposited with Interments records that many pieces of worked flint were found in the body of the mound (Mortimer 1905, 421). Three assemblages of worked flint were attributed to the barrow in the *Mortimer Collection* at the Hull and East Riding Museum. The largest of these assemblages comprised forty-eight pieces of worked flint (284 to 331). It included a polyhedral core [328], two broken scrapers [288 and 297], a long end scraper [290], a short end scraper [329], a side scraper [310], a burin or fabricator [317] and a serrated blade [318]. The polyhedral core could potentially have been one of the 'slingstones' found in the fill of the grave close to the centre of the mound. In the absence of further evidence, however, this assertion cannot be maintained.

Catalogue of the lithic assemblages from the Neolithic burial mounds

ID	Barrow	Context	Class	Group	Sub Group	KINCM
1	Towthorpe 18	N M Chamber	Coarse Stone	Other	Hammerstone	126a.1942.1
2	Towthorpe 18	N M Chamber	Coarse Stone	Other	Hammerstone	126a.1942.2
3	Towthorpe 18	N M Chamber	Coarse Stone	Other	Hammerstone	126a.1942.3
4	Towthorpe 18	Burial Mound	Stone Tool	Other	Serrated flake	247.1987.1
5	Towthorpe 18	Burial Mound	Lithic Debitage	Flake	Cortical	247.1987.2
6	Towthorpe 18	N M Chamber	Stone Tool	Arrowhead	Leaf-shaped	136f.1942
7	Towthorpe 18	N M Chamber	Stone Tool	Other	Serrated blade	126b.42.1
8	Towthorpe 18	N M Chamber	Stone Tool	Other	Serrated blade	126b.42.2
9	Towthorpe 18	N M Chamber	Stone Tool	Other	Serrated blade	126b.42.3
10	Towthorpe 18	N M Chamber	Stone Tool	Other	Serrated blade	126b.42.4
11	Towthorpe 18	N M Chamber	Stone Tool	Other	Serrated flake	126b.42.5
12	Towthorpe 18	N M Chamber	Lithic Debitage	Flake	Cortical	126b.42.6
13	Towthorpe 18	N M Chamber	Stone Tool	Other	Serrated flake	126b.42.7
14	Towthorpe 273	Outer Mound	Lithic Debitage	Core	Other	152.1942
15	Towthorpe 273	Outer Mound	Stone Tool	Arrowhead	Oblique	1173.1984
16	Towthorpe 273	Outer Mound	Stone Tool	Other	Fabricator	1173.1984
17	Towthorpe 273	Grave A	Stone Tool	Scraper	Broken	1172.1984.3
18	Towthorpe 273	Grave B	Stone Tool	Other	Serrated blade	1656.1984
19	Towthorpe 273	Grave B	Lithic Debitage	Blade	Non-cortical	1656.1984
20	Towthorpe 273	Grave B	Lithic Debitage	Blade	Non-cortical	1656.1984
21	Towthorpe 273	Grave B	Stone Tool	Scraper	Broken	1656.1984
22	Towthorpe 273	Grave B	Stone Tool	Other	Serrated blade	1656.1984
23	Towthorpe 273	Grave B	Stone Tool	Scraper	Disc	1656.1984
24	Towthorpe 273	Grave B	Lithic Debitage	Flake	Cortical	1656.1984
25	Towthorpe 291	Old Land Surface	Stone Tool	Other	Leaf point	338.1942.16
26	Towthorpe 291	Burial Mound	Lithic Debitage	Core	Polyhedral	n/a
27	Towthorpe 291	Burial Mound	Lithic Debitage	Flake	Cortical	n/a
28	Towthorpe 291	Burial Mound	Lithic Debitage	Flake	Cortical	n/a
29	Towthorpe 291	Burial Mound	Lithic Debitage	Flake	Non-cortical	n/a
30	Towthorpe 291	Burial Mound	Lithic Debitage	Flake	Cortical	n/a
31	Towthorpe 291	Burial Mound	Lithic Debitage	Core	Polyhedral reused	n/a
32	Towthorpe 291	Burial Mound	Lithic Debitage	Flake	Cortical	n/a
33	Towthorpe 291	Burial Mound	Stone Tool	Scraper	End	n/a
34	Towthorpe 291	Burial Mound	Lithic Debitage	Flake	Non-cortical	n/a
35	Towthorpe 291	Burial Mound	Lithic Debitage	Flake	Cortical	n/a
36	Towthorpe 291	Burial Mound	Stone Tool	Scraper	Broken	n/a
37	Towthorpe 291	Burial Mound	Lithic Debitage	Flake	Cortical	n/a
38	Towthorpe 291	Burial Mound	Lithic Debitage	Flake	Cortical	n/a

ID	Barrow	Context	Class	Group	Sub Group	KINCM
39	Towthorpe 291	Burial Mound	Lithic Debitage	Flake	Non-cortical	n/a
40	Towthorpe 291	Burial Mound	Lithic Debitage	Flake	Cortical	n/a
41	Towthorpe 291	Burial Mound	Stone Tool	Other	Awl	n/a
42	Towthorpe 291	Burial Mound	Lithic Debitage	Flake	Cortical	n/a
43	Towthorpe 291	Burial Mound	Lithic Debitage	Flake	Non-cortical	n/a
44	Towthorpe 291	Burial Mound	Stone Tool	Other	Microburin	n/a
45	Towthorpe 291	Burial Mound	Unworked	Gravel	Fragment	n/a
46	Towthorpe 291	Burial Mound	Stone Tool	Other	Burin	n/a
47	Towthorpe 291	Burial Mound	Lithic Debitage	Flake	Non-cortical	n/a
48	Towthorpe 291	Burial Mound	Lithic Debitage	Flake	Broken	n/a
49	Towthorpe 291	Burial Mound	Lithic Debitage	Flake	Cortical	n/a
50	Towthorpe 291	Burial Mound	Lithic Debitage	Flake	Non-cortical	n/a
51	Towthorpe 291	Burial Mound	Lithic Debitage	Flake	Fragment	n/a
52	Towthorpe 291	Burial Mound	Lithic Debitage	Flake	Cortical	n/a
53	Towthorpe 291	Burial Mound	Lithic Debitage	Flake	Fragment	n/a
66	Wharram Percy 46	Unknown	Lithic Debitage	Core	Polyhedral	n/a
67	Wharram Percy 46	Unknown	Lithic Debitage	Core	Polyhedral	n/a
68	Wharram Percy 46	Unknown	Lithic Debitage	Core	Other	n/a
69	Wharram Percy 46	Unknown	Stone Tool	Knife	Edge-retouched	n/a
70	Wharram Percy 46	Unknown	Lithic Debitage	Flake	Cortical	n/a
71	Wharram Percy 46	Unknown	Lithic Debitage	Core	Polyhedral	n/a
72	Wharram Percy 46	Unknown	Lithic Debitage	Shatter	Debris	n/a
73	Wharram Percy 46	Unknown	Lithic Debitage	Flake	Cortical	n/a
74	Wharram Percy 46	Unknown	Stone Tool	Scraper	Broken	n/a
75	Wharram Percy 46	Unknown	Lithic Debitage	Flake	Cortical	n/a
76	Wharram Percy 46	Unknown	Stone Tool	Scraper	End	n/a
77	Wharram Percy 46	Unknown	Lithic Debitage	Blade	Cortical	n/a
78	Wharram Percy 46	Unknown	Lithic Debitage	Flake	Cortical	n/a
79	Wharram Percy 46	Unknown	Lithic Debitage	Flake	Non-cortical	n/a
80	Wharram Percy 46	Unknown	Stone Tool	Other	Retouched flake	n/a
81	Wharram Percy 46	Unknown	Lithic Debitage	Blade	Non-cortical	n/a
82	Wharram Percy 46	Unknown	Lithic Debitage	Shatter	Debris	n/a
83	Wharram Percy 46	Unknown	Lithic Debitage	Flake	Cortical	n/a
84	Wharram Percy 46	Unknown	Lithic Debitage	Shatter	Debris	n/a
85	Wharram Percy 46	Unknown	Lithic Debitage	Flake	Cortical	n/a
86	Wharram Percy 46	Unknown	Stone Tool	Other	Retouched flake	n/a
87	Aldro 30	Burial Mound	Lithic Debitage	Flake	Cortical	133b.42
88	Aldro 30	Burial Mound	Stone Tool	Scraper	Disc	133a.42
89	Aldro 49	Old Land Surface	Stone Tool	Knife	Plano-convex	n/a
90	Aldro 49	Unknown	Stone Tool	Scraper	End	n/a
91	Aldro 49	Old Land Surface	Lithic Debitage	Flake	Cortical	162b.1942.1
92	Aldro 49	Old Land Surface	Stone Tool	Knife	Edge-retouched	162b.1942.2
93	Aldro 88	N M Chamber	Stone Tool	Arrowhead	Leaf-shaped	395.1942
94	Aldro 88	N M Chamber	Lithic Debitage	Blade	Cortical	68a.1942.1
95	Aldro 88	N M Chamber	Lithic Debitage	Blade	Cortical	68a.1942.2
96	Aldro 88	N M Chamber	Lithic Debitage	Blade	Fragment (crested)	68a.1942.3
97	Aldro 88	Burial Mound	Stone Tool	Other	Retouched core	n/a

ID	Barrow	Context	Class	Group	Sub Group	KINCM
98	Aldro 88	Burial Mound	Lithic Debitage	Shatter	Debris	n/a
99	Aldro 88	Burial Mound	Lithic Debitage	Flake	Cortical	n/a
100	Aldro 94	Burial Mound	Stone Tool	Arrowhead	Barbed and tanged	1994.467.1
101	Aldro 94	Burial Mound	Stone Tool	Other	Serrated blade	1994.467.2
102	Aldro 94	Burial Mound	Stone Tool	Other	Awl	1994.467.3
103	Aldro 94	Burial Mound	Lithic Debitage	Flake	Non-cortical	1994.467.4
104	Aldro 94	Burial Mound	Lithic Debitage	Blade	Segment	1994.467.5
105	Aldro 94	Burial Mound	Lithic Debitage	Core	Single platform	1994.467.6
106	Aldro 116	Burial Mound	Lithic Debitage	Flake	Non-cortical	n/a
107	Aldro 116	Burial Mound	Lithic Debitage	Flake	Non-cortical	n/a
108	Aldro 116	Burial Mound	Stone Tool	Knife	Blunted-back	135a.1942
109	Aldro 116	Grave A	Lithic Debitage	Flake	Fragment	251a.1942
110	Aldro 116	Burial Mound	Stone Tool	Knife	Plano-convex	685.1942.1
111	Aldro 116	Burial Mound	Stone Tool	Scraper	Disc	685.1942.2
112	Aldro C75	Burial 1	Stone Tool	Knife	Polished-edge	160b.1942.2
113	Aldro C75	Burial 1	Stone Tool	Knife	Polished-edge	160b.1942.3
114	Aldro C75	Burial 1	Stone Tool	Knife	Edge-retouched	160c.1942
115	Aldro C75	Burial 1	Lithic Debitage	Blade	Fragment	1993.224.1
116	Aldro C75	Burial 1	Lithic Debitage	Flake	Cortical	1993.224.2
117	Aldro C75	Burial 1	Lithic Debitage	Flake	Cortical	1993.224.3
118	Aldro C75	Burial 1	Lithic Debitage	Flake	Cortical	1993.224.4
119	Aldro C75	Burial 1	Lithic Debitage	Blade	Fragment	1993.224.5
120	Aldro C75	Burial 1	Stone Tool	Other	Serrated blade	1993.224.6
121	Aldro C75	Burial 1	Lithic Debitage	Blade	Cortical	1993.224.7
122	Aldro C75	Burial 1	Lithic Debitage	Blade	Cortical	1993.224.8
123	Aldro C75	Burial 1	Lithic Debitage	Flake	Cortical	1993.224.9
124	Aldro C75	Burial 1	Lithic Debitage	Flake	Non-cortical	1993.224.10
125	Aldro C75	Burial 1	Lithic Debitage	Flake	Cortical	1993.224.11
126	Aldro C75	Burial 1	Lithic Debitage	Flake	Cortical	1993.224.12
127	Aldro C75	Burial 1	Lithic Debitage	Flake	Cortical	1993.224.13
128	Aldro C75	Burial 1	Lithic Debitage	Flake	Cortical	1993.224.14
129	Aldro C75	Burial 1	Lithic Debitage	Flake	Non-cortical	1992.28.1
130	Aldro C75	Burial 1	Lithic Debitage	Flake	Non-cortical	1992.28.2
131	Aldro C75	Burial 1	Lithic Debitage	Flake	Cortical	1992.28.3
132	Aldro C75	Burial 1	Lithic Debitage	Flake	Cortical	1992.28.4
133	Aldro C75	Burial 1	Stone Tool	Other	Serrated flake	1992.28.5
134	Aldro C75	Burial 1	Lithic Debitage	Blade	Non-cortical	1992.28.6
135	Aldro C75	Burial 1	Lithic Debitage	Flake	Cortical	1992.28.7
136	Aldro C75	Burial 1	Lithic Debitage	Flake	Non-cortical	1992.28.8
137	Aldro C75	Burial 1	Lithic Debitage	Flake	Non-cortical	1992.28.9
138	Aldro C75	Burial 1	Lithic Debitage	Flake	Cortical	1992.28.10
139	Aldro C75	Burial 1	Lithic Debitage	Flake	Fragment	1992.28.11
140	Aldro C75	Burial 1	Lithic Debitage	Flake	Non-cortical	1992.28.12
141	Aldro C75	Burial 1	Lithic Debitage	Flake	Cortical	1992.28.13
142	Aldro C75	Burial 1	Lithic Debitage	Core	Single platform	1992.28.14
143	Aldro C75	Burial 1	Lithic Debitage	Flake	Broken	1992.28.15
144	Aldro C75	Burial 1	Lithic Debitage	Flake	Non-cortical	1992.28.16

ID	Barrow	Context	Class	Group	Sub Group	KINCM
145	Aldro C75	Burial 1	Lithic Debitage	Flake	Broken	1992.28.17
146	Aldro C75	Burial 1	Lithic Debitage	Flake	Cortical	1992.28.18
147	Aldro C75	Burial 1	Lithic Debitage	Flake	Cortical	1992.28.19
148	Aldro C75	Burial 1	Lithic Debitage	Flake	Fragment	1992.28.20
149	Aldro C75	Burial 1	Lithic Debitage	Flake	Cortical	1992.28.21
150	Aldro C75	Burial 1	Lithic Debitage	Flake	Cortical	1992.28.22
151	Aldro C75	Burial 1	Lithic Debitage	Flake	Cortical	1992.28.23
152	Aldro C75	Burial 1	Lithic Debitage	Blade	Segment	1992.28.24
153	Aldro C75	Burial 1	Lithic Debitage	Flake	Fragment	1992.28.25
154	Aldro C75	Burial 1	Lithic Debitage	Flake	Non-cortical	1992.28.26
155	Aldro C75	Burial Mound	Stone Tool	Other	Retouched flake	1992.28.28
156	Aldro C75	Burial Mound	Lithic Debitage	Flake	Non-cortical	1992.28.29
157	Aldro C75	Burial Mound	Lithic Debitage	Flake	Fragment	1992.28.30
158	Aldro C75	Burial Mound	Stone Tool	Other	Burin	1992.28.31
159	Aldro C75	Burial Mound	Lithic Debitage	Flake	Non-cortical	1992.28.32
160	Aldro C75	Burial Mound	Lithic Debitage	Flake	Cortical	1992.28.33
161	Aldro C75	Burial Mound	Lithic Debitage	Flake	Fragment	1992.28.34
162	Aldro C75	Burial Mound	Lithic Debitage	Shatter	Debris	1992.28.35
163	Aldro C75	Burial Mound	Stone Tool	Scraper	Disc	1992.28.36
164	Aldro C75	Burial Mound	Lithic Debitage	Flake	Non-cortical	1992.28.37
165	Aldro C75	Burial Mound	Other	Pounder	Fragment	1992.28.38
166	Aldro C75	Burial Mound	Lithic Debitage	Flake	Cortical	1992.28.39
167	Aldro C75	Burial Mound	Stone Tool	Other	Retouched flake	1992.28.40
168	Aldro C75	Burial Mound	Stone Tool	Other	Retouched flake	1992.28.41
169	Aldro C75	Burial Mound	Stone Tool	Scraper	End	1992.28.42
170	Aldro C75	Burial Mound	Stone Tool	Scraper	End	1992.28.43
171	Aldro C75	Burial Mound	Stone Tool	Other	Retouched flake	1992.28.44
172	Aldro C75	Burial Mound	Stone Tool	Other	Retouched blade	1992.28.45
173	Aldro C75	Burial Mound	Stone Tool	Scraper	Broken	1992.28.46
174	Aldro C75	Burial Mound	Stone Tool	Scraper	End	1992.28.47
175	Aldro C75	Burial Mound	Stone Tool	Scraper	End	1992.28.48
176	Aldro C75	Burial Mound	Lithic Debitage	Flake	Cortical	1992.28.49
177	Acklam Wold 211	Grave	Stone Tool	Knife	Plano-convex	423a.1942
178	Acklam Wold 211	Grave	Stone Tool	Other	Retouched flake	270.1942
179	Acklam Wold 211	Grave	Stone Tool	Other	Serrated blade	271.1942
180	Acklam Wold 211	Unknown	Lithic Debitage	Flake	Cortical	n/a
181	Acklam Wold 211	Unknown	Lithic Debitage	Shatter	Debris	n/a
182	Acklam Wold 211	Circular Pit	Lithic Debitage	Flake	Non-cortical	n/a
183	Acklam Wold 211	Circular Pit	Stone Tool	Other	Retouched flake	n/a
184	Acklam Wold 211	Circular Pit	Lithic Debitage	Flake	Cortical	n/a
185	Painsthorpe Wold 98	Burial Mound	Lithic Debitage	Core	Polyhedral	338.1942.59
186	Painsthorpe Wold 98	Burial Mound	Stone Tool	Scraper	Thumbnail	338.1942.58.1
187	Painsthorpe Wold 98	Burial Mound	Stone Tool	Scraper	End	338.1942.58.2
188	Painsthorpe Wold 98	Cremation 3	Stone Tool	Knife	Plano-convex	372b.1942
189	Painsthorpe Wold 98	Cremation 3	Stone Tool	Knife	Plano-convex	372a.1942
190	Painsthorpe Wold 98	Grave C	Stone Tool	Knife	Plano-convex	339.1942
191	Painsthorpe Wold 98	Burial Mound	Stone Tool	Scraper	Side	338.1942.57

ID	Barrow	Context	Class	Group	Sub Group	KINCM
192	Painsthorpe Wold 98	Burial Mound	Stone Tool	Knife	Edge-retouched	338.1942.56.1
193	Painsthorpe Wold 98	Burial Mound	Stone Tool	Scraper	End	338.1942.56.2
194	Painsthorpe Wold 98	Grave B	Stone Tool	Knife	Discoidal	338.1942.53
195	Painsthorpe Wold 98	Burial Mound	Lithic Debitage	Flake	Cortical	n/a
196	Painsthorpe Wold 98	Burial Mound	Lithic Debitage	Shatter	Debris	n/a
197	Calais Wold C70	Unknown	Lithic Debitage	Flake	Non-cortical (crested)	526.1942
198	Calais Wold C70	Burial 2	Lithic Debitage	Flake	Non-cortical	526a.1942
199	Calais Wold 275	Interim Mound	Lithic Debitage	Core	Polyhedral reused	1786.1984.9
200	Calais Wold 275	Interim Mound	Lithic Debitage	Core	Opposed platform	1786.1984.10
201	Calais Wold 275	Interim Mound	Lithic Debitage	Core	Polyhedral	1786.1984.11
202	Calais Wold 275	Interim Mound	Lithic Debitage	Core	Polyhedral reused	1786.1984.12
203	Calais Wold 275	Interim Mound	Lithic Debitage	Core	Polyhedral reused	1786.1984.13
204	Calais Wold 275	Interim Mound	Lithic Debitage	Core	Polyhedral reused	1786.1984.14
205	Calais Wold 275	Interim Mound	Lithic Debitage	Flake	Non-cortical (rejuvenation)	1786.1984.15
206	Calais Wold 275	Interim Mound	Lithic Debitage	Flake	Cortical	1786.1984.16
207	Calais Wold 275	Interim Mound	Lithic Debitage	Blade	Non-cortical	1786.1984.17
208	Calais Wold 275	Interim Mound	Lithic Debitage	Blade	Non-cortical	1786.1984.18
209	Calais Wold 275	Interim Mound	Lithic Debitage	Blade	Non-cortical	1786.1984.19
210	Calais Wold 275	Interim Mound	Lithic Debitage	Blade	Non-cortical	1786.1984.20
211	Calais Wold 275	Interim Mound	Stone Tool	Other	Serrated blade	1786.1984.21
212	Calais Wold 275	Interim Mound	Stone Tool	Other	Burin	1786.1984.22
213	Calais Wold 275	Interim Mound	Lithic Debitage	Flake	Cortical	1786.1984.23
214	Calais Wold 275	Interim Mound	Stone Tool	Scraper	Side	1786.1984.24
215	Calais Wold 275	Interim Mound	Lithic Debitage	Flake	Non-cortical (rejuvenation)	1786.1984.25
216	Calais Wold 275	Interim Mound	Lithic Debitage	Flake	Non-cortical	1786.1984.26
217	Calais Wold 275	Interim Mound	Stone Tool	Other	Burin	1786.1984.27
218	Calais Wold 275	Interim Mound	Lithic Debitage	Flake	Cortical	1786.1984.28
219	Calais Wold 275	Interim Mound	Lithic Debitage	Flake	Non-cortical	1786.1984.29
220	Calais Wold 275	Interim Mound	Stone Tool	Arrowhead	Leaf-shaped	1786.1984.30
221	Calais Wold 275	Interim Mound	Stone Tool	Arrowhead	Petit-tranchet	1786.1984.31
222	Calais Wold 275	Interim Mound	Stone Tool	Scraper	End	1786.1984.32
223	Calais Wold 275	Interim Mound	Stone Tool	Scraper	Broken	1786.1984.33
224	Calais Wold 275	Interim Mound	Stone Tool	Scraper	End	1786.1984.34
225	Calais Wold 275	Interim Mound	Lithic Debitage	Flake	Non-cortical	1786.1984.35
226	Calais Wold 275	Interim Mound	Stone Tool	Other	Retouched flake	1786.1984.36
227	Calais Wold 275	Interim Mound	Stone Tool	Other	Burin	1786.1984.37
228	Calais Wold 275	Interim Mound	Lithic Debitage	Shatter	Debris	1786.1984.38
229	Calais Wold 275	Interim Mound	Stone Tool	Scraper	Thumbnail	1786.1984.39
230	Calais Wold 275	Interim Mound	Lithic Debitage	Flake	Cortical	1786.1984.40
231	Calais Wold 275	Interim Mound	Stone Tool	Other	Burin	1786.1984.41
232	Calais Wold 275	Interim Mound	Lithic Debitage	Flake	Cortical	1786.1984.42
233	Calais Wold 275	Interim Mound	Lithic Debitage	Shatter	Debris	1786.1984.43
234	Calais Wold 275	Interim Mound	Lithic Debitage	Flake	Non-cortical	1786.1984.44
235	Calais Wold 275	Interim Mound	Lithic Debitage	Flake	Non-cortical	1786.1984.45

ID	Barrow	Context	Class	Group	Sub Group	KINCM
236	Calais Wold 275	Interim Mound	Lithic Debitage	Flake	Cortical	1786.1984.46
237	Calais Wold 275	Interim Mound	Lithic Debitage	Flake	Cortical	1786.1984.47
238	Calais Wold 275	Interim Mound	Lithic Debitage	Flake	Cortical	1786.1984.48
239	Calais Wold 275	Interim Mound	Lithic Debitage	Flake	Non-cortical	1786.1984.49
240	Calais Wold 275	Interim Mound	Lithic Debitage	Flake	Cortical	1786.1984.50
241	Calais Wold 275	Interim Mound	Lithic Debitage	Flake	Non-cortical	1786.1984.51
242	Calais Wold 275	Interim Mound	Stone Tool	Other	Awl	1786.1984.52
243	Calais Wold 275	Interim Mound	Lithic Debitage	Shatter	Debris	1786.1984.53
244	Calais Wold 275	Interim Mound	Lithic Debitage	Flake	Cortical	1786.1984.54
245	Calais Wold 275	Interim Mound	Lithic Debitage	Flake	Non-cortical	1786.1984.55
246	Calais Wold 275	Interim Mound	Lithic Debitage	Flake	Non-cortical	1786.1984.56
247	Calais Wold 275	Interim Mound	Lithic Debitage	Flake	Non-cortical	1786.1984.57
248	Calais Wold 275	Interim Mound	Stone Tool	Other	Retouched flake	1786.1984.58
249	Calais Wold 275	Interim Mound	Lithic Debitage	Flake	Fragment	1786.1984.59
250	Calais Wold 275	Interim Mound	Lithic Debitage	Flake	Cortical	1786.1984.60
251	Calais Wold 275	Interim Mound	Stone Tool	Scraper	Broken	1786.1984.61
252	Calais Wold 275	Interim Mound	Lithic Debitage	Blade	Non-cortical	1786.1984.62
253	Calais Wold 275	Interim Mound	Lithic Debitage	Flake	Non-cortical	1786.1984.63
254	Calais Wold 275	Interim Mound	Lithic Debitage	Flake	Non-cortical	1786.1984.64
255	Calais Wold 275	Interim Mound	Lithic Debitage	Flake	Cortical	1786.1984.65
256	Calais Wold 275	Interim Mound	Lithic Debitage	Core	Polyhedral	1786.1984.66
257	Calais Wold 275	Interim Mound	Lithic Debitage	Flake	Cortical	1786.1984.67
258	Calais Wold 275	Interim Mound	Lithic Debitage	Flake	Cortical	1786.1984.68
259	Calais Wold 275	Interim Mound	Lithic Debitage	Flake	Cortical	1786.1984.69
260	Calais Wold 275	Interim Mound	Lithic Debitage	Flake	Cortical	1786.1984.70
261	Calais Wold 275	Interim Mound	Lithic Debitage	Blade	Segment	1786.1984.71
262	Calais Wold 275	Interim Mound	Lithic Debitage	Flake	Non-cortical	1786.1984.72
263	Calais Wold 275	Interim Mound	Lithic Debitage	Flake	Non-cortical	1786.1984.73
264	Calais Wold 275	Interim Mound	Lithic Debitage	Flake	Cortical	1786.1984.74
265	Calais Wold 275	Interim Mound	Lithic Debitage	Flake	Fragment	1786.1984.75
266	Calais Wold 275	Interim Mound	Lithic Debitage	Flake	Fragment	1786.1984.76
267	Calais Wold 275	Interim Mound	Stone Tool	Other	Burin	1786.1984.77
268	Calais Wold 275	Interim Mound	Lithic Debitage	Shatter	Debris	1786.1984.78
269	Calais Wold 275	Interim Mound	Lithic Debitage	Flake	Cortical (rejuvenation)	1786.1984.79
270	Calais Wold 275	Interim Mound	Lithic Debitage	Flake	Fragment	1786.1984.80
271	Calais Wold 275	Interim Mound	Lithic Debitage	Flake	Non-cortical	1786.1984.81
272	Calais Wold 275	Interim Mound	Lithic Debitage	Flake	Non-cortical	1786.1984.82
273	Calais Wold 275	Interim Mound	Lithic Debitage	Shatter	Debris	1786.1984.83
274	Calais Wold 275	Interim Mound	Stone Tool	Scraper	Disc	1786.1984.84
275	Calais Wold 275	Interim Mound	Lithic Debitage	Flake	Non-cortical	1786.1984.85
276	Riggs 20	Burial Mound	Stone Tool	Other	Retouched flake	249.1987.49
277	Riggs 20	Grave	Stone Tool	Scraper	Discoidal	249.1987.62
278	Riggs 20	Grave	Stone Tool	Other	Serrated blade	338.42.82.1
279	Riggs 20	Grave	Lithic Debitage	Blade	Non-cortical	338.42.82.2
280	Riggs 20	Grave	Stone Tool	Other	Burin	338.42.82.3
281	Riggs 20	Burial Mound	Stone Tool	Scraper	Side	338.42.83.1

ID	Barrow	Context	Class	Group	Sub Group	KINCM
282	Riggs 20	Burial Mound	Stone Tool	Scraper	End	338.42.83.2
283	Riggs 20	Burial Mound	Stone Tool	Scraper	End	338.42.83.3
284	Riggs 20	Burial Mound	Lithic Debitage	Flake	Fragment	249.1987.1
285	Riggs 20	Burial Mound	Lithic Debitage	Flake	Cortical	249.1987.2
286	Riggs 20	Burial Mound	Lithic Debitage	Shatter	Debris	249.1987.3
287	Riggs 20	Burial Mound	Lithic Debitage	Flake	Cortical	249.1987.4
288	Riggs 20	Burial Mound	Stone Tool	Scraper	Broken	249.1987.5
289	Riggs 20	Burial Mound	Lithic Debitage	Flake	Cortical	249.1987.6
290	Riggs 20	Burial Mound	Stone Tool	Scraper	End	249.1987.7
291	Riggs 20	Burial Mound	Lithic Debitage	Flake	Non-cortical	249.1987.8
292	Riggs 20	Burial Mound	Lithic Debitage	Flake	Cortical	249.1987.9
293	Riggs 20	Burial Mound	Lithic Debitage	Shatter	Debris	249.1987.10
294	Riggs 20	Burial Mound	Lithic Debitage	Shatter	Debris	249.1987.11
295	Riggs 20	Burial Mound	Lithic Debitage	Flake	Cortical	249.1987.12
296	Riggs 20	Burial Mound	Lithic Debitage	Flake	Fragment	249.1987.13
297	Riggs 20	Burial Mound	Stone Tool	Scraper	Broken	249.1987.14
298	Riggs 20	Burial Mound	Lithic Debitage	Flake	Non-cortical	249.1987.15
299	Riggs 20	Burial Mound	Lithic Debitage	Flake	Cortical	249.1987.16
300	Riggs 20	Burial Mound	Lithic Debitage	Flake	Cortical	249.1987.17
301	Riggs 20	Burial Mound	Lithic Debitage	Flake	Non-cortical	249.1987.18
302	Riggs 20	Burial Mound	Lithic Debitage	Shatter	Debris	249.1987.19
303	Riggs 20	Burial Mound	Lithic Debitage	Flake	Cortical	249.1987.20
304	Riggs 20	Burial Mound	Lithic Debitage	Flake	Cortical	249.1987.21
305	Riggs 20	Burial Mound	Lithic Debitage	Flake	Cortical	249.1987.22
306	Riggs 20	Burial Mound	Lithic Debitage	Flake	Cortical	249.1987.23
307	Riggs 20	Burial Mound	Lithic Debitage	Flake	Cortical	249.1987.24
308	Riggs 20	Burial Mound	Lithic Debitage	Flake	Cortical	249.1987.25
309	Riggs 20	Burial Mound	Lithic Debitage	Flake	Cortical (rejuvenation)	249.1987.26
310	Riggs 20	Burial Mound	Stone Tool	Scraper	Side	249.1987.27
311	Riggs 20	Burial Mound	Lithic Debitage	Flake	Non-cortical	249.1987.28
312	Riggs 20	Burial Mound	Lithic Debitage	Flake	Non-cortical	249.1987.29
313	Riggs 20	Burial Mound	Lithic Debitage	Flake	Fragment	249.1987.30
314	Riggs 20	Burial Mound	Lithic Debitage	Flake	Cortical	249.1987.31
315	Riggs 20	Burial Mound	Lithic Debitage	Flake	Cortical	249.1987.32
316	Riggs 20	Burial Mound	Lithic Debitage	Flake	Broken	249.1987.33
317	Riggs 20	Burial Mound	Stone Tool	Other	Burin	249.1987.34
318	Riggs 20	Burial Mound	Stone Tool	Other	Serrated blade	249.1987.35
319	Riggs 20	Burial Mound	Lithic Debitage	Flake	Cortical	249.1987.36
320	Riggs 20	Burial Mound	Lithic Debitage	Flake	Cortical	249.1987.37
321	Riggs 20	Burial Mound	Lithic Debitage	Flake	Non-cortical	249.1987.38
322	Riggs 20	Burial Mound	Lithic Debitage	Flake	Non-cortical	249.1987.39
323	Riggs 20	Burial Mound	Lithic Debitage	Flake	Non-cortical	249.1987.40
324	Riggs 20	Burial Mound	Lithic Debitage	Blade	Segment	249.1987.41
325	Riggs 20	Burial Mound	Lithic Debitage	Blade	Segment	249.1987.42
326	Riggs 20	Burial Mound	Lithic Debitage	Flake	Fragment	249.1987.43
327	Riggs 20	Burial Mound	Lithic Debitage	Blade	Segment	249.1987.44

ID	Barrow	Context	Class	Group	Sub Group	KINCM
328	Riggs 20	Burial Mound	Lithic Debitage	Core	Polyhedral	249.1987.45
329	Riggs 20	Burial Mound	Stone Tool	Scraper	End	249.1987.46
330	Riggs 20	Burial Mound	Lithic Debitage	Shatter	Debris	249.1987.47
331	Riggs 20	Burial Mound	Lithic Debitage	Shatter	Debris	249.1987.48
A	Towthorpe 18	N M Chamber	Stone Tool	Arrowhead	Leaf-shaped	13a.1942
B	Towthorpe 18	N M Chamber	Stone Tool	Arrowhead	Leaf-shaped	13b.1942
C	Towthorpe 18	N M Chamber	Stone Tool	Arrowhead	Leaf-shaped	13c.1942
D	Towthorpe 18	N M Chamber	Stone Tool	Arrowhead	Leaf-shaped	13d.1942
E	Towthorpe 18	N M Chamber	Stone Tool	Arrowhead	Leaf-shaped	13f.1942
F	Towthorpe 273	Grave A	Stone Tool	Arrowhead	Chisel-shaped	139a.1942
G	Towthorpe 273	Grave A	Stone Tool	Arrowhead	Chisel-shaped	139b.1942
H	Towthorpe 273	Grave A	Stone Tool	Arrowhead	Chisel-shaped	139c.1942
I	Towthorpe 273	Grave A	Stone Tool	Arrowhead	Chisel-shaped	139d.1942
J	Towthorpe 273	Grave A	Stone Tool	Arrowhead	Oblique	139e.1942
K	Towthorpe 273	Burial D	Stone Tool	Knife	Polished discoidal	142.1942
L	Towthorpe 273	Burial G	Stone Tool	Arrowhead	Kite-shaped	144.1942
M	Towthorpe 273	Burial G	Stone Tool	Other	Polished adze	145.1942
N	Towthorpe 273	Cremation 3	Stone Tool	Arrowhead	Chisel-shaped	148.1942
O	Aldro C75	Burial 1	Stone Tool	Other	Serrated blade	160b.1942.1
P	Aldro C75	Burial 2	Stone Tool	Knife	Polished discoidal	160a.1942
Q	Aldro 94	Linear Zone	Stone Tool	Knife	Polished-edge	158.1942
R	Calais Wold 275	Linear Zone	Stone Tool	Arrowhead	Leaf-shaped	n/a
S	Calais Wold 275	Linear Zone	Stone Tool	Arrowhead	Leaf-shaped	n/a
T	Calais Wold 275	Linear Zone	Stone Tool	Arrowhead	Leaf-shaped	n/a
U	Calais Wold 275	Upper Levels	Stone Tool	Arrowhead	Barbed and tanged	n/a
V	Painsthorpe Wold 98	Grave C	Stone Tool	Knife	Plano-convex	n/a

Life histories of the stone tools from the Neolithic burial mounds

Arrowheads

Leaf-Shaped Arrowheads

Towthorpe 18

6 ***Leaf shaped arrowhead*** (Incomplete) L>39mm and B=22mm (Mortimer 1905, Figure 20). Broken leaf shaped arrowhead struck from a fine tertiary flake. Hinge fracture along broken edge, characteristic of accidental breakage resulting from use of soft hammer. **Face I:** Possible evidence for thinning with single removal from right edge of dorsal surface. Semi-invasive retouch to middle section of left-hand edge. Pressure flaking along right edge/distal end of left edge. **Face II:** Striking platform/bulb of percussion 'platform' trimmed with at least two removals from ventral surface of flake. Pressure flaking along both edges.

A ***Leaf shaped arrowhead*** (Type 1C; Green 1980, II i 87) L=87mm and B=34mm (Mortimer 1905, Figure 16). Complete lozenge point. **Face I:** Evidence of thinning with at least two removals from left edge, extending to centre of arrowhead. Both edges subsequently shaped/straightened. Four well defined removals along lower right edge. Semi-invasive retouch along lower left and upper right edges. Possible pressure flaking along right edge. **Face II:** Not illustrated.

B ***Leaf shaped arrowhead*** (Type 2B; Green 1980, II i 87) L=53mm and B=25mm (Mortimer 1905, Figure 17). Complete double pointed leaf shaped arrowhead. **Face I:** Possible evidence for thinning with two removals from right edge, extending to centre of arrowhead. Semi-invasive retouch along upper right edge. Left edge shaped by a continuous series of well-defined removals. Possible pressure flaking along lower right edge. **Face II:** Not illustrated.

C ***Leaf shaped arrowhead*** (Type 2C; Green 1980, II i 87) L=53mm and B=22mm (Mortimer 1905, Figure 18). Complete double pointed leaf shaped arrowhead. **Face**

I: Possible evidence of thinning with removals from both edges, extending to centre of arrowhead. Semi-invasive retouch along upper left edge. Right edge shaped by a continuous series of well-defined removals. Possible pressure flaking or abrasion along both edges. **Face II:** Not illustrated.

D ***Leaf shaped arrowhead*** (Type 1B; Green 1980, II i 87) L=61mm and B=29mm (Mortimer 1905, Figure 19). Complete double pointed leaf shaped arrowhead. **Face I:** Evidence of thinning with three well-defined removals from right edge, extending to centre of arrowhead. Middle section of left edge shaped by several crude removals. Semi-invasive retouch along upper left and upper right edges. Pressure flaking along both edges. **Face II:** Not illustrated.

E ***Leaf shaped arrowhead*** (Type 1C; Green 1980, II i 87) L=84mm and B=29mm (Mortimer 1905, Figure 21). Complete leaf point. **Face I:** Possible evidence of thinning with single removal from left edge, extending across surface of arrowhead. Lower edges and middle section of left edge shaped by a continuous series of well-defined removals. Semi-invasive retouch to upper right edge. Possible pressure flaking along both edges. **Face II:** Not illustrated.

Towthorpe 273 (Duggleby Howe)

L ***Kite shaped arrowhead*** (Incomplete: Type 2C; Green 1980, II i 85) L>47mm and B=21mm (Mortimer 1905, Figure 64). Broken kite shaped arrowhead. **Face I:** Evidence of thinning with two removals from left edge and four removals from right edge, extending to centre of arrowhead. Lower right edge shaped by a series of well-defined removals. Middle section of left edge shaped by several crude removals. Semi-invasive retouch along left edge. Possible pressure flaking along both edges. **Face II:** Not illustrated.

Aldro 88

93 ***Leaf shaped arrowhead*** (Incomplete: Type 2C; Green 1980, II i 83) L=42mm and B=19mm (Mortimer 1905, Figure 117). Broken lozenge shaped arrowhead. Step fracture along broken edge. **Face I:** Evidence of thinning with removals from both edges. Scars from thinning flakes truncated by later removals. Semi-invasive retouch along lower right edge. Fine point created by pressure flaking along both upper edges. **Face II:** Evidence of thinning with shallow removals from both lower edges, extending

to centre of arrowhead. Possible semi-invasive retouch along lower right edge. Carefully shaped fine point created by pressure flaking.

Calais Wold 275

220 ***Leaf shaped arrowhead*** (Incomplete) L=n/a and B=n/a. Possible fragment of leaf-shaped arrowhead broken during manufacture. Distal end of fine tertiary flake with step fracture along broken edge. **Face I:** Dorsal surface of flake. Semi-invasive retouch along lower right edge truncated by large flake scar with pronounced curvature. **Face II:** Ventral surface of flake, terminating in hinge fracture. Abrasion to lower left edge - possible platform preparation for removal of flakes from dorsal surface.

R ***Leaf shaped arrowhead*** (Type 3B; Green 1980, II i 77) L=37mm and B=20mm (Mortimer 1905, Figure 410d). Complete leaf shaped arrowhead. **Face I:** Possible evidence of thinning with crude removals from both edges. Base of arrowhead shaped by two well defined removals from lower right edge. Carefully shaped point created by fine semi-invasive retouch along both upper edges. Possible pressure flaking along lower right edge. **Face II:** Not illustrated.

S ***Leaf shaped arrowhead*** (Incomplete: Type 2B?; Green 1980, II i 78) L>38mm and B=24mm (Mortimer 1905, Figure 410e). Broken double pointed leaf shaped arrowhead, both points missing. **Face I:** Possible evidence of thinning with at least one removal from left edge, extending to centre of arrowhead. Both edges shaped by a series of shallow removals. Semi-invasive retouch along lower right edge. **Face II:** Not illustrated.

T ***Leaf shaped arrowhead*** (Incomplete: Type 3C?; Green 1980, II i 78) L>29mm and B=16mm (Mortimer 1905, Figure 410f). Broken double pointed leaf shaped arrowhead, both points missing. **Face I:** No visible evidence of thinning. Upper right edge and middle section of right edge shaped by a continuous series of shallow removals. Semi-invasive retouch along left edge and lower right edge. Possible pressure flaking along left edge. **Face II:** Not illustrated.

Transverse Arrowheads

Towthorpe 273 (Duggleby Howe)

15 ***?Oblique arrowhead*** (Green 1980, II i 84) t=54mm and r=31mm. Triangular arrowhead struck from fine secondary flake - possible oblique arrowhead or preform for barbed and tanged arrowhead. **Face I:** Dorsal surface of flake. Corticated dorsal surface of flake. Primary flake edge thinned with four shallow removals from left edge. Abrupt retouch along right edge and base. **Face II:** Ventral surface of flake. Carefully shaped point created by abrupt retouch to both edges.

F ***Chisel shaped arrowhead*** (Clark 1934, F26; Green 1980, II i 84) t=37mm and r=33mm (Mortimer 1905, Figure 47). Complete chisel shaped transverse arrowhead. **Face I:** Dorsal surface of flake. Flake struck from left side of primary edge. Semi-invasive retouch along both edges and at base. **Face II:** Ventral surface of flake. Semi invasive retouch along left edge. Right edge chipped at base.

G ***Chisel shaped arrowhead*** (Clark 1934, F23; Green 1980, II i 84) t=41mm and r=35mm (Mortimer 1905, Figure 48). Complete chisel shaped transverse arrowhead. **Face I:** Dorsal surface of flake. Four removals from primary flake edge with 'centripetal' flake scars, possibly indicative of manufacture from a flake struck from a discoidal or prepared-core. Semi-invasive retouch along right edge and at base. **Face II:** Ventral surface of flake. Semi-invasive retouch along left edge and at base. Abrupt retouch along upper right edge.

H ***Chisel shaped arrowhead*** (Clark 1934, F24; Green 1980, II i 84) t=30mm and r=33mm (Mortimer 1905, Figure 49). Complete chisel shaped transverse arrowhead. **Face I:** Dorsal surface of flake. Three removals from primary flake edge, left hand flake scar opposed to the two to the right. Flakes struck from primary flake edge truncate scars from two previous removals. Semi-invasive along both edges and at base. **Face II:** Ventral surface of flake. Semi-invasive retouch along both edges.

I ***Chisel shaped arrowhead*** (Clark 1934, F25; Green 1980, II i 84) t=32mm and r=29mm (Mortimer 1905, Figure 50). Complete chisel shaped transverse arrowhead. **Face I:** Single removal from primary flake edge. Several crude removals from left edge. Semi-

invasive retouch along right edge. **Face II:** Ventral surface of flake. Semi invasive along left edge.

J ***Oblique arrowhead*** (Green 1980, II i 84) t=43mm, r=23mm and FL=40mm (Mortimer 1905, Figure 51). Complete oblique transverse arrowhead. **Face I:** Two removals from primary flake edge. Crude retouch along left edge and at base. Semi-invasive retouch or pressure flake along upper right edge, creating carefully shaped point. **Face II:** Not illustrated.

N ***Chisel shaped arrowhead*** (Green 1980, II i 84) t=43mm and r>23mm (Mortimer 1905, Figure 52). Broken chisel shaped transverse arrowhead. Hinge fracture along broken edge, characteristic of accidental breakage resulting from use of soft hammer. **Face I:** Two removals from primary flake edge, with possible retouch at right hand side. Flakes struck from primary flake edge truncated scars from two previous removals. Semi-invasive along right edge. **Face II:** Not illustrated.

Calais Wold 275

221 ***Petit tranchet arrowhead*** t=37mm and r=20mm. Complete petit tranchet transverse arrowhead. **Face I:** Dorsal surface of flake. Single removal from primary edge (distal end). Shallow scar at base from flake struck to reduce striking platform. Two shallow removals from right edge. **Face II:** Ventral surface of flake. Possible crude retouch or abrasion to left edge.

Barbed and Tanged Arrowheads

Aldro 94

100 ***Barb and tanged arrowhead*** (Sutton Type a) L=44mm and B=23mm. Crude unfinished arrowhead manufactured from tertiary flake. **Face I:** Dorsal surface of flake with pronounced curvature. Two removals from struck proximal end of flake, to reduce the striking platform. Several crude removals from left edge. Right edge serrated or abraded, possibly strengthened in advance of pressure flaking. Vestigial tang created by four removals from base and single flake struck from lower left corner. **Face II:** Ventral surface of flake with bulb or percussion still visible. Possible removal from distal end of flake.

Calais Wold 275

U ***Barbed and tanged arrowhead*** (Sutton Type b/c; Green 1980, II i 503) L=28mm and B=26mm (Mortimer 1905, Figure 52). Complete barbed and tanged arrowhead. **Face I:** Possible thinning with two removals from both edges of point. Oblique or broken tang with well-defined round pointed barbs. Two removals from base of tang. Pressure flaking to middle section of both edges. **Face II:** Not illustrated.

Knives

Edge-Retouched Flake Knives

Wharram Percy 46

69 ***Edge-retouched flake knife*** L=55mm and B=32mm. Crude edge-retouched knife manufactured from a tertiary flake of brown flint. **Dorsal surface:** Central ridge formed by flake scars from two previous removals. Semi-invasive retouch along both edges. Distal end of flake unworked. **Ventral surface:** Unworked with bulb of percussion and striking platform still visible.

Aldro 116

108 ***?Blunted-back knife*** L=85mm and B=44mm (Mortimer 1905, Figure 106). Possible blunted-back knife manufactured from a D-shaped Group VI flake. **Dorsal surface:** Offset ridge formed by flake scars from three previous removals, two of which were perpendicular to the long axis of the flake. Abrupt retouch along right edge. **Ventral surface:** Unworked with bulb of percussion and striking platform still visible.

Aldro C75

114 ***Edge-retouched flake knife*** L=105mm and B=24mm (Mortimer 1905, Figure 159a/b). Unusual edge-retouched knife manufactured from a possible blade. **Dorsal surface:** Abrupt retouch to left edge and proximal third of right edge. Possible retouch to distal end of flake. **Ventral surface:** Unworked with pronounced bulb of percussion. Striking platform still visible.

Aldro 49

92 ***Edge-retouched flake knife*** L=55mm and B=24mm (Mortimer 1905, Figure 177). Heavily patinated edge-retouched knife manufactured from a possible blade. **Dorsal surface:** Offset ridge formed by flake scars from two previous removals. Possible

evidence of platform preparation (trimming). Parasitic removal from left side of striking platform. Semi-invasive retouch along distal third of right edge, creating a sharp point. Pressure flaking along both edges. **Ventral surface:** Unworked with bulb of percussion still visible.

Painsthorpe Wold 98

192 ***Edge-retouched flake knife*** L=71mm and B=25mm. Edge-retouched knife manufactured from a possible blade. **Ventral surface:** Central ridge created by flake scars from two previous removals. Evidence of thinning with six shallow flakes struck from left edge. Semi-invasive retouch along lower right edge. Possible pressure flaking along right edge and middle section of left edge. **Dorsal surface:** Unworked with bulb of percussion and striking platform still visible. Parasitic removal from middle of striking platform.

194 ***Discoidal knife*** L=62mm and B=47mm (Mortimer 1905, Figure336). Crude discoidal knife. **Dorsal surface:** Possible evidence of platform preparation (façeting). Two flakes struck from proximal end to reduce striking platform. Three centripetal removals from left edge, characteristic of a flake struck from a discoidal core. Abrupt retouch along left edge. Fine semi-invasive retouch to middle section of right edge. **Ventral surface:** Unworked with bulb of percussion and possibly part of striking platform still visible.

Plano-Convex Knives

Aldro 116

110 ***Plano-convex knife*** L=52mm and B=35mm. Plano-convex knife with rounded point at distal end. **Dorsal surface:** Striking platform reduced by a series of removals. Evidence of blank preparation with two removals from right edge, extending across the centre of the flake. Possible evidence of subsequent thinning with three further removals from right edge. Proximal end/base shaped by fine semi-invasive retouch Semi-invasive retouch and pressure flaking along both edges. **Ventral surface:** Lower left edge thinned by a series of crude removals.

Aldro 49

89 ***?Plano-convex knife*** L=42mm and B=52mm (Mortimer 1905, Figure178). Possible plano-convex knife manufactured from secondary flake. **Dorsal surface:** Distal end partially corticated. Possible evidence of blank preparation with at least two removals struck from proximal end to reduce the striking platform. Semi-invasive retouch along lower left edge and left side of distal end, forming rounded end. Pressure flaking along right edge and distal end. Possible abrasion along left edge. **Ventral surface:** Upper left edge fractured. Several shallow flakes removed from upper right edge.

Acklam Wold 211

177 ***Plano-convex knife*** (Clark 1932a, Table 5.1) L=51mm and B=22mm (Mortimer 1905, Figure220). Triangular plano-convex knife. **Dorsal surface:** Evidence of blank preparation with at least four flakes struck from left edge, extending to centre. Possible evidence of subsequent thinning along left edge, with flake scars from seven further removals. Semi-invasive retouch along left edge. Fine invasive and semi-invasive retouch along right edge. Pressure flaking along both edges. **Ventral surface:** Unworked with bulb of percussion and corticated striking platform still visible.

Painsthorpe Wold 98

188 ***Plano-convex knife*** L=43mm and B=20mm (Mortimer 1905, Figure332). Plano-convex knife. **Dorsal surface:** Evidence of blank preparation with several removals from both edges, extending to centre. Possible evidence of subsequent thinning with further removals from both edges, including regular scars from three flakes struck from the lower left edge. Several flakes struck from proximal end to remove striking platform. Pressure flaking along both edges. **Ventral surface:** Unworked with bulb of percussion still visible.

189 ***Plano-convex knife*** L=56mm and B=24mm (Mortimer 1905, Figure333). Plano-convex knife manufactured from a secondary flake. **Dorsal surface:** Evidence of blank preparation with shallow flakes struck from both edges. Dorsal surface of flake still visible in several places. Possible evidence of subsequent thinning with several removals from left edge. Semi-invasive retouch along left edge. Possible pressure flaking along right edge. **Ventral surface:** Unworked with bulb of percussion and part of striking platform still visible.

190 ***Plano-convex knife*** (Clark 1932a, Table 2.2) L=64mm and B=23mm (Mortimer 1905, Figure341). Plano-convex knife with rounded ends. **Dorsal surface:** Evidence of platform preparation with several shallow flakes struck from both edges, extending to centre. Possible evidence of subsequent thinning with further removals from left edge. Several flakes struck from proximal end to remove striking platform. Semi-invasive retouch to proximal and distal ends, creating rounded ends. Pressure flaking along left edge and at proximal end. Right edge possibly serrated. **Ventral surface:** Unworked with bulb of percussion still visible.

V ***Plano-convex knife*** L=50mm and B=16mm (Mortimer 1905, Figure339). Narrow plano-convex knife manufactured from a possible blade. **Dorsal surface:** Semi-invasive retouch along both edges. Dorsal surface of flake still visible. Possible pressure flaking along upper right edge. Fine retouch at distal end of both edges, creating a blunt point. **Ventral surface:** Not illustrated.

Polished-Edge Knives

Towthorpe 273 (Duggleby Howe)

K ***?Polished discoidal knife*** (Type 1; Manby 1974, Figure36.1) L=60mm and B =30mm (Mortimer 1905, Figure58). Polished rectangular knife with slight curvature, possible Type IV polished discoidal knife (Clark 1928, p.44). **Face I:** Surface completely polished. Bevelled edges. **Face II:** Not illustrated.

Aldro C75

112 ***Marginal polished-edge blade*** (Type 5; Manby 1974, Figure37.16) L=75mm and B=24mm (Mortimer 1905, Figure157). Heavily patinated marginal polished-edge blade. **Dorsal surface:** Distal end partially corticated. Abrupt retouch at proximal end. Semi invasive retouch at distal end. Indentation characteristic of hafting close to base of right edge, opposite a corticated 'notch' (natural) on left edge. Right edge ground/polished. **Ventral surface:** Unworked with bulb of percussion and part of striking platform still visible.

113 ***Polished-edge blade*** (Type 4; Sheppard 1929, xliii) L=68mm and B=21mm. Thin heavily patinated polished-edge blade. Not listed by Manby (1974; Appendix 4).

Dorsal surface: Abrupt/semi-invasive retouch to proximal end of right edge. Left edge ground/polished. **Ventral surface:** Unworked with bulb of percussion still visible.

P ***?Polished discoidal knife*** (Type 1; Manby 1974, Figure36.2) L=103mm and B=35mm (Mortimer 1905, Figure160). Polished rectangular knife with slight curvature, possible Type IV polished discoidal knife (Clark 1928, p.44). **Face I:** Surface completely polished. Left edge bevelled. Broken during course of excavation – notch or chip in left edge. Ripples, possibly indicative of centripetal flaking, still visible. **Face II:** Not illustrated.

Aldro 94

Q ***Polished-edge blade*** (Type 4; Manby 1974, Figure36.8) L=90mm and B=22mm (Mortimer 1905, Figure180). Polished-edge blade with a trapezoidal cross-section. **Dorsal surface:** Four flakes struck from proximal end to reduce striking platform. Possible second stage of thinning with two further removals from right side of proximal end. Abrupt retouch at proximal end. Semi-invasive retouch at both ends, creating rounded corners. Both edges ground/polished, creating two façets. **Ventral surface:** Not illustrated.

Scrapers

End Scrapers

Towthorpe 291

33 ***End scraper*** (Type A ii, Class 4) L=36mm and B=30mm. Short end scraper manufactured from a tertiary flake. **Dorsal surface:** Two diverging ridges formed by flake scars from three previous removals. Right ridge truncated by shallow flake scar from a removal struck from the proximal end of the right edge. Abrupt retouch at distal end, extending along lower right edge. **Ventral surface:** Flake scar at proximal end from a single removal (parasitic?).

Towthorpe 292

56 ***?End scraper*** (Type A ii, Class 4) L=42mm and B=30mm. Crude end scraper manufactured from a tertiary flake or core fragment. **Dorsal surface:** possible retouch to distal end of lower left edge. **Ventral surface:** unworked.

Wharram Percy 46

76 ***End (distal) scraper*** (Type A i, Class 4) L=35mm and B=23mm. Long end (distal) scraper manufactured from a rejuvenation flake. **Dorsal surface:** Flake struck from base of core (opposed platform) to remove step fracture. Central ridge formed by flake scars from two previous removals. Ridge truncated by flake scars from two (opposed) removals struck from the same striking platform as the rejuvenation flake. Right edge corticated. Abrupt retouch at proximal end. **Ventral surface:** Flake scar from a single removal struck to reduce pronounced bulb of percussion (struck from left edge of bulb of percussion).

Aldro C75

169 ***End scraper*** (Type A ii, Class 5) L=45mm and B=48mm. End scraper manufactured from a short squat secondary flake. **Dorsal surface:** Two diverging ridges formed by flake scars from three previous removals. Two flake scars at proximal end from removals struck to reduce striking platform. Upper right edge corticated. Abrupt retouch at distal end, extending along lower right edge. **Ventral surface:** Striking platform still visible. Fine retouch along left edge.

170 ***End scraper*** (Type A ii, Class 5) L=35mm and B=45mm. End scraper manufactured from a short squat tertiary flake. **Dorsal surface:** Shallow scars from two flakes struck from right edge to remove cortex. Semi-invasive retouch at distal end and along left edge to remove cortex. Abrupt retouch at distal end. **Ventral surface:** Unworked with diffuse bulb of percussion and corticated striking platform still visible.

174 ***?End scraper*** (Type A ii, Class 9/10) L=38mm and B=40mm. Expedient end scraper manufactured from a primary flake. **Dorsal surface:** 'Blocky' surface with cortex along right edge. Crude retouch at distal end, possibly extending along left edge. **Ventral surface:** Shallow flake scar at left edge of striking platform from a single removal struck to reduce the bulb of percussion.

175 ***End scraper*** (Type A i, Class 4) L=39mm and B=25mm. Long end scraper manufactured from a tertiary flake. **Dorsal surface:** Flake scars from three previous removals. Lower right edge lightly corticated or 'rolled'. Semi-invasive/abrupt retouch at distal end,

possibly extending along lower left edge. **Ventral surface:** Unworked with striking platform still visible.

Aldro 49

90 ***End scraper*** (Type A i, Class 4) L=26mm and B=17mm. Patinated end scraper manufactured from a secondary flake. **Dorsal surface:** Two flake scars at left side of proximal end from blade-like flakes struck to reduce striking platform. Semi-invasive/abrupt retouch at distal end, possibly extending along lower right edge. **Ventral surface:** Unworked with poorly defined bulb of percussion and striking platform.

Painsthorpe Wold 98

187 ***End scraper*** (Type A ii, Class 5) L=23mm and B=30mm. Short end scraper manufactured on a crude secondary flake. **Dorsal surface:** Shallow flake struck from left edge to remove 'cortex'. Right edge crushed and weathered. Semi-invasive retouch at distal end. **Ventral surface:** Unworked with partially corticated striking platform still visible. Possible thermal fracture at distal end.

193 ***End scraper*** (Type A i, Class 4) L=28mm and B=18mm. End scraper manufactured from secondary flake. **Dorsal surface:** Flake scar from one previous removal. Proximal end and left edge corticated. Semi-invasive/abrupt retouch at distal end. **Ventral surface:** Unworked with bulb of percussion and striking platform still visible.

Calais Wold 275

222 ***End scraper*** (Type A ii, Class 5) L=27mm and B=39mm. End scraper manufactured from a short squat tertiary flake. **Dorsal surface:** Crude flake scars from several previous removals. Fine semi-invasive retouch along left edge and at distal end, extending along lower right edge. **Ventral surface:** Unworked with striking platform still visible.

224 ***End scraper*** (Type A i, Class 5) L=22mm and B=29mm. End scraper manufactured from a short squat secondary flake. **Dorsal surface:** 'Blocky' surface with corticated striking platform. Fine semi-invasive retouch at distal end, extending along lower right edge. **Ventral surface:** Flake scar below striking platform from tangential flake, possibly struck to reduce bulb of percussion.

Riggs 20

282 ***End scraper*** (Type A ii, Class 4) L=35mm and B=33mm. Short end scraper manufactured from a tertiary flake. **Dorsal surface:** Four flake scars from previous removals. Abrupt retouch at distal end, extending along lower right edge. **Ventral surface:** Unworked with bulb of percussion still visible.

283 ***End scraper*** (Type A ii, Class 4) L=34mm and B=27mm. Short end scraper manufactured from a secondary flake. **Dorsal surface:** Two flakes struck from left edge to remove cortex. Semi-invasive/abrupt retouch at distal end. **Ventral surface:** Unworked.

290 ***End scraper*** (Type A i, Class 4) L=24mm and B=16mm. Long end scraper manufactured from a tertiary flake or core fragment. **Dorsal surface:** Two closely spaced offset ridges formed by flake scars from three previous removals. Abrupt retouch at distal end. **Ventral surface:** Unworked with striking platform still visible.

329 ***End scraper*** (Type A ii, Class 4) L=52mm and B=37mm. End scraper manufactured from a secondary flake. **Dorsal surface:** Irregular offset ridge formed by flake scar from two previous removals. Flake scar at distal end from an earlier removal. Left edge partially corticated. 'Notch' close to midpoint of right edge, suggesting that the scraper was hafted. Crude abrupt retouch at distal end. **Ventral surface:** Crude retouch along right edge, opposite 'notch'.

Side Scrapers

Painsthorpe Wold 98

191 ***Side scraper*** (Type D i, Class 6) L=64mm and B=37mm. Heavily patinated double side scraper manufactured from a secondary flake. **Dorsal surface:** Flake scars from two previous removals. Five shallow flakes struck from distal end and both edges. Abrupt retouch along both edges and at distal end. **Ventral surface:** Unworked with bulb of percussion and striking platform still visible.

Calais Wold 275

214 ***Side scraper*** (Type D i, Class 6?) L=46mm and B=24mm. Crude double side scraper manufactured from a secondary flake. **Dorsal surface:** Flake scar from one previous removal. Single flake struck from proximal end to reduce or remove striking platform.

Shallow scars along right edges, possibly from flakes struck to remove cortex. Distal end corticated. Possible abrupt retouch to left edge. **Ventral surface:** Unworked.

Riggs 20

281 ***Side scraper*** (Type D ii, Class 3) L=43mm and B=39mm. Double side scraper manufactured from a tertiary flake. **Dorsal surface:** Offset ridge formed by flake scars from two previous removals. Flake scar at proximal end from shallow flake struck to reduce striking platform. Semi-invasive retouch to left edge, lower right edge and at distal end. **Ventral surface:** Unworked.

310 ***?Side scraper*** (Type D ii?, Class 5) L=26mm and B=30mm. End or side scraper manufactured from an irregular secondary flake. **Dorsal surface:** Flake scars from three removals struck from a second (corticated) striking platform at the distal end of the right edge. Shallow flake scar at proximal end from flake struck to reduce striking platform. Left edge of distal end corticated. Abrupt retouch along left edge with a notch created by pressure flaking, possibly suggesting that the scraper was hafted. Abrupt retouch at distal end. **Ventral surface:** Flake scar at proximal end from a chip (parasitic?).

Disc Scrapers

Towthorpe 273 (Duggleby Howe)

23 ***Disc scraper*** (Type C, Class 7?) L=33mm and B=32mm. Burnt or heavily patinated circular scraper manufactured from a tertiary flake. **Dorsal surface:** Flake scar from previous removal or flake struck to reduce striking platform. Crude invasive retouch along right edge and at distal end. Possible abrupt retouch along upper left and upper right edges. **Ventral surface:** Diffuse scar at distal end, possibly from a flake struck to remove a hinge or step fracture. Similar removal from right edge of proximal end to reduce bulb of percussion. Striking platform still visible.

Aldro 116

111 ***Disc scraper*** (Type C, Class 5) L=38mm and B=44mm. Circular scraper manufactured from a short squat secondary flake or crude core. **Dorsal surface:** Flake scars from six previous removals (centripetal?). Semi-invasive or abrupt retouch along right edge. **Ventral surface:** Flake scar at midpoint of proximal end from a chip (parasitic?).

Aldro 30

88 ***Disc scraper*** (Type C, Class 5) L=36mm and B=41mm. Crude circular scraper manufactured from a short squat secondary flake. **Dorsal surface:** Flake scars at distal end from three crude removals. Right edge corticated. Abrupt retouch at distal end. Fine retouch along right edge. **Ventral surface:** Unworked.

Aldro C75

163 ***Disc scraper*** (Type C, Class 7?) L=31mm and B=36mm. Crude circular scraper manufactured from a secondary flake. **Dorsal surface:** Flake scars from six previous removals (centripetal?). Distal end partially corticated. Possible abrupt retouch at distal end. **Ventral surface:** Unworked with striking platform still visible.

Painsthorpe Wold 98

187 ***Thumbnail scraper*** (Type 3, Class 7) L=22mm and B=20mm. Small sub-circular scraper manufactured from a tertiary flake. **Dorsal surface:** Shallow flake scar at proximal end from removals struck to reduce striking platform. Fine semi-invasive retouch along left edge. Possible retouch at distal end, extending along lower right edge. **Ventral surface:** Unworked.

Calais Wold 275

229 ***Thumbnail scraper*** (Type C, Class 7) L=17mm and B=14mm. Small circular scraper manufactured from a tertiary flake. **Dorsal surface:** Flake scars from two previous removals. Shallow flake struck from proximal end to reduce striking platform. Fine semi-invasive retouch at distal end, extending along both edges. **Ventral surface:** Unworked with striking platform still visible.

274 ***?Disc scraper*** (Type C, Class 5?) L=33mm and B=49mm. Heavily patinated crude sub-circular scraper manufactured from a short squat secondary flake. **Dorsal surface:** Five crude flakes removed from distal end and both edges. Distal end corticated. **Ventral surface:** Unworked.

Riggs 20

277 ***?Discoidal scraper*** (Type C?, Class 9?) L=61mm and B=57mm. Heavily patinated crude circular scraper manufactured from a secondary flake or discoidal core. **Dorsal surface:** 'Blocky' surface at proximal end. Flake scars from three removals struck from

right edge, extending to centre of scraper. Crude semi-invasive retouch at distal end and along right edge. Possible abrupt retouch at distal end, extending along lower right edge. **Ventral surface:** Unworked.

Broken Scrapers

Towthorpe 273 (Duggleby Howe)

17 ***Broken scraper*** (Type E, Class 10) L=n/a and B=21mm. Double side scraper manufactured from a secondary flake. Distal end broken (fresh break?). **Dorsal surface:** Central ridge formed by flake scars from two previous removals. Flake scar at right side of proximal end from shallow flake struck to reduce striking platform. Right side of broken end corticated. Semi-invasive retouch along left edge. Semi invasive/abrupt retouch along right edge. **Ventral surface:** Three flake scars at left side of proximal end from crude removals. Abrupt retouch or abrasion along lower right edge – possible platform preparation for pressure flaking.

21 ***Broken scraper*** (Type E, Class 10) L=n/a and B=32mm. Extended end scraper manufactured from a tertiary flake. Proximal end broken. **Dorsal surface:** Abrupt/semi invasive retouch at distal end, extending a short distance along both sides. **Ventral surface:** Unworked.

Towthorpe 291

36 ***?Broken scraper*** (Type E, Class 10) L=n/a B=27mm. Possible fragment of scraper manufactured from a secondary flake. Proximal end broken. **Dorsal surface:** Distal end partially corticated. Possible abrupt retouch along lower right edge. **Ventral surface:** Flake scar at midpoint of broken edge from a chip (parasitic?).

Wharram Percy 46

74 ***?Broken scraper*** (Type E, Class 10) L=n/a and B=37mm. Fragment of scraper manufactured from a secondary flake, possibly re-used as an awl. Proximal end broken. **Dorsal surface:** 'Blocky' surface and striking platform. Shallow semi-invasive retouch along left edge. Abrupt retouch along left edge and broken edge, creating sharp point. **Ventral surface:** Unworked.

Aldro C75

173 ***Broken Scraper*** (Type E, Class 10) L=20mm and B=n/a. Lightly patinated extended end scraper manufactured from a tertiary flake. Left edge broken. **Dorsal surface:** Flake scars from three previous removals. Five shallow flakes removed from distal end and both edges. Abrupt retouch at distal end, extending along lower left and lower right margins. **Ventral surface:** Unworked with bulb of percussion and striking platform still visible.

Calais Wold 275

222 ***Broken scraper*** (Type E, Class 10) L=28mm and B=n/a. End scraper manufactured from a secondary flake. Left edge broken. **Dorsal surface:** Flake scars from two previous removals. Fine semi-invasive retouch at distal end. Possible abrupt retouch along right edge. **Ventral surface:** Unworked.

251 ***?Broken scraper*** (Type E, Class 10) L=n/a and B=35mm. Possible crude (proximal) end scraper manufactured from a secondary flake or core fragment. Distal end broken. **Dorsal surface:** Three parallel or diverging ridges formed by flake scars from four previous removals. Right edge corticated. Four shallow flakes struck from proximal end to reduce or remove striking platform. **Ventral surface:** Unworked with diffuse bulb of percussion.

Riggs 20

288 ***?Broken Scraper*** (Type E, Class 10) L=21mm and B=n/a. Possible (proximal) end scraper manufactured from a secondary flake. Left edge broken. **Dorsal surface:** Flake scars from two previous removals. Three shallow flakes struck from upper right edge. Pronounced flake scar at distal end of right edge from one further removal. Proximal end partially corticated. Abrupt retouch at proximal end, possible extending along upper right edge. **Ventral surface:** Unworked with corticated striking platform still visible.

297 ***Broken scraper*** (Type E, Class 10) L=21mm and B=n/a. Side scraper manufactured from a secondary flake. Right edge broken. **Dorsal surface:** Offset ridge formed by flake scars from two previous removals. Upper right (unbroken portion) corticated.

Abrupt retouch along left edge. **Ventral surface:** Unworked with hinge fracture still visible.

Other

Awls

Towthorpe 291

41 ***?Awl*** L=27mm and B=20mm. Possible awl or dihedral burin manufactured from a tertiary flake. **Dorsal surface:** Flake scars from four previous removals. Crude retouch at proximal end either side of striking platform. **Ventral surface:** Two flakes (burin spalls?) removed from both sides of proximal end, creating a narrow point. Point rounded by abrasion or crude retouch on dorsal surface.

Aldro 94

102 ***?Awl*** L=37mm and B=26mm. Crude awl manufactured from a broad tertiary flake. **Dorsal surface:** Flakes removed from the left edge and distal end, creating a narrow point. Both edges of point abraded or crudely retouched. **Ventral surface:** Unworked with pronounced bulb of percussion still visible.

Calais Wold 275

242 ***?Awl*** L=29mm and B=16mm. Possible awl manufactured from a flake struck from a discoidal core. **Dorsal surface:** Truncated flake scars at distal end and along right edge from four centripetal removals, characteristic of a flake struck from a discoidal core. Flake scars truncated by a single removal (recurrent) from the proximal end. Crude retouch at right side of distal end. Notch created at midpoint of right edge by pressure flaking, possibly suggesting that the implement was hafted. Slight 'notch' created on opposite edge by crude retouch. **Ventral surface:** Possible flake (burin spall?) struck from proximal end of right edge, creating a fine point.

Burins

Towthorpe 291

44 ***Micro-burin*** L=41mm and W=16mm. Double ended micro burin manufactured from the medial segment of a blade. **Dorsal surface:** Two diverging ridges formed by flake scars from previous removals. Blade segment produced by parallel fractures initiated by the creation of two notches (micro-burin technique), one at the distal end of the

left edge and the other at the proximal end of the right edge. Both edges abraded or crudely retouched. **Ventral surface:** Unworked.

46 ***Burin*** L=35mm and W=15mm. Burin manufactured from a possible blade. **Dorsal surface:** Central ridge formed by flake scars from two previous removals. Possible second ridge at left edge formed by the flake scar from a third removal. Burin spall struck from left side of distal end. Flake scar at left edge of distal end from an earlier burin blow, indicating that the instrument had been sharpened. Possible 'notch' created along the right edge by the removal of a single flake or chip, suggesting that the burin might have been hafted. **Ventral surface:** Unworked with bulb of percussion still visible.

Aldro C75

158 ***Burin*** L=51mm and B=28mm. Dihedral burin manufactured from a broken discoidal core. **Dorsal surface:** Truncated flake scars along right edge from three centripetal removals. Flake scars truncated by a single removal (preferential?) from the proximal end. Left edge broken. **Ventral surface:** Flake scars along left edge and at proximal end from three previous removals. Burin spalls removed from both sides of the distal end, creating a sharp point. Flake scar from right (broken) edge terminates in step fracture.

Calais Wold 275

212 ***?Burin*** L=34mm and B=17mm. Possible dihedral burin manufactured from the medial segment of a blade. **Dorsal surface:** Two parallel ridges formed by flake scars from previous removals. Flake scar at distal end from an earlier removal. Two flakes (burin spalls?) removed from both sides of distal end, creating a fine point. Left side of proximal end fractured. Right side of proximal end blunted by crude retouch, possibly indicating that the implement was hafted. Right edge finely serrated. **Ventral surface:** Unworked.

217 ***Burin*** L=48mm and B=19mm. Burin manufactured from a possible blade. **Dorsal surface:** Two diverging ridges formed by flake scars from three previous removals. Abrasion or crude retouch along right edge. **Ventral surface:** Bulb of percussion and

crushed striking platform still visible. Burin spall removed from right edge of distal end, creating a narrow point.

227 ***?Burin*** L=23mm and B=34mm. Possible burin manufactured from a crude secondary flake. **Dorsal surface:** Flake scar at right side of proximal end from one previous removal. Striking platform crushed and weathered. Distal end corticated. Flake (burin spall?) removed from left side of proximal end, creating a sharp point. **Ventral surface:** Unworked with bulb of percussion and striking platform still visible.

231 ***?Burin*** L=47mm and B=16mm. Possible burin manufactured from a possible blade. **Dorsal surface:** Offset ridge formed by flake scars from two previous removals. Flake scar at distal end from an earlier removal. Right edge corticated. Abrasion or crude retouch at left side of distal end, extending along lower left edge. **Ventral surface:** Flake (burin spall?) removed from left edge of distal end, creating a narrow point.

267 ***Burin*** L=42mm and B=20mm. Dihedral burin manufactured from a possible blade. **Dorsal surface:** Two truncated parallel ridges formed by flake scars from three previous removals. Ridges truncated by a flake struck at an oblique angle from the same striking platform. Flake (burin spall?) removed from right side of proximal end. Abrasion or crude retouch along right edge. **Ventral surface:** Two flakes (burin spalls) removed from both sides of distal end, creating a fine point.

Riggs 20

280 ***?Burin*** L=42mm and B=11mm. Burin or awl manufactured from a fine blade. **Dorsal surface:** Central ridge formed by flake scars from two previous removals. Flake (burin spall) removed from right side of distal end, creating a sharp point. Right side of distal end retouched, with retouch extending along lower right edge. 'Notch' created along right edge by the removal of a single flake or chip, possibly suggesting that the implement was hafted. Right edge abraded above 'notch'. **Ventral surface:** Unworked with striking platform still visible.

317 ***?Burin*** L=60mm and B=19mm. Possible burin or fabricator manufactured from a crude blade. **Dorsal surface:** Truncated offset ridge formed by flake scars from two previous removals. Ridge truncated by a crude removal struck from the left edge of the same striking platform. Flake scars at proximal end from two earlier removals.

Flake (burin spall?) removed from right side of distal end, creating a narrow point. Crude retouch along left edge, with a slight 'step' opposite the terminal of the flake scar from the possible burin blow. **Ventral surface:** Unworked with striking platform still visible.

Fabricators

Towthorpe 273 (Duggleby Howe)

16 ***Fabricator*** L=60mm and B=17mm. Fabricator or punch manufactured from a crude secondary flake. **Dorsal surface:** Proximal end and upper right edge partially corticated. Several poorly defined removals from left edge. Two shallow flakes removed from lower right edge. Semi invasive retouch along left edge of dorsal surface. Abrasion or crude retouch at distal end. **Ventral surface:** Seven removals from left edge. Abrasion or crude retouch at distal end.

Leaf Points

Towthorpe 291

25 **?Leaf point** L=106mm and B=48mm (Mortimer 1905, Figure41b). Possible rough out for a large leaf point. Base of rough out broken. **Face I:** Partially corticated. Evidence of thinning and/or cortex removal with one shallow flake struck from the left edge and four shallow removals from the right edge, extending to the centre of the leaf point. Possible evidence of second stage of thinning with seven further removals from the left edge. Semi-invasive retouch along both edges. Abrupt retouch either side of rounded point. **Face II:** Partially corticated. Evidence of thinning or cortex removal with two shallow flakes struck from right edge. Flake scars from three removals from left edge. Semi-invasive retouch along left edge and lower right edge. Abrupt retouch either side of rounded point.

Polished Adzes

Towthorpe 273 (Duggleby Howe)

M ***Polished adze*** (Duggleby Type) L=244mm and B=64mm (Mortimer 1905, Figure56). Polished Duggleby adze. **Face I:** Evidence of thinning with six removals from the left edge and four removals from the right edge, extending to centre of adze. Possible second stage of thinning with three further removals from left edge. Semi-invasive retouch at proximal end and along both edges. Abrupt retouch at both sides of

proximal end, creating rounded corners. Distal end of adze polished on both faces. **Face II:** Not illustrated.

Retouched

Wharram Percy 46

80 ***Retouched flake*** L=27mm and B=23mm. Retouched secondary flake, possibly a crude blank for a transverse arrowhead. **Dorsal surface:** Central ridge formed by flake scars from two previous removals. Fine semi-invasive retouch at left side of distal end. **Ventral surface:** 'Blocky' texture. Corticated striking platform. Possible abrupt retouch at right side of distal end.

86 ***Retouched flake*** L=22mm and B=16mm. Retouched secondary flake, possibly a crude awl. **Dorsal surface:** Left edge corticated. Distal end 'crushed' and weathered. Proximal end abraded or crudely retouched, with an isolated 'point'. **Ventral surface:** Proximal end abraded.

Aldro 88

97 ***?Retouched core*** L=31mm and B=36mm. Retouched angular shatter or crude flake core. **Dorsal surface:** Angular piece of flint with flake scars from six previous removals. Crude retouch along one edge. **Ventral surface:** 'Crushed' and weathered. Flake scar from a single removal (accidental?) with a pronounced hinge fracture.

Aldro C75

155 ***Retouched flake*** L=48mm and B=27mm. Retouched secondary flake, possibly a crude borer. **Dorsal surface:** Left side of proximal end partially corticated. Flake scars from three previous removals. Abrupt retouch at distal end, creating sharp point. **Ventral surface:** Unworked with striking platform still visible.

167 ***?Retouched flake*** L=61mm and B=37mm. Retouched primary flake. **Dorsal surface:** Corticated surface. Crude retouch along left edge. **Ventral surface:** unworked with bulb of percussion and corticated striking platform still visible.

168 ***Retouched flake*** L=33mm and B=40mm. Retouched primary flake. **Dorsal surface:** Corticated surface. Abrupt retouch along upper right edge. Possible retouch at distal end. **Ventral surface:** Possible retouch along upper left and upper right edges.

171 ***Retouched flake*** L=36mm and B=41mm. Retouched tertiary flake, possibly a crude leaf shaped arrowhead. **Dorsal surface:** Two truncated parallel or slightly diverging ridges formed by flake scars from three previous removals. Ridges truncated by two shallow removals struck from proximal end to reduce the striking platform. Abrasion or crude retouch at proximal end. Semi-invasive retouch along left edge. Fine retouch at distal end and along right edge, creating sharp point. **Ventral surface:** Flake scar at proximal end from a single removal (parasitic?). Fine semi-invasive retouch at left edge of distal end and along lower left edge, creating sharp point.

172 ***?Retouched blade*** L=59mm and B=22mm. Retouched blade. **Dorsal surface:** three possible ridges formed by flake scars from three previous removals. Ridges truncated by flake scars from removal struck from proximal end of right edge and several shallow removals from distal end of both edges. Abrupt retouch or pressure flaking along both edges and at distal end. **Ventral surface:** unworked.

Acklam Wold 211

178 ***Retouched flake*** L=44mm and B=24mm. Retouched secondary flake, possibly a borer. **Dorsal surface:** Flake scars from two previous removals. Shallow flake scar at proximal end from removal struck to reduce the striking platform. Semi-invasive/abrupt retouch along upper left edge. Right edge broken. **Ventral surface:** Overshot flake removing base of core, with flake scars from two previous removals. Two flakes (burin spalls?) removed from distal end, creating a narrow point.

183 ***Retouched flake*** L=40mm and B=25mm. Retouched secondary flake. **Dorsal surface:** Left edge and striking platform 'crushed' and weathered. Flake scars from two previous removals. Several shallow removals from distal end. Possible retouch at proximal end. **Ventral surface:** Unworked with striking platform still visible.

Calais Wold 275

226 ***Retouched flake*** L=31mm and B=49mm. Retouched secondary flake. **Dorsal surface:** Irregular flake with a flake scar from one previous removal. Fine retouch along upper left edge. **Ventral surface:** Unworked.

248 ***Retouched flake*** L=36mm and B=25mm. Retouched secondary flake, possibly a crude blank for a barbed and tanged arrowhead. **Dorsal surface:** Two ridges formed by flake

scars from three previous removals. Flake scar at distal end from an earlier (opposed) removal. Crude retouch along left edge, with possible 'notch' created at left side of distal end. **Ventral surface:** Unworked with striking platform still visible.

Riggs 20

276 ***Retouched flake*** L=20mm and B=25mm. Retouched secondary flake, possibly a crude chisel-shaped arrowhead. **Dorsal surface:** Two offset ridges formed by flake scars from three previous removals from right side of striking platform. Pronounced flake scar from a single removal struck from the right edge (primary flake edge?) to reduce the striking platform. Distal end weathered. **Ventral surface:** Unworked.

Serrated

Towthorpe 18

4 ***Serrated flake*** L=53mm and B=19mm. Serrated secondary flake. **Dorsal surface:** Truncated central ridge formed by flake scars from two previous removals, one of which terminated in a step fracture. Ridge truncated by flake struck from proximal end to reduce striking platform. Lower right edge corticated. Flake scar at distal end from an earlier removal. Corticated 'notches' along upper left and lower right edges. Upper right edge finely serrated. **Ventral surface:** Unworked.

7 ***?Serrated Blade*** L=33mm and B=10mm. Serrated blade. **Dorsal surface:** Two convergent ridges formed by flake scars from three previous removals. Left ridge truncated by a flake scar from a removal terminating in a pronounced hinge fracture (mis-hit?). Right edge finely serrated. **Ventral Surface:** Unworked.

8 ***Serrated Blade*** L=39mm and B=10mm. Serrated blade. **Dorsal surface:** Two parallel ridges formed by flake scars from three previous removals. Left ridge truncated by a flake scar from a chip (parasitic?). Flake scar at midpoint of blade from an earlier removal. Left edge finely serrated. Slight curvature. **Ventral Surface:** Unworked.

9 ***Serrated Blade*** L=36mm and B=13mm. Partially corticated serrated blade. **Dorsal surface:** Offset ridge formed by flake scars from two previous removal. Ridge truncated by a flake scar from a shallow removal from the same striking platform. Left

edge of flake scar central to striking platform. Distal end of blade corticated. Left edge finely serrated. **Ventral Surface:** Unworked.

10 ***?Serrated Blade*** L=39mm and B=13mm. Serrated blade. **Dorsal surface:** Offset ridge formed by flake scars from previous removals. Right edge finely serrated. **Ventral Surface:** Unworked.

11 ***Serrated flake*** L=32mm and B=24mm. Serrated secondary flake, refitting to secondary flake 12. **Dorsal surface:** Upper left edge and lower right edge corticated. Flake scar from one previous removal. Flake struck from right side of distal end. Distal end finely serrated. **Ventral surface:** Unworked with diffuse bulb of percussion still visible.

13 ***Serrated flake*** L=52mm and B=23mm. Serrated secondary flake. **Dorsal surface:** Distal end of left edge partially corticated. Central ridge formed by flake scar from two previous removals. Second ridge at distal end of right edge from a third removal from the same striking platform. Two flake scars from (opposed) removals from the distal end. Overshot flake (rejuvenation flake?) struck to remove base of core. Proximal end of right edge finely serrated. **Ventral surface:** Unworked.

Towthorpe 273

18 ***Serrated blade*** L=46mm and B=16mm. Heavily patinated serrated blade. **Dorsal surface:** Three parallel ridges formed by flake scars from four previous removals. Central ridge truncated by a scar from a flake struck in the opposite direction, suggesting that the blade was struck from either an opposed platform or bipolar core. Lower left edge serrated. Possible abrasion or abrupt retouch along right edge. **Ventral Surface:** Unworked.

22 ***Serrated blade (segment)*** L=n/a and B=12mm. Medial segment of serrated blade. **Dorsal surface:** Two divergent ridges formed by flake scars from three previous removals. Both edges serrated. Left edge slightly concave. **Ventral Surface:** Unworked.

Aldro C75

120 ***Serrated blade*** L=49mm and B=13mm. Serrated blade. **Dorsal surface:** Truncated central ridge formed by flake scars from two previous removals. Ridge truncated by a further removal from the same striking platform. Two flakes scars at distal end of blade from earlier removals. Distal end of left edge finely serrated. Mid section of right edge abruptly retouched or abraded. Slight notches were noted on both edges, above the serration and retouch, suggesting that the blade was hafted. **Ventral surface:** Unworked.

133 ***Serrated flake*** L=49mm and B=14mm. Serrated flake. **Dorsal surface:** Offset ridge formed by flake scars from two previous removals. Truncated flake scar from a third removal from the same striking platform, terminating in a pronounced step fracture. Flake scar terminated by two shallow removals from right side of proximal end. Flake scars at distal end from two earlier removals. Mid section of right edge finely serrated. **Ventral surface:** Unworked.

O ***Serrated blade*** L=71mm and B=21mm {Mortimer 1905, Fig.158}. Serrated blade. **Dorsal surface:** Two intersected ridges formed by flake scars from three previous removals. Flakes scars at distal end of blade from two earlier removals. Right edge serrated. **Ventral surface:** Not illustrated.

Aldro 94

101 ***?Serrated blade*** L=38mm and B=16mm. Serrated blade. **Dorsal surface:** Central ridge formed by flake scars from two previous removals. Left edge serrated. ***Ventral surface:*** Unworked.

Acklam Wold 211

179 ***?Serrated blade*** L=52mm and B=19mm. Possible serrated blade. **Dorsal surface:** Two truncated oblique ridges formed by flake scars from three previous removals. Ridges truncated by a flake scar from a removal from the same striking platform. Left edge and distal end possibly serrated. **Ventral surface:** Unworked.

Calais Wold 275

211 ***Serrated Blade*** L=38mm and B=15mm. Serrated blade. **Dorsal surface:** Two parallel ridges formed by flake scars from three previous removals, one of which terminated

in a hinge fracture. Flake scar at distal end from one earlier removal. Both edges serrated. One removal opposed to platform. **Ventral surface:** Unworked.

Riggs 20

278 ***Serrated blade*** L=44mm and B=15mm. Serrated blade or fragment of blade core. **Dorsal surface:** Three diverging ridges formed by flake scars from previous removals. Flake scar at distal end from an earlier removal from the same striking platform. Left edge serrated. **Ventral surface:** Unworked.

318 ***Serrated blade*** L=43mm and B=12mm. Serrated blade. **Dorsal surface:** Central ridge formed by edge of flake scar from two previous removals. Flake scar from a chip removed from right edge of striking platform. Left edge serrated. Right edge corticated. **Ventral surface:** Right edge serrated.

Characteristics of the lithic debitage from the Neolithic burial mounds

Cores

ID	Sub Group	Source	Colour	Reuse	Cortication	Condition	L	B	T	Intensity	Volume	Regularity	Platform
14	Other	-	Brown (Dark)	-	3	Abraded	61.78	112.53	55.08	4	382921.86	57.45	Trimmed
26	Polyhedral	-	Grey (Dark)	-	3	Fresh	34.64	29.20	25.02	5	25307.43	9.62	-
31	Polyhedral reused	-	Grey (Mid)	Yes	6	Fresh	23.13	31.97	27.53	10	20357.50	4.44	Trimmed
66	Polyhedral	-	Grey (Light)	-	3	Patinated	62.28	57.05	44.17	5	156939.28	18.11	-
67	Polyhedral	-	Brown (Light)	-	5	Fresh	52.39	47.79	32.35	7	80995.28	20.04	-
68	Other	-	White	-	3	Fresh	38.74	54.23	35.47	6	74517.87	18.76	-
71	Polyhedral	-	Brown (Light)	-	6	Fresh	35.84	38.61	15.72	8	21753.06	22.89	Trimmed
105	Single platform	-	Grey (Mid)	-	3	Fresh	48.34	42.74	23.59	10	48738.16	24.75	Trimmed
142	Single platform	-	Grey (Mid)	-	7	Patinated	40.89	27.10	13.86	14	15358.53	27.03	-
185	Polyhedral	-	Grey (Dark)	-	5	Abraded	28.69	31.56	21.45	15	19422.04	10.11	Trimmed
199	Polyhedral reused	Tabular	Grey (Mid)	Yes	3	Fresh	35.42	39.46	20.09	10	28079.25	19.37	Trimmed
200	Opposed platform	-	Grey (Mid)	-	5	Fresh	26.09	31.79	17.30	13	14348.64	14.49	-
201	Polyhedral	-	Grey (Mid)	-	5	Fresh	27.07	21.24	23.83	11	13701.46	5.83	-
202	Polyhedral reused	-	Grey (Mid)	Yes	5	Fresh	36.88	23.81	24.71	15	21698.17	13.07	-
203	Polyhedral reused	Tabular	Grey (Mid)	Yes	5	Patinated	34.03	31.85	24.06	11	26077.56	9.97	-
204	Polyhedral reused	Tabular	Grey (Mid)	Yes	5	Fresh	34.08	25.81	21.81	13	19184.18	12.27	-
256	Polyhedral	-	Grey (Dark)	-	5	Fresh	37.62	29.09	18.23	7	19950.29	19.39	-
328	Polyhedral	-	Grey (Light)	-	6	Broken	46.73	37.28	39.60	16	68986.94	9.45	-

Other

Morphology

ID	Group	Sub Group	Source	Colour	Reuse	Cortication	Condition	Platform	EPA	Termination	Removals	Directions	Pattern
5	Flake	Cortical	-	Grey (Dark)	-	6	Fresh	Crushed	80	Feathered	4	2	Opposed
12	Flake	Cortical	-	Grey (Dark)	-	2	Fresh	Trimmed	80	Stepped	2	1	n/a
19	Blade	Non-cortical	-	Brown (Light)	-	7	Patinated	Abraded	85	Overshot	2	1	n/a
20	Blade	Non-cortical	-	Grey (Mid)	-	7	Burnt	Crushed	80	Stepped	5	1	Parallel
24	Flake	Cortical	-	Grey (Mid)	-	5	Burnt	Trimmed	80	Feathered	3	1	Irregular
27	Flake	Cortical	-	Grey (Light)	-	4	Fresh	Abraded	80	Hinged	3	2	Irregular
28	Flake	Cortical	-	Grey (Light)	-	4	Abraded	None	100	Stepped	2	1	n/a
29	Flake	Non-cortical	-	Grey (Light)	-	7	Patinated	Abraded	75	Stepped	2	1	n/a
30	Flake	Cortical	-	Grey (Mid)	-	6	Fresh	Crushed	80	Feathered	3	2	Irregular
32	Flake	Cortical	-	Grey (Mid)	-	6	Fresh	Abraded	80	Stepped	3	2	Irregular
34	Flake	Non-cortical	-	Grey (Light)	-	7	Fresh	None	0	Overshot	6	2	Opposed
35	Flake	Cortical	-	Grey (Mid)	-	2	Fresh	Crushed	85	Stepped	2	1	n/a
37	Flake	Cortical	-	Grey (Light)	-	6	Fresh	Trimmed	80	Feathered	3	1	Irregular
38	Flake	Cortical	-	Grey (Mid)	-	3	Abraded	Crushed	80	Feathered	1	1	None
39	Flake	Non-cortical	-	Grey (Mid)	-	7	Fresh	None	85	Stepped	3	1	Parallel
40	Flake	Cortical	-	Grey (Dark)	-	5	Abraded	Crushed	75	Feathered	2	1	n/a
42	Flake	Cortical	-	Grey (Mid)	-	4	Fresh	Trimmed	100	Feathered	2	1	n/a
43	Flake	Non-cortical	-	Black	-	7	Fresh	Crushed	80	Overshot	5	1	Parallel
47	Flake	Non-cortical	-	Black	-	7	Fresh	Trimmed	85	Stepped	3	1	Parallel
48	Flake	Broken	-	Grey (Mid)	-	6	Broken	Crushed	80	-	2	1	n/a
49	Flake	Cortical	-	Grey (Light)	-	6	Fresh	Trimmed	85	Feathered	2	1	n/a
50	Flake	Non-cortical	-	Black	-	7	Fresh	Crushed	0	Feathered	1	1	None
51	Flake	Fragment	-	Brown (Light)	-	6	Broken	-	80	Hinged	3	1	Parallel
52	Flake	Cortical	-	Grey (Dark)	-	5	Abraded	Corticated	85	Feathered	1	1	None
53	Flake	Fragment	-	Grey (Light)	-	3	Broken	-	80	Stepped	1	1	None

ID	Group	Sub Group	Source	Colour	Reuse	Cortication	Condition	Platform	EPA	Termination	Removals	Directions	Pattern
70	Flake	Cortical	-	Grey (Light)	-	4	Patinated	Isolated	80	Feathered	2	2	n/a
72	Shatter	Debris	-	Grey (Mid)	-	3	Fresh	-	0	-	3	2	Irregular
73	Flake	Cortical	-	Grey (Mid)	-	6	Fresh	Trimmed	75	Feathered	4	2	Centripetal
75	Flake	Cortical	-	Grey (Dark)	-	2	Fresh	Trimmed	80	Stepped	1	1	None
77	Blade	Cortical	-	Grey (Light)	-	6	Abraded	Crushed	85	Overshot	3	1	Parallel
78	Flake	Cortical	-	Grey (Mid)	-	6	Fresh	Abraded	0	Hinged	2	1	n/a
79	Flake	Non-cortical	-	Grey (Mid)	-	7	Fresh	Crushed	75	Feathered	4	1	Parallel
81	Blade	Non-cortical	-	Grey (Light)	-	7	Abraded	Abraded	80	Overshot	4	1	Parallel
82	Shatter	Debris	-	Grey (Light)	-	5	Fresh	-	0	-	6	2	Irregular
83	Flake	Cortical	-	Grey (Mid)	-	6	Fresh	Trimmed	80	Overshot	3	1	Parallel
84	Shatter	Debris	-	Grey (Dark)	-	6	Fresh	-	0	-	3	1	Irregular
85	Flake	Cortical	-	Grey (Mid)	-	3	Fresh	Crushed	90	Stepped	1	1	None
87	Flake	Cortical	-	Grey (Dark)	-	5	Fresh	Abraded	80	Overshot	2	1	n/a
91	Flake	Cortical	-	Grey (Light)	-	4	Patinated	None	100	Overshot	4	2	Irregular
94	Blade	Cortical	-	Grey (Mid)	-	6	Fresh	Trimmed	85	Overshot	4	1	Parallel
95	Blade	Cortical	-	Grey (Mid)	-	6	Fresh	Abraded	85	Feathered	4	1	Parallel
96	Blade	Fragment (crested)	-	Grey (Mid)	-	7	Broken	-	0	Feathered	2	2	n/a
98	Shatter	Debris	-	Grey (Light)	-	3	Abraded	-	0	-	8	2	Irregular
99	Flake	Cortical	-	Grey (Mid)	-	3	Patinated	Trimmed	70	Feathered	1	1	None
103	Flake	Non-cortical	-	Grey (Light)	-	7	Fresh	Trimmed	90	Feathered	5	1	Parallel
104	Blade	Segment	-	Grey (Mid)	-	7	Broken	-	0	Feathered	3	1	Parallel
106	Flake	Non-cortical	-	White	-	7	Fresh	Trimmed	65	Hinged	3	1	Irregular
107	Flake	Non-cortical	-	Grey (Mid)	-	7	Fresh	Isolated	80	Overshot	4	1	Parallel
109	Flake	Fragment	-	Grey (Mid)	-	0	Broken	-	0	Hinged	0	0	None
115	Blade	Fragment	-	Grey (Mid)	-	6	Broken	-	0	Feathered	2	1	n/a
116	Flake	Cortical	-	Grey (Dark)	-	4	Patinated	Abraded	75	Stepped	3	1	Parallel
117	Flake	Cortical	-	Grey (Mid)	-	5	Patinated	Abraded	75	Feathered	3	1	Parallel
118	Flake	Cortical	-	Grey (Dark)	-	5	Patinated	Isolated	80	Overshot	4	1	Irregular

ID	Group	Sub Group	Source	Colour	Reuse	Cortication	Condition	Platform	EPA	Termination	Removals	Directions	Pattern
119	Blade	Fragment	-	Grey (Mid)	-	6	Broken	-	0	Feathered	3	1	Parallel
121	Blade	Cortical	-	Grey (Dark)	-	5	Patinated	Isolated	80	Stepped	4	1	Parallel
122	Blade	Cortical	-	Grey (Dark)	-	6	Patinated	Trimmed	75	Overshot	7	1	Parallel
123	Flake	Cortical	-	Grey (Dark)	-	6	Patinated	Abraded	75	Feathered	3	2	Parallel
124	Flake	Non-cortical	-	Grey (Mid)	-	7	Patinated	Abraded	80	Feathered	4	1	Opposed
125	Flake	Cortical	-	Grey (Mid)	-	5	Patinated	None	75	Feathered	3	1	Parallel
126	Flake	Cortical	-	Grey (Dark)	-	4	Patinated	Abraded	70	Feathered	3	2	Parallel
127	Flake	Cortical	-	Grey (Dark)	-	6	Patinated	Isolated	80	Stepped	3	1	Irregular
128	Flake	Cortical	-	Grey (Mid)	-	5	Patinated	Isolated	80	Overshot	5	1	Irregular
129	Flake	Non-cortical	-	Grey (Mid)	-	7	Patinated	Crushed	80	Overshot	2	2	n/a
130	Flake	Non-cortical	-	Grey (Mid)	-	7	Patinated	None	80	Stepped	4	1	Parallel
131	Flake	Cortical	-	Grey (Mid)	-	5	Patinated	Trimmed	80	Overshot	2	1	n/a
132	Flake	Cortical	-	Grey (Light)	-	4	Patinated	Isolated	80	Feathered	4	1	Parallel
134	Blade	Non-cortical	-	Grey (Mid)	-	7	Patinated	Abraded	80	Overshot	3	1	Parallel
135	Flake	Cortical	-	Grey (Mid)	-	6	Patinated	Abraded	75	Stepped	3	1	Parallel
136	Flake	Non-cortical	-	Grey (Dark)	-	7	Patinated	Isolated	80	Feathered	3	1	Parallel
137	Flake	Non-cortical	-	Grey (Dark)	-	7	Patinated	None	85	Stepped	4	1	Parallel
138	Flake	Cortical	-	Grey (Dark)	-	5	Patinated	Corticated	75	Feathered	4	2	Parallel
139	Flake	Fragment	-	Grey (Mid)	-	6	Broken	-	0	Feathered	3	1	Parallel
140	Flake	Non-cortical	-	Grey (Mid)	-	7	Fresh	Abraded	75	Feathered	5	2	Irregular
141	Flake	Cortical	-	Grey (Mid)	-	5	Patinated	Abraded	80	Overshot	3	1	Parallel
143	Flake	Broken	-	Grey (Mid)	-	7	Broken	Trimmed	80	-	1	1	None
144	Flake	Non-cortical	-	Grey (Mid)	-	7	Patinated	Isolated	80	Stepped	3	1	Irregular
145	Flake	Broken	-	Grey (Mid)	-	6	Broken	Abraded	80	-	1	1	None
146	Flake	Cortical	-	Grey (Mid)	-	4	Patinated	Trimmed	75	Hinged	3	2	Irregular
147	Flake	Cortical	-	Grey (Mid)	-	6	Patinated	Corticated	85	Feathered	1	1	None
148	Flake	Fragment	-	Grey (Dark)	-	6	Broken	-	0	Feathered	6	3	Irregular
149	Flake	Cortical	-	Grey (Mid)	-	6	Patinated	Trimmed	80	Feathered	4	1	Irregular
150	Flake	Cortical	-	Grey (Mid)	-	6	Patinated	Abraded	80	Stepped	1	1	None

ID	Group	Sub Group	Source	Colour	Reuse	Cortication	Condition	Platform	EPA	Termination	Removals	Directions	Pattern
151	Flake	Cortical	-	Grey (Mid)	-	5	Patinated	Isolated	85	Feathered	3	2	Centripetal
152	Blade	Segment	-	Grey (Mid)	-	7	Broken	-	0	Feathered	2	1	n/a
153	Flake	Fragment	-	Grey (Mid)	-	6	Broken	-	0	Stepped	2	1	n/a
154	Flake	Non-cortical	-	Grey (Mid)	-	7	Patinated	Isolated	80	Overshot	5	2	Opposed
156	Flake	Non-cortical	-	Grey (Mid)	-	7	Fresh	Isolated	75	Hinged	3	1	Centripetal
157	Flake	Fragment	-	Grey (Dark)	-	5	Broken	-	0	Overshot	4	1	Irregular
159	Flake	Non-cortical	-	Grey (Mid)	-	7	Fresh	Trimmed	80	Hinged	2	1	n/a
160	Flake	Cortical	-	Grey (Mid)	-	6	Burnt	Isolated	80	Overshot	2	1	n/a
161	Flake	Fragment	-	Grey (Mid)	-	7	Broken	-	85	Overshot	5	1	Parallel
162	Shatter	Debris	-	Grey (Mid)	-	6	Burnt	-	0	-	8	1	Irregular
164	Flake	Non-cortical	-	Grey (Mid)	-	6	Fresh	Isolated	85	Feathered	2	1	n/a
166	Flake	Cortical	-	Grey (Dark)	-	3	Fresh	Isolated	80	Stepped	3	1	Parallel
176	Flake	Cortical	-	Grey (Mid)	-	6	Fresh	Trimmed	80	Overshot	7	1	Parallel
180	Flake	Cortical	-	Black	-	5	Fresh	Isolated	85	Feathered	4	2	Irregular
181	Shatter	Debris	-	Grey (Dark)	-	5	Fresh	-	0	-	3	1	Irregular
182	Flake	Non-cortical	-	Grey (Mid)	-	7	Fresh	None	0	Feathered	8	4	Centripetal
184	Flake	Cortical	-	Brown (Light)	-	6	Fresh	Abraded	75	Overshot	2	1	n/a
195	Flake	Cortical	-	White	-	1	Abraded	None	0	Feathered	0	0	None
196	Shatter	Debris	-	Grey (Mid)	-	6	Fresh	-	0	-	2	1	n/a
197	Flake	Non-cortical (crested)	-	Grey (Mid)	-	7	Patinated	None	75	Feathered	4	3	Opposed
198	Flake	Non-cortical	-	Grey (Mid)	-	7	Fresh	Trimmed	70	Feathered	3	3	Irregular
205	Flake	Non-cortical (rejuvenation)	-	Grey (Dark)	-	7	Fresh	Trimmed	85	Overshot	7	2	Opposed
206	Flake	Cortical	Gravel	Grey (Mid)	-	3	Rolled	Abraded	80	Overshot	2	1	n/a
207	Blade	Non-cortical	-	Grey (Mid)	-	7	Fresh	Trimmed	75	Stepped	4	1	Parallel
208	Blade	Non-cortical	-	Grey (Mid)	-	7	Patinated	Abraded	75	Feathered	4	2	Parallel
209	Blade	Non-cortical	-	Grey (Mid)	-	7	Fresh	None	80	Feathered	3	1	Parallel
210	Blade	Non-cortical	-	Grey (Mid)	-	7	Fresh	Abraded	85	Feathered	3	1	Parallel

ID	Group	Sub Group	Source	Colour	Reuse	Cortication	Condition	Platform	EPA	Termination	Removals	Directions	Pattern
213	Flake	Cortical	-	Grey (Mid)	-	5	Patinated	Crushed	85	Feathered	3	2	Centripetal
215	Flake	Non-cortical (rejuvenation)	-	Grey (Mid)	-	7	Fresh	None	80	Hinged	5	1	Irregular
216	Flake	Non-cortical	-	Grey (Dark)	-	7	Fresh	Faceted	100	Feathered	3	2	Irregular
218	Flake	Cortical	-	Grey (Mid)	-	5	Fresh	None	80	Hinged	2	1	n/a
219	Flake	Non-cortical	-	Grey (Dark)	-	7	Fresh	Trimmed	75	Stepped	4	1	Parallel
225	Flake	Non-cortical	-	Grey (Light)	-	7	Fresh	Isolated	75	Feathered	3	2	Centripetal
228	Shatter	Debris	-	Grey (Mid)	-	5	Fresh	Crushed	0	-	5	3	Irregular
230	Flake	Cortical	-	Grey (Mid)	-	5	Fresh	None	0	Overshot	4	1	Parallel
232	Flake	Cortical	-	Grey (Dark)	-	5	Patinated	Abraded	80	Overshot	4	2	Opposed
233	Shatter	Debris	-	Grey (Dark)	-	3	Fresh	-	0	-	5	2	Irregular
234	Flake	Non-cortical	-	White	-	7	Patinated	Crushed	85	Hinged	4	1	Centripetal
235	Flake	Non-cortical	-	Grey (Light)	-	7	Fresh	Crushed	80	Feathered	3	2	Irregular
236	Flake	Cortical	-	Grey (Dark)	-	3	Fresh	Corticated	75	Stepped	4	2	Irregular
237	Flake	Cortical	-	Grey (Dark)	-	4	Fresh	None	85	Stepped	1	1	None
238	Flake	Cortical	-	Grey (Dark)	-	5	Fresh	Crushed	80	Feathered	3	1	Parallel
239	Flake	Non-cortical	-	White	-	7	Patinated	None	80	Feathered	3	1	Parallel
240	Flake	Cortical	-	Grey (Dark)	-	2	Fresh	Abraded	75	Overshot	2	1	n/a
241	Flake	Non-cortical	-	Grey (Light)	-	7	Fresh	Trimmed	70	Feathered	2	1	n/a
243	Shatter	Debris	-	Grey (Light)	-	7	Fresh	-	0	-	3	2	Irregular
244	Flake	Cortical	-	Grey (Mid)	-	5	Fresh	None	80	Hinged	2	1	n/a
245	Flake	Non-cortical	-	Brown (Light)	-	7	Patinated	Crushed	85	Hinged	1	1	None
246	Flake	Non-cortical	-	Grey (Mid)	-	7	Fresh	None	0	Feathered	1	1	None
247	Flake	Non-cortical	-	Grey (Light)	-	7	Fresh	Isolated	80	Feathered	3	1	Parallel
249	Flake	Fragment	-	Grey (Mid)	-	2	Broken	-	0	Feathered	2	1	n/a
250	Flake	Cortical	-	Grey (Mid)	-	6	Fresh	Crushed	75	Overshot	6	5	Centripetal
252	Blade	Non-cortical	-	Grey (Mid)	-	7	Fresh	Isolated	85	Hinged	3	1	Parallel
253	Flake	Non-cortical	-	Grey (Dark)	-	7	Fresh	Trimmed	80	Feathered	3	1	Parallel
254	Flake	Non-cortical	-	Grey (Light)	-	7	Fresh	Trimmed	70	Feathered	1	1	None

ID	Group	Sub Group	Source	Colour	Reuse	Cortication	Condition	Platform	EPA	Termination	Removals	Directions	Pattern
255	Flake	Cortical	-	Grey (Dark)	-	6	Fresh	Crushed	100	Hinged	1	1	None
257	Flake	Cortical	Gravel	Grey (Mid)	-	5	Rolled	Abraded	95	Overshot	0	0	None
258	Flake	Cortical	-	Grey (Mid)	-	2	Abraded	Crushed	80	Hinged	1	1	None
259	Flake	Cortical	-	Grey (Dark)	-	6	Fresh	Abraded	80	Feathered	2	1	n/a
260	Flake	Cortical	-	Grey (Dark)	-	6	Fresh	Abraded	45	Feathered	4	1	Parallel
261	Blade	Segment	-	Grey (Light)	-	5	Broken	-	0	-	4	1	Parallel
262	Flake	Non-cortical	-	Grey (Mid)	-	7	Abraded	Abraded	80	Feathered	2	1	n/a
263	Flake	Non-cortical	-	Grey (Mid)	-	7	Fresh	Trimmed	70	Hinged	3	1	Parallel
264	Flake	Cortical	-	Grey (Dark)	-	5	Fresh	None	80	Overshot	2	1	n/a
265	Flake	Fragment	-	Grey (Light)	-	7	Broken	-	0	Stepped	2	1	n/a
266	Flake	Fragment	-	Grey (Dark)	-	5	Broken/ Patinated	None	0	Overshot	2	1	n/a
268	Shatter	Debris	Gravel	Grey (Mid)	-	2	Rolled	-	0	-	3	2	Irregular
269	Flake	Cortical (rejuvenation)	-	Grey (Light)	-	6	Patinated	Crushed	80	Feathered	5	2	Irregular
270	Flake	Fragment	-	Grey (Light)	-	6	Broken	-	75	Feathered	3	1	Irregular
271	Flake	Non-cortical	-	Grey (Light)	-	7	Fresh	None	80	Hinged	4	1	Irregular
272	Flake	Non-cortical	-	Grey (Light)	-	7	Fresh	None	75	Feathered	3	1	Parallel
273	Shatter	Debris	-	Grey (Light)	-	6	Fresh	-	0	-	6	4	Irregular
275	Flake	Non-cortical	-	Grey (Light)	-	7	Patinated	None	0	Feathered	0	0	None
279	Blade	Non-cortical	-	Grey (Dark)	-	7	Fresh	Trimmed	85	Feathered	2	1	n/a
284	Flake	Fragment	-	Grey (Light)	-	7	Broken	None	0	Stepped	2	1	n/a
285	Flake	Cortical	-	Brown (Light)	-	6	Fresh	Isolated	85	Feathered	2	1	n/a
286	Shatter	Debris	Gravel	Grey (Light)	-	5	Rolled	-	0	-	4	2	Irregular
287	Flake	Cortical	-	Grey (Mid)	-	6	Fresh	Isolated	80	Stepped	4	1	Irregular
289	Flake	Cortical	-	Grey (Light)	-	7	Fresh	Crushed	90	Feathered	3	1	Irregular
291	Flake	Non-cortical	-	Grey (Mid)	-	7	Fresh	Abraded	80	Hinged	3	1	Irregular
292	Flake	Cortical	-	Grey (Mid)	-	4	Fresh	Trimmed	75	Hinged	2	1	n/a
293	Shatter	Debris	Gravel	Grey (Mid)	-	7	Rolled	-	0	-	5	3	Irregular

ID	Group	Sub Group	Source	Colour	Reuse	Cortication	Condition	Platform	EPA	Termination	Removals	Directions	Pattern
294	Shatter	Debris	-	Grey (Mid)	-	6	Fresh	None	0	-	4	3	Irregular
295	Flake	Cortical	-	Grey (Mid)	-	6	Fresh	Corticated	60	Overshot	5	3	Irregular
296	Flake	Fragment	-	Grey (Dark)	-	3	Fresh	Abraded	70	Stepped	2	1	n/a
298	Flake	Non-cortical	-	Grey (Dark)	-	7	Fresh	Abraded	80	Overshot	4	2	Irregular
299	Flake	Cortical	-	Grey (Mid)	-	6	Abraded	Abraded	80	Feathered	5	4	Irregular
300	Flake	Cortical	-	Grey (Mid)	-	2	Fresh	Corticated	0	Feathered	1	1	None
301	Flake	Non-cortical	-	Grey (Light)	-	7	Fresh	Crushed	75	Hinged	3	2	Irregular
302	Shatter	Debris	-	Grey (Light)	-	7	Fresh	-	0	-	3	1	Parallel
303	Flake	Cortical	-	Grey (Dark)	-	6	Fresh	Trimmed	60	Stepped	2	1	n/a
304	Flake	Cortical	-	Grey (Mid)	-	3	Patinated	Abraded	85	Stepped	1	1	None
305	Flake	Cortical	Gravel	Grey (Mid)	-	1	Rolled	Crushed	80	Overshot	0	0	None
306	Flake	Cortical	-	Grey (Mid)	-	6	Patinated	Isolated	85	Overshot	3	1	Parallel
307	Flake	Cortical	-	Grey (Mid)	-	2	Fresh	None	0	Stepped	1	1	None
308	Flake	Cortical	-	Grey (Light)	-	4	Patinated	Abraded	80	Feathered	2	1	n/a
309	Flake	Cortical (rejuvenation)	-	Brown (Light)	-	6	Fresh	Crushed	80	Feathered	2	1	n/a
311	Flake	Non-cortical	-	Grey (Mid)	-	7	Patinated	Crushed	80	Stepped	4	1	Parallel
312	Flake	Non-cortical	-	Grey (Light)	-	7	Patinated	None	80	Hinged	4	4	Centripetal
313	Flake	Fragment	-	Grey (Light)	-	7	Broken/ Patinated	None	0	Feathered	3	1	Irregular
314	Flake	Cortical	-	Grey (Dark)	-	6	Abraded	Crushed	0	Feathered	1	1	None
315	Flake	Cortical	-	Grey (Mid)	-	3	Patinated	Corticated	75	Hinged	2	1	n/a
316	Flake	Broken	-	Grey (Mid)	-	7	Broken	Abraded	75	-	6	1	Parallel
319	Flake	Cortical	-	Grey (Mid)	-	6	Fresh	Abraded	75	Stepped	4	2	Parallel
320	Flake	Cortical	-	Grey (Mid)	-	6	Patinated	None	0	Stepped	1	1	None
321	Flake	Non-cortical	-	Grey (Mid)	-	7	Fresh	Trimmed	75	Stepped	4	1	Parallel
322	Flake	Non-cortical	-	Grey (Mid)	-	7	Fresh	Abraded	80	Feathered	2	1	n/a
323	Flake	Non-cortical	-	Grey (Dark)	-	7	Patinated	Trimmed	75	Stepped	4	1	Parallel
324	Blade	Segment	-	Grey (Mid)	-	7	Broken	-	0	Hinged	3	1	Parallel

ID	Group	Sub Group	Source	Colour	Reuse	Cortication	Condition	Platform	EPA	Termination	Removals	Directions	Pattern
325	Blade	Segment	-	Grey (Mid)	-	6	Broken	-	0	Feathered	2	1	n/a
326	Flake	Fragment	-	Grey (Mid)	-	7	Broken	None	0	Feathered	2	1	n/a
327	Blade	Segment	-	Grey (Mid)	-	3	Broken	-	0	Stepped	2	1	n/a
330	Shatter	Debris	Gravel	Grey (Mid)	-	6	Rolled	-	0	-	7	3	Irregular
331	Shatter	Debris	-	Grey (Mid)	-	4	Patinated	-	0	-	4	3	Irregular

Metric Properties

ID	Group	Sub Group	L1	B1	B2	B3	T1	T2	T3	Lmax	Bmax	Tmax	Surface	Ratio	Depth	Area	Bulb	Variation
5	Flake	Cortical	33.25	10.53	8.99	2.52	4.21	6.45	4.76	33.25	8.99	4.76	298.92	3.70	4.21	44.33	1.44	8.01
12	Flake	Cortical	40.63	7.64	17.98	18.44	2.36	3.96	3.38	40.63	17.98	3.38	730.53	2.26	2.36	18.03	1.38	10.80
19	Blade	Non-cortical	52.22	7.51	9.71	8.13	2.46	4.69	5.30	52.22	9.71	5.30	507.06	5.38	2.46	18.47	1.21	2.20
20	Blade	Non-cortical	48.44	10.00	11.62	7.48	4.13	4.88	3.83	48.44	11.62	3.83	562.87	4.17	4.13	41.30	1.23	4.14
24	Flake	Cortical	48.12	16.01	22.48	7.20	7.11	8.17	10.18	48.12	22.48	10.18	1081.74	2.14	7.11	113.83	0.95	15.28
27	Flake	Cortical	43.10	8.82	27.19	32.36	2.58	4.80	10.16	43.10	27.19	10.16	1171.89	1.59	2.58	22.76	0.75	23.54
28	Flake	Cortical	28.38	13.30	26.74	6.96	4.48	6.98	7.48	28.38	26.74	7.48	758.88	1.06	4.48	59.58	1.17	19.78
29	Flake	Non-cortical	18.74	30.03	21.94	13.37	7.60	5.66	4.29	18.74	21.94	4.29	411.16	0.85	7.60	228.23	0.95	16.66
30	Flake	Cortical	24.14	12.94	31.62	28.42	2.93	4.00	3.76	24.14	31.62	3.76	763.31	0.76	2.93	37.91	1.20	18.68
32	Flake	Cortical	24.76	27.40	35.79	22.33	7.39	7.64	7.81	24.76	35.79	7.81	886.16	0.69	7.39	202.49	1.01	13.46
34	Flake	Non-cortical	42.07	14.62	18.09	9.42	5.36	8.80	10.31	42.07	18.09	10.31	761.05	2.33	5.36	78.36	1.12	8.67
35	Flake	Cortical	41.48	6.45	19.36	24.71	3.47	4.77	6.05	41.48	19.36	6.05	803.05	2.14	3.47	22.38	1.00	18.26
37	Flake	Cortical	26.72	3.79	30.24	17.45	1.26	2.86	4.16	26.72	30.24	4.16	808.01	0.88	1.26	4.78	1.06	26.45
38	Flake	Cortical	23.83	8.09	24.92	12.50	3.21	7.15	8.26	23.83	24.92	8.26	593.84	0.96	3.21	25.97	1.25	16.83
39	Flake	Non-cortical	27.26	20.86	34.79	17.15	3.79	4.99	4.84	27.26	34.79	4.84	948.38	0.78	3.79	79.06	1.16	17.64
40	Flake	Cortical	20.16	14.00	27.82	22.45	7.55	7.98	4.25	20.16	27.82	4.25	560.85	0.72	7.55	105.70	1.35	13.82
42	Flake	Cortical	25.99	7.03	16.99	12.91	1.41	1.92	1.93	25.99	16.99	1.93	441.57	1.53	1.41	9.91	1.15	9.96
43	Flake	Non-cortical	32.72	7.09	21.01	21.06	2.65	4.10	4.54	32.72	21.01	4.54	687.45	1.56	2.65	18.79	1.14	13.97
47	Flake	Non-cortical	26.44	5.05	16.77	11.98	2.12	2.94	2.35	26.44	16.77	2.35	443.40	1.58	2.12	10.71	1.32	11.72
48	Flake	Broken	19.53	10.90	12.21	12.96	1.90	3.12	5.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
49	Flake	Cortical	22.92	8.71	14.11	11.98	1.78	3.38	3.09	22.92	14.11	3.09	323.40	1.62	1.78	15.50	1.39	5.40
50	Flake	Non-cortical	17.20	12.02	33.15	13.59	1.24	2.72	3.04	17.20	33.15	3.04	570.18	0.52	1.24	14.90	1.27	21.13
51	Flake	Fragment	24.11	10.45	14.25	9.25	2.56	3.06	2.94	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
52	Flake	Cortical	17.01	6.86	14.48	11.47	2.10	2.54	2.10	17.01	14.48	2.10	246.30	1.17	2.10	14.41	1.21	7.62
53	Flake	Fragment	20.57	5.37	24.38	18.50	3.83	5.48	4.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
70	Flake	Cortical	55.44	17.80	44.74	33.02	10.37	14.61	13.68	55.44	44.74	13.68	2480.39	1.24	10.37	184.59	1.21	26.94
72	Shatter	Debris	36.53	0.00	38.96	0.00	0.00	0.00	11.67	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

ID	Group	Sub Group	L1	B1	B2	B3	T1	T2	T3	Lmax	Bmax	Tmax	Surface	Ratio	Depth	Area	Bulb	Variation
73	Flake	Cortical	46.64	5.87	26.02	2.12	4.58	4.31	4.20	46.64	26.02	4.20	1213.57	1.79	4.58	26.88	0.98	23.90
75	Flake	Cortical	27.54	7.79	27.44	34.34	4.24	4.69	3.18	27.54	27.44	3.18	755.70	1.00	4.24	33.03	1.26	26.55
77	Blade	Cortical	31.36	4.12	10.62	8.09	2.09	2.83	5.49	31.36	10.62	5.49	333.04	2.95	2.09	8.61	0.75	6.50
78	Flake	Cortical	42.50	3.88	34.49	3.50	2.10	6.36	5.41	42.50	34.49	5.41	1465.83	1.23	2.10	8.15	1.69	30.99
79	Flake	Non-cortical	27.08	14.98	36.07	9.49	5.08	6.46	6.58	27.08	36.07	6.58	976.78	0.75	5.08	76.10	1.11	26.58
81	Blade	Non-cortical	36.49	4.19	15.19	4.10	1.50	2.22	3.68	36.49	15.19	3.68	554.28	2.40	1.50	6.29	0.86	11.09
82	Shatter	Debris	22.19	0.00	38.99	0.00	0.00	0.00	10.54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
83	Flake	Cortical	36.62	4.14	11.82	2.87	1.80	2.92	3.12	36.62	11.82	3.12	432.85	3.10	1.80	7.45	1.19	8.95
84	Shatter	Debris	15.59	0.00	20.90	0.00	0.00	0.00	8.78	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
85	Flake	Cortical	15.28	7.31	15.92	4.43	2.07	5.19	4.35	15.28	15.92	4.35	243.26	0.96	2.07	15.13	1.62	11.49
87	Flake	Cortical	46.91	2.78	19.46	10.31	1.44	2.35	5.63	46.91	19.46	5.63	912.87	2.41	1.44	4.00	0.66	16.68
91	Flake	Cortical	46.51	31.39	37.70	37.90	7.94	15.43	14.58	46.51	37.70	14.58	1753.43	1.23	7.94	249.24	1.37	6.51
94	Blade	Cortical	40.30	3.43	11.26	5.11	1.16	2.10	3.78	40.30	11.26	3.78	453.78	3.58	1.16	3.98	0.85	7.83
95	Blade	Cortical	34.19	4.44	11.19	12.06	2.41	3.81	2.31	34.19	11.19	2.31	382.59	3.06	2.41	10.70	1.61	7.62
96	Blade	Fragment (crested)	35.68	0.00	15.16	0.00	0.00	0.00	6.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
98	Shatter	Debris	36.80	0.00	35.62	0.00	0.00	0.00	15.73	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
99	Flake	Cortical	47.34	13.22	19.68	8.87	6.57	7.23	5.45	47.34	19.68	5.45	931.65	2.41	6.57	86.86	1.20	10.81
103	Flake	Non-cortical	30.76	3.30	14.45	8.41	1.39	2.75	4.30	30.76	14.45	4.30	444.48	2.13	1.39	4.59	0.97	11.15
104	Blade	Segment	17.79	0.00	10.63	0.00	0.00	0.00	2.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
106	Flake	Non-cortical	27.06	20.69	28.34	15.54	6.33	6.00	4.80	27.06	28.34	4.80	766.88	0.95	6.33	130.97	1.08	12.80
107	Flake	Non-cortical	32.43	7.93	14.96	10.45	2.85	2.69	4.53	32.43	14.96	4.53	485.15	2.17	2.85	22.60	0.73	7.03
109	Flake	Fragment	47.48	7.43	21.58	41.59	7.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
115	Blade	Fragment	54.26	0.00	13.82	0.00	0.00	0.00	4.74	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
116	Flake	Cortical	69.40	7.73	18.65	12.43	3.78	4.17	5.56	69.40	18.65	5.56	1294.31	3.72	3.78	29.22	0.89	10.92
117	Flake	Cortical	56.03	7.00	15.31	9.98	2.65	3.32	3.76	56.03	15.31	3.76	857.82	3.66	2.65	18.55	1.04	8.31
118	Flake	Cortical	74.72	3.31	17.57	8.10	1.94	2.76	5.57	74.72	17.57	5.57	1312.83	4.25	1.94	6.42	0.74	14.26
119	Blade	Fragment	53.03	6.87	13.61	16.72	1.10	1.79	3.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
121	Blade	Cortical	53.04	7.35	10.12	7.54	3.05	3.88	2.85	53.04	10.12	2.85	536.76	5.24	3.05	22.42	1.32	2.77

ID	Group	Sub Group	L1	B1	B2	B3	T1	T2	T3	Lmax	Bmax	Tmax	Surface	Ratio	Depth	Area	Bulb	Variation
122	Blade	Cortical	79.98	4.56	10.83	6.66	2.08	2.81	6.57	79.98	10.83	6.57	866.18	7.39	2.08	9.48	0.65	6.27
123	Flake	Cortical	64.67	7.33	9.45	5.76	2.37	2.53	7.32	64.67	9.45	7.32	611.13	6.84	2.37	17.37	0.52	3.69
124	Flake	Non-cortical	63.18	5.90	21.32	10.66	2.67	2.87	5.26	63.18	21.32	5.26	1347.00	2.96	2.67	15.75	0.72	15.42
125	Flake	Cortical	43.13	7.91	15.12	4.05	0.95	2.46	2.90	43.13	15.12	2.90	652.13	2.85	0.95	7.51	1.28	11.07
126	Flake	Cortical	59.48	11.63	23.08	4.56	2.43	4.27	7.10	59.48	23.08	7.10	1372.80	2.58	2.43	28.26	0.90	18.52
127	Flake	Cortical	53.89	4.42	13.58	10.73	2.61	2.64	4.06	53.89	13.58	4.06	731.83	3.97	2.61	11.54	0.79	9.16
128	Flake	Cortical	42.05	5.49	15.70	11.06	4.01	5.18	6.97	42.05	15.70	6.97	660.18	2.68	4.01	22.01	0.94	10.21
129	Flake	Non-cortical	47.65	3.95	11.27	22.92	3.57	3.31	4.88	47.65	11.27	4.88	537.02	4.23	3.57	14.10	0.78	18.97
130	Flake	Non-cortical	47.43	6.77	16.30	10.15	1.27	2.15	1.88	47.43	16.30	1.88	773.11	2.91	1.27	8.60	1.37	9.53
131	Flake	Cortical	44.50	4.22	13.96	17.38	1.75	3.58	5.47	44.50	13.96	5.47	621.22	3.19	1.75	7.38	0.99	13.16
132	Flake	Cortical	50.30	7.51	15.55	17.08	4.31	3.96	4.84	50.30	15.55	4.84	782.16	3.23	4.31	32.37	0.87	9.57
134	Blade	Non-cortical	29.96	2.44	9.78	9.24	1.52	2.12	2.22	29.96	9.78	2.22	293.01	3.06	1.52	3.71	1.13	7.34
135	Flake	Cortical	44.98	5.00	12.38	4.36	2.54	2.89	2.86	44.98	12.38	2.86	556.85	3.63	2.54	12.70	1.07	8.02
136	Flake	Non-cortical	30.99	4.53	10.60	3.31	1.88	1.95	1.63	30.99	10.60	1.63	328.49	2.92	1.88	8.52	1.11	7.29
137	Flake	Non-cortical	40.93	8.49	13.60	5.31	1.25	1.47	2.00	40.93	13.60	2.00	556.65	3.01	1.25	10.61	0.90	8.29
138	Flake	Cortical	51.55	4.77	12.19	7.49	2.45	3.36	5.33	51.55	12.19	5.33	628.39	4.23	2.45	11.69	0.86	7.42
139	Flake	Fragment	32.79	0.00	13.93	0.00	0.00	0.00	1.97	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
140	Flake	Non-cortical	35.29	6.06	13.26	11.61	2.60	2.96	3.70	35.29	13.26	3.70	467.95	2.66	2.60	15.76	0.94	7.20
141	Flake	Cortical	45.81	7.61	13.64	7.77	5.14	5.09	4.64	45.81	13.64	4.64	624.85	3.36	5.14	39.12	1.04	6.03
143	Flake	Broken	23.16	8.70	28.98	28.14	3.63	5.18	5.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
144	Flake	Non-cortical	41.91	6.70	29.73	7.34	6.68	7.24	4.13	41.91	29.73	4.13	1245.98	1.41	6.68	44.76	1.34	23.03
145	Flake	Broken	19.98	9.35	28.55	29.88	7.32	6.22	4.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
146	Flake	Cortical	62.98	4.12	31.30	17.60	1.82	2.79	6.58	62.98	31.30	6.58	1971.27	2.01	1.82	7.50	0.66	27.18
147	Flake	Cortical	32.12	7.97	21.73	17.35	5.58	4.24	2.07	32.12	21.73	2.07	697.97	1.48	5.58	44.47	1.11	13.76
148	Flake	Fragment	24.81	0.00	29.73	0.00	0.00	0.00	9.51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
149	Flake	Cortical	35.43	10.24	19.09	9.81	3.01	3.72	1.88	35.43	19.09	1.88	676.36	1.86	3.01	30.82	1.52	9.28
150	Flake	Cortical	19.31	7.76	17.49	25.41	2.17	4.92	3.91	19.31	17.49	3.91	337.73	1.10	2.17	16.84	1.62	17.65
151	Flake	Cortical	32.47	13.42	22.37	17.00	6.19	7.38	7.16	32.47	22.37	7.16	726.35	1.45	6.19	83.07	1.11	8.95
152	Blade	Segment	24.50	18.63	16.56	13.79	3.09	3.15	3.52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

ID	Group	Sub Group	L1	B1	B2	B3	T1	T2	T3	Lmax	Bmax	Tmax	Surface	Ratio	Depth	Area	Bulb	Variation
153	Flake	Fragment	20.83	14.33	16.14	17.75	2.61	2.87	2.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
154	Flake	Non-cortical	47.58	14.13	27.15	14.67	6.82	12.90	8.87	47.58	27.15	8.87	1291.80	1.75	6.82	96.37	1.64	13.02
156	Flake	Non-cortical	36.43	12.61	30.97	54.03	8.10	10.26	7.04	36.43	30.97	7.04	1128.24	1.18	8.10	102.14	1.36	41.42
157	Flake	Fragment	34.62	16.08	16.90	19.94	5.94	6.51	7.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
159	Flake	Non-cortical	36.46	9.78	31.25	21.17	1.78	4.30	3.84	36.46	31.25	3.84	1139.38	1.17	1.78	17.41	1.53	21.47
160	Flake	Cortical	32.17	14.11	24.97	19.89	7.06	6.65	4.92	32.17	24.97	4.92	803.28	1.29	7.06	99.62	1.11	10.86
161	Flake	Fragment	48.79	15.20	25.06	7.05	2.27	2.06	3.39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
162	Shatter	Debris	39.75	0.00	26.10	0.00	0.00	0.00	11.81	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
164	Flake	Non-cortical	58.11	27.17	38.03	36.05	9.82	11.08	8.08	58.11	38.03	8.08	2209.92	1.53	9.82	266.81	1.24	10.86
166	Flake	Cortical	55.61	8.81	40.75	20.55	2.20	8.72	7.95	55.61	40.75	7.95	2266.11	1.36	2.20	19.38	1.72	31.94
176	Flake	Cortical	49.56	0.00	20.04	0.00	0.00	0.00	15.83	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
180	Flake	Cortical	30.85	15.04	20.43	26.92	4.11	6.31	4.60	30.85	20.43	4.60	630.27	1.51	4.11	61.81	1.45	11.88
181	Shatter	Debris	16.63	0.00	14.38	0.00	0.00	0.00	2.96	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
182	Flake	Non-cortical	31.76	9.30	37.06	28.39	2.39	6.94	12.36	31.76	37.06	12.36	1177.03	0.86	2.39	22.23	0.94	27.76
184	Flake	Cortical	35.04	7.14	24.19	28.57	3.26	6.06	8.47	35.04	24.19	8.47	847.62	1.45	3.26	23.28	1.03	21.43
195	Flake	Cortical	36.91	0.00	27.87	0.00	0.00	0.00	7.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
196	Shatter	Debris	18.11	0.00	15.61	0.00	0.00	0.00	6.42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
197	Flake	Non-cortical (crested)	36.69	4.00	12.95	2.88	3.20	3.83	5.08	36.69	12.95	5.08	475.14	2.83	3.20	12.80	0.93	10.07
198	Flake	Non-cortical	30.84	11.56	26.05	2.10	1.75	5.50	1.83	30.84	26.05	1.83	803.38	1.18	1.75	20.23	3.07	23.95
205	Flake	Non-cortical (rejuvenation)	30.55	10.88	10.76	8.11	5.24	5.64	5.93	30.55	10.76	5.93	328.72	2.84	5.24	57.01	1.01	2.77
206	Flake	Cortical	39.07	11.07	13.55	16.53	2.60	2.91	7.19	39.07	13.55	7.19	529.40	2.88	2.60	28.78	0.59	5.46
207	Blade	Non-cortical	32.19	8.35	11.89	9.60	1.88	2.03	3.67	32.19	11.89	3.67	382.74	2.71	1.88	15.70	0.73	3.54
208	Blade	Non-cortical	44.06	5.99	11.43	9.69	2.00	2.60	5.50	44.06	11.43	5.50	503.61	3.85	2.00	11.98	0.69	5.44
209	Blade	Non-cortical	37.85	4.42	10.30	9.07	0.98	4.04	3.84	37.85	10.30	3.84	389.86	3.67	0.98	4.33	1.68	5.88
210	Blade	Non-cortical	36.94	2.95	11.82	4.97	1.81	2.53	3.37	36.94	11.82	3.37	436.63	3.13	1.81	5.34	0.98	8.87
213	Flake	Cortical	61.52	4.95	34.89	14.47	4.26	11.70	13.64	61.52	34.89	13.64	2146.43	1.76	4.26	21.09	1.31	29.94
215	Flake	Non-cortical (rejuvenation)	21.39	36.14	40.66	16.10	8.58	9.49	4.32	21.39	40.66	4.32	869.72	0.53	8.58	310.08	1.47	24.56

ID	Group	Sub Group	L1	B1	B2	B3	T1	T2	T3	Lmax	Bmax	Tmax	Surface	Ratio	Depth	Area	Bulb	Variation
216	Flake	Non-cortical	39.51	6.60	32.52	19.37	3.52	3.69	4.17	39.51	32.52	4.17	1284.87	1.21	3.52	23.23	0.96	25.92
218	Flake	Cortical	32.78	20.52	20.56	12.82	3.97	5.31	6.47	32.78	20.56	6.47	673.96	1.59	3.97	81.46	1.02	7.74
219	Flake	Non-cortical	44.84	9.68	21.39	12.67	3.98	4.50	3.25	44.84	21.39	3.25	959.13	2.10	3.98	38.53	1.24	11.71
225	Flake	Non-cortical	33.24	12.33	42.27	20.67	5.68	7.75	5.27	33.24	42.27	5.27	1405.05	0.79	5.68	70.03	1.42	29.94
228	Shatter	Debris	23.79	0.00	42.19	0.00	0.00	0.00	15.74	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
230	Flake	Cortical	66.40	0.00	15.26	0.00	0.00	0.00	6.83	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
232	Flake	Cortical	58.92	3.30	15.15	16.48	1.25	2.68	7.58	58.92	15.15	7.58	892.64	3.89	1.25	4.13	0.61	13.18
233	Shatter	Debris	32.39	0.00	21.71	0.00	0.00	0.00	20.61	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
234	Flake	Non-cortical	52.42	21.97	51.18	28.43	7.20	12.18	9.42	52.42	51.18	9.42	2682.86	1.02	7.20	158.18	1.47	29.21
235	Flake	Non-cortical	34.25	7.86	20.27	4.84	1.83	4.04	5.21	34.25	20.27	5.21	694.25	1.69	1.83	14.38	1.15	15.43
236	Flake	Cortical	45.96	22.60	36.74	21.23	8.78	15.09	17.27	45.96	36.74	17.27	1688.57	1.25	8.78	198.43	1.16	15.51
237	Flake	Cortical	23.97	18.28	29.03	12.39	5.62	7.88	3.74	23.97	29.03	3.74	695.85	0.83	5.62	102.73	1.68	16.64
238	Flake	Cortical	29.00	5.19	10.01	1.45	0.98	4.72	3.71	29.00	10.01	3.71	290.29	2.90	0.98	5.09	2.01	8.56
239	Flake	Non-cortical	47.65	20.90	20.17	1.69	9.13	9.61	10.10	47.65	20.17	10.10	961.10	2.36	9.13	190.82	1.00	19.21
240	Flake	Cortical	37.99	9.30	24.04	27.20	2.97	8.41	7.58	37.99	24.04	7.58	913.28	1.58	2.97	27.62	1.59	17.90
241	Flake	Non-cortical	43.15	4.65	11.94	3.57	2.47	5.06	4.03	43.15	11.94	4.03	515.21	3.61	2.47	11.49	1.56	8.37
243	Shatter	Debris	32.01	0.00	16.87	0.00	0.00	0.00	8.57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
244	Flake	Cortical	44.74	25.29	35.97	10.01	10.24	10.88	10.15	44.74	35.97	10.15	1609.30	1.24	10.24	258.97	1.07	25.96
245	Flake	Non-cortical	16.26	10.85	24.24	8.94	2.49	3.61	3.08	16.26	24.24	3.08	394.14	0.67	2.49	27.02	1.30	15.30
246	Flake	Non-cortical	18.79	0.00	12.31	0.00	0.00	0.00	1.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
247	Flake	Non-cortical	46.91	5.94	17.41	3.86	4.28	5.86	4.58	46.91	17.41	4.58	816.70	2.69	4.28	25.42	1.32	13.55
249	Flake	Fragment	38.41	0.00	17.59	0.00	0.00	0.00	4.63	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
250	Flake	Cortical	49.07	11.56	33.66	20.97	3.96	9.82	13.07	49.07	33.66	13.07	1651.70	1.46	3.96	45.78	1.15	22.10
252	Blade	Non-cortical	31.97	7.07	8.77	5.83	1.60	2.85	3.98	31.97	8.77	3.98	280.38	3.65	1.60	11.31	1.02	2.94
253	Flake	Non-cortical	28.94	2.80	8.56	4.03	0.95	1.52	2.19	28.94	8.56	2.19	247.73	3.38	0.95	2.66	0.97	5.76
254	Flake	Non-cortical	16.07	11.66	19.73	10.29	3.33	3.64	3.04	16.07	19.73	3.04	317.06	0.81	3.33	38.83	1.14	9.44
255	Flake	Cortical	17.71	12.10	24.87	13.55	3.58	5.25	3.08	17.71	24.87	3.08	440.45	0.71	3.58	43.32	1.58	12.77
257	Flake	Cortical	33.24	4.95	45.19	28.56	9.57	9.91	5.88	33.24	45.19	5.88	1502.12	0.74	9.57	47.37	1.28	40.24
258	Flake	Cortical	33.07	4.73	21.61	22.09	2.42	5.25	4.68	33.07	21.61	4.68	714.64	1.53	2.42	11.45	1.48	17.36

ID	Group	Sub Group	L1	B1	B2	B3	T1	T2	T3	Lmax	Bmax	Tmax	Surface	Ratio	Depth	Area	Bulb	Variation
259	Flake	Cortical	44.11	6.70	10.53	4.38	1.91	3.33	5.32	44.11	10.53	5.32	464.48	4.19	1.91	12.80	0.92	6.15
260	Flake	Cortical	34.70	4.38	23.85	21.75	1.67	2.82	4.98	34.70	23.85	4.98	827.60	1.45	1.67	7.31	0.85	19.47
261	Blade	Segment	28.56	0.00	16.66	0.00	0.00	0.00	6.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
262	Flake	Non-cortical	34.82	4.70	13.21	6.47	2.51	4.56	4.80	34.82	13.21	4.80	459.97	2.64	2.51	11.80	1.25	8.51
263	Flake	Non-cortical	41.96	6.92	17.52	25.21	3.31	4.74	5.14	41.96	17.52	5.14	735.14	2.39	3.31	22.91	1.12	18.29
264	Flake	Cortical	36.40	8.17	16.40	19.18	2.84	3.24	3.46	36.40	16.40	3.46	596.96	2.22	2.84	23.20	1.03	11.01
265	Flake	Fragment	23.72	0.00	16.08	0.00	0.00	0.00	2.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
266	Flake	Fragment	31.97	0.00	10.34	0.00	0.00	0.00	3.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
268	Shatter	Debris	18.74	0.00	20.12	0.00	0.00	0.00	5.66	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
269	Flake	Cortical (rejuvenation)	35.05	6.65	24.65	23.38	2.21	3.96	4.69	35.05	24.65	4.69	863.98	1.42	2.21	14.70	1.15	18.00
270	Flake	Fragment	31.97	27.57	35.00	19.88	8.29	6.87	2.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
271	Flake	Non-cortical	22.97	5.00	28.99	17.70	2.02	3.20	4.51	22.97	28.99	4.51	665.90	0.79	2.02	10.10	0.98	23.99
272	Flake	Non-cortical	29.24	12.14	18.13	8.77	6.26	6.21	4.82	29.24	18.13	4.82	530.12	1.61	6.26	76.00	1.12	9.36
273	Shatter	Debris	34.56	0.00	42.87	0.00	0.00	0.00	12.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
275	Flake	Non-cortical	24.70	0.00	22.97	0.00	0.00	0.00	4.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
279	Blade	Non-cortical	36.13	4.69	9.94	7.61	3.56	0.33	2.95	36.13	9.94	2.95	359.13	3.63	3.56	16.70	0.10	5.25
284	Flake	Fragment	19.32	0.00	23.37	0.00	0.00	0.00	2.31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
285	Flake	Cortical	30.79	8.02	29.82	11.66	4.64	7.66	5.99	30.79	29.82	5.99	918.16	1.03	4.64	37.21	1.44	21.80
286	Shatter	Debris	22.06	0.00	14.99	0.00	0.00	0.00	12.31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
287	Flake	Cortical	28.76	10.38	20.01	8.58	5.08	4.63	2.50	28.76	20.01	2.50	575.49	1.44	5.08	52.73	1.22	11.43
289	Flake	Cortical	20.93	30.51	28.04	28.23	4.75	6.87	5.12	20.93	28.04	5.12	586.88	0.75	4.75	144.92	1.39	2.47
291	Flake	Non-cortical	26.66	4.60	35.94	16.37	10.08	12.01	4.08	26.66	35.94	4.08	958.16	0.74	10.08	46.37	1.70	31.34
292	Flake	Cortical	28.58	10.75	25.63	13.61	4.03	4.24	3.82	28.58	25.63	3.82	732.51	1.12	4.03	43.32	1.08	14.88
293	Shatter	Debris	27.20	0.00	23.14	0.00	0.00	0.00	11.47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
294	Shatter	Debris	27.02	0.00	22.49	0.00	0.00	0.00	5.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
295	Flake	Cortical	23.93	0.00	19.69	0.00	0.00	0.00	8.48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
296	Flake	Fragment	22.31	0.00	19.18	0.00	0.00	0.00	27.63	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
298	Flake	Non-cortical	23.69	4.13	23.58	11.60	1.33	2.68	2.62	23.69	23.58	2.62	558.61	1.00	1.33	5.49	1.36	19.45

ID	Group	Sub Group	L1	B1	B2	B3	T1	T2	T3	Lmax	Bmax	Tmax	Surface	Ratio	Depth	Area	Bulb	Variation
299	Flake	Cortical	49.45	2.79	16.77	16.91	3.78	6.20	8.21	49.45	16.77	8.21	829.28	2.95	3.78	10.55	1.03	14.12
300	Flake	Cortical	21.30	0.00	16.35	0.00	0.00	0.00	1.96	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
301	Flake	Non-cortical	37.61	2.51	26.10	21.63	1.15	2.36	3.92	37.61	26.10	3.92	981.62	1.44	1.15	2.89	0.93	23.59
302	Shatter	Debris	26.16	0.00	19.42	0.00	0.00	0.00	7.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
303	Flake	Cortical	25.44	8.27	17.25	19.55	3.68	4.19	3.26	25.44	17.25	3.26	438.84	1.47	3.68	30.43	1.21	11.28
304	Flake	Cortical	20.31	7.87	14.20	14.71	2.50	5.72	5.13	20.31	14.20	5.13	288.40	1.43	2.50	19.68	1.50	6.84
305	Flake	Cortical	28.05	2.89	26.74	21.01	1.79	4.23	5.45	28.05	26.74	5.45	750.06	1.05	1.79	5.17	1.17	23.85
306	Flake	Cortical	55.85	5.62	34.42	28.95	5.67	5.91	6.98	55.85	34.42	6.98	1922.36	1.62	5.67	31.87	0.93	28.80
307	Flake	Cortical	44.08	0.00	28.13	0.00	0.00	0.00	6.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
308	Flake	Cortical	32.44	9.98	26.20	6.54	2.53	5.38	6.34	32.44	26.20	6.34	849.93	1.24	2.53	25.25	1.21	19.66
309	Flake	Cortical (rejuvenation)	27.99	4.09	29.66	16.00	3.28	5.38	2.90	27.99	29.66	2.90	830.18	0.94	3.28	13.42	1.74	25.57
311	Flake	Non-cortical	58.87	20.98	37.85	37.18	6.66	6.95	5.90	58.87	37.85	5.90	2228.23	1.56	6.66	139.73	1.11	16.87
312	Flake	Non-cortical	55.89	5.53	26.70	22.14	2.24	5.30	8.07	55.89	26.70	8.07	1492.26	2.09	2.24	12.39	1.03	21.17
313	Flake	Fragment	34.35	0.00	35.51	0.00	0.00	0.00	7.41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
314	Flake	Cortical	32.61	2.49	35.09	11.94	1.12	4.83	11.63	32.61	35.09	11.63	1144.28	0.93	1.12	2.79	0.76	32.60
315	Flake	Cortical	53.18	7.22	40.06	5.50	5.35	10.28	10.02	53.18	40.06	10.02	2130.39	1.33	5.35	38.63	1.34	34.56
316	Flake	Broken	51.06	4.35	33.58	28.77	3.56	10.34	10.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
319	Flake	Cortical	42.78	3.16	18.14	9.03	2.42	3.89	4.07	42.78	18.14	4.07	776.03	2.36	2.42	7.65	1.20	14.98
320	Flake	Cortical	36.38	0.00	15.10	0.00	0.00	0.00	2.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
321	Flake	Non-cortical	29.02	6.13	10.42	5.60	1.23	2.20	2.51	29.02	10.42	2.51	302.39	2.79	1.23	7.54	1.18	4.82
322	Flake	Non-cortical	25.86	4.92	14.77	9.60	1.92	4.28	1.75	25.86	14.77	1.75	381.95	1.75	1.92	9.45	2.33	9.85
323	Flake	Non-cortical	29.13	4.24	9.73	10.36	1.59	2.74	3.27	29.13	9.73	3.27	283.43	2.99	1.59	6.74	1.13	6.12
324	Blade	Segment	41.25	0.00	10.20	0.00	0.00	0.00	2.34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
325	Blade	Segment	21.45	0.00	12.63	0.00	0.00	0.00	3.59	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
326	Flake	Fragment	20.28	0.00	11.30	0.00	0.00	0.00	3.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
327	Blade	Segment	25.41	0.00	20.71	0.00	0.00	0.00	8.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
330	Shatter	Debris	37.03	0.00	29.90	0.00	0.00	0.00	11.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
331	Shatter	Debris	48.54	0.00	25.08	0.00	0.00	0.00	21.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Life histories of the stone tools from the Wharram-le-Street case study

Arrowheads

Leaf-Shaped Arrowheads

07/09

20 ***?Leaf-shaped arrowhead*** (?Type 4a) L=40mm B=29mm T=8mm. Crude leaf-shaped arrowhead manufactured from a heavily patinated non-cortical flake of mid grey flint. **Face I:** Four flake scars from previous removals perpendicular to striking platform from which the blank was struck. Crude edge retouching at distal end. Abrupt edge retouching along upper right and lower right edges to create a well-defined point. **Face II:** Pronounced curvature at distal end from hinged flake termination. Semi-invasive edge retouching along upper left and lower left edge to create well defined point.

Transverse Arrowheads

08/05

23 ***Oblique transverse arrowhead*** T=20mm R=20mm UL=20mm FL=23mm T=3mm. Complete oblique transverse arrowhead manufactured from a cortical flake of dark grey flint. **Face I:** Distal end of flake partially corticated. Single removal from left edge of flake used as blank to create the primary flake edge. Possible crude edge retouching or abrasion to right edge of flake used as a blank, possibly relating to hafting of the arrowhead. **Face II:** Unworked.

21/18

256 ***Oblique transverse arrowhead*** T=>19mm R=>21mm UL=>19mm FL=>23mm. Crude oblique shaped arrowhead manufactured from a cortical flake of mid grey flint. Tip broken. **Face I:** Single flake scar from previous removal truncated by flake scar from a single removal from the right edge of the striking platform of the flake used as a

blank. **Face II:** Shallow flake scar from at least one removal struck to remove bulb of percussion for the purposes of hafting. Right edge (FL) formed by step fracture.

Barbed and Tanged Arrowheads

33/23

20 ***Barbed and tanged arrowhead*** L=19mm B=16mm T=3mm. Patinated crude Barb and Tang Arrowhead manufactured from a broken non-cortical flake of mid grey flint. **Face I:** Tip and right edge possibly broken. Two flake scars from previous removals. Two notches created by pressure flaking to create barb and tangs. Left tang broken off, right tang partially broken. **Face II:** Base of tang chipped (no patination).

Knives

Edge-Retouched Flake Knives

13/15

131 ***Backed edge retouched flake knife*** L=38mm B=18 T=6mm. Backed edge retouched flake knife manufactured from a heavily patinated non-cortical flake of mid grey flint. **Dorsal surface:** Three flake scars from previous removals. Five flakes struck from right edge of flake to create blunt backed edge. Crude edge retouching along left edge of flake. Possible evidence of trimming or reduction of edge of striking platform. **Ventral surface:** Unworked.

Scrapers

End

05/05

9 ***End scraper*** (Type A i; Class 2) L=29mm B=22mm T=7mm. Crude long end scraper manufactured from a patinated non-cortical flake of light or mid brown flint. **Dorsal surface:** Two diverging ridges formed by flake scars from three previous removals. Abrupt edge retouching at distal end, extending along lower right edge. Semi-invasive edge retouching along lower left edge. **Ventral surface:** Unworked.

09/08

57 ***End Scraper*** (Type A i, Class 2) L=46mm B=23mm T=14mm. Crude long end scraper manufactured from a chunky cortical flake of mid grey flint, lightly patinated. **Dorsal surface:** Rounded cortical surface characteristic of a pebble of beach flint. One flake

scar from previous removal. Crude abrupt edge retouching at distal end extending along lower left and lower right edges. Abrupt edge retouching to upper right edge. Abrupt edge retouching to upper left edge to create a notch for the purposes of hafting. **Ventral surface:** Unworked.

09/10

65 ***End scraper*** (Type A ii, Class 8) L=28mm B=24mm T=7mm. Short end scraper manufactured from a heavily patinated non-cortical flake of mid grey flint. **Dorsal surface:** Six flake scars from previous removals. Semi-invasive and abrupt edge retouching at distal end, extending along lower left edge. Abrupt edge retouching to upper left and right edge for the purposes of hafting. **Ventral surface:** Unworked.

10/07

68 ***End scraper*** (Type A i, Class 2) L=42mm B=27mm T=8mm. Crude proximal end scraper manufactured from a non-cortical flake of mid to dark grey flint. **Dorsal surface:** Four flake scars from previous removals, base of core removed when flake detached. Five flakes removed from proximal end. Abrupt edge retouching to proximal end. **Ventral surface:** Unworked.

18/15

224 ***Double-ended scraper*** L=25mm B=20mm T=9mm. Double-ended scraper manufactured from a non-cortical flake of light grey flint with a faceted striking platform. **Dorsal surface:** Two flake scars from previous removals. Abrupt edge retouching at proximal end. Semi-invasive and abrupt edge retouching along left edge of flake. Invasive, semi-invasive and abrupt edge retouching at distal end to create a concave working edge. **Ventral surface:** Unworked.

18/18

227 ***End scraper*** (Type A i, Class 2) L=44mm B=25 T=8mm. Long end scraper manufactured from a cortical flake of dark grey flint. **Dorsal surface:** Right edge and distal end corticated, two flake scars from previous removals. Crude edge retouching to upper left edge. Semi-invasive and abrupt edge retouching at distal end, extending along lower left edge. **Ventral surface:** Pronounced overshot flake termination. Semi-invasive edge retouching to create a possible notch at middle section of right edge.

24/14

279 ***End scraper*** (Type A ii, Class 4) L=42mm B=30mm T=10mm. End scraper manufactured from a patinated non-cortical flake of mid grey flint. **Dorsal surface:** three parallel ridges formed by the intersections of flake scars from four previous removals. Left hand and central ridge truncated by a flake scar from a single removal from the left edge of a striking platform. Invasive and abrupt edge retouching to distal end of flake used as a blank extending along the lower left and lower right edges. Two possible notches created by abrupt edge retouching to upper left and middle section of right edge. **Ventral surface:** Unworked with pronounced bulb of percussion.

24/17

286 ***End scraper*** (Type A ii, Class 4) L=38mm B=29mm T=8.66mm. End scraper manufactured from a lightly patinated non-cortical flake of mid grey flint. ?Rejuvenation flake. **Dorsal surface:** Four flake scars from previous removals. Semi invasive and abrupt edge retouching to distal end of flake, continuing along lower left edge. Possible fine edge retouching or serration along upper left edge. **Ventral surface:** Unworked with pronounced bulb of percussion and crushed striking platform.

27/23

317 ***End scraper*** (Type A ii, Class 4) L=25mm B=19mm T=8mm. Short end scraper manufactured from a cortical flake of mid grey flint with a rough pitted cortical surface c.f. 318. **Dorsal surface:** Left edge and middle of flake partially corticated. Three flake scars from previous removals. Invasive and abrupt edge retouching at the distal end . Abrupt edge retouching continues along lower left and lower right edges. Crude edge retouching to upper left and upper right edges and proximal end for the purposes of hafting. **Ventral surface:** Two shallow flake scars with well-defined flake scars characteristic of the use of a soft hammer from flakes struck to reduce the bulb of percussion.

Side

08/07

28 ***Side scraper*** (Type D i, Class 6) L=43mm B=26mm T=8mm. Side scraper manufactured from a cortical piece of light grey chalk flint with a corticated striking platform. **Dorsal**

surface: Two flake scars from previous removals. Semi-invasive edge retouching along right edge of flake used as a blank, extending along distal end. Abrupt edge retouching at distal end of left end of flake used as a blank to create a blunt point/notch possibly for purposes of hafting. **Ventral surface:** Unworked.

08/09

36 ***Double-sided scraper*** (Type D i, Class 6) L=53mm W=32mm T=11mm. Crude double-sided scraper manufactured from a patinated cortical flake of mid brown flint with a corticated striking platform. **Dorsal surface:** Four flake scars from previous removals. Traces of cortex at distal end. Crude abrupt edge retouching along left edge of flake used as a blank. Abrupt/semi-invasive edge retouching along right edge to create a notch for the purposes of hafting. **Ventral surface:** Unworked.

08/11

42 ***Side scraper*** (Type D i, Class 6) L=44mm B=34mm T=14mm. Crude side scraper manufactured from a cortical flake of patinated mid grey flint. **Dorsal surface:** Trimmed striking platform. Flake scars from three previous removals, semi-invasive and abrupt edge retouching along right edge of flake used as a blank. Abrupt edge retouching along the upper left edge. **Ventral surface:** Unworked with pronounced bulb of percussion and hinged flake termination.

15/11

161 ***Side scraper*** (Type D ii, Class 6) L=28mm B=24mm T=11mm. Crude short side scraper manufactured from a cortical flake of mid grey flint. **Dorsal surface:** Four flake scars from previous removals. Crude edge retouching along left edge, possibly extending along distal end of flake used as blank. **Ventral surface:** Unworked.

32/19

327 ***Side scraper*** (Type D ii, Class 6) L=24mm B=25mm T=11mm. Side scraper manufactured from a broken cortical flake of mid grey flint. **Dorsal surface:** Proximal end broken, distal end corticated. Three shallow flake scars from flakes struck from an opposed platform at the bottom right edge. Concave scraping edge created by at least two shallow removals followed by invasive, semi invasive and abrupt edge retouching. **Ventral surface:** Unworked.

32/22

328 ***Side scraper*** (Type D ii, Class 6) L=31mm B=23mm T=10mm. Side scraper manufactured from a lightly patinated flake of mid grey flint. **Dorsal surface:** Two flake scars from previous removals. Working edge created by a series of shallow removals followed by invasive and abrupt edge retouching along left edge extending along the proximal and distal ends of the flake used as a blank. **Ventral surface:** Shallow flake scar struck from upper right edge to reduce pronounced bulb of percussion.

Disc

09/05

46 ***Disc scraper*** (Type C, Class 9) L=30mm B=45mm T=16mm. Crude disc scraper manufactured from a flake of patinated mid grey flint. **Dorsal surface:** Three flake scars from previous removals truncated by a single flake scar from an earlier removal struck from the lower right edge of the flake used as a blank. Three flake scars from removals struck from upper left edge of flake and crude edge retouching along lower left edge of flake possibly for purposes of hafting. **Ventral surface:** Three flake scars from removals struck from upper right edge and abrupt retouching along middle section of right edge to create blunt edge for the purposes of hafting. Crude edge retouching at distal end of flake extending along lower and lower right edges.

12/09

99 ***Disc scraper*** (Type C, Class 7) L=30mm B=27mm 14mm. Crude disc scraper manufactured from a patinated cortical flake of light grey flint. **Dorsal surface:** Approximately half of dorsal surface retains traces of cortex. Four removals struck from proximal end and right edge to create crude working edge. Three flake scars from previous removals from distal end of flake used as blank. **Ventral surface:** Unworked.

15/10

158 ***Disc scraper*** (Type C, Class 7) L=29mm B=30mm T=11mm. Crude disc scraper manufactured from a heavily patinated non-cortical flake of light grey flint. **Dorsal surface:** Two flake scars from previous removals. Three flakes struck from proximal

end to reduce striking platform. Five flakes struck from circumference of scraper to create working edge. **Ventral surface:** Unworked.

23/19

272 ***Disc scraper*** (Type C, Class 7) L=26mm B=27mm T=9mm. Disc scraper manufactured from a patinated non-cortical flake of mid grey flint. **Dorsal surface:** Four flake scars from previous removals, one of which had been struck from a second striking platform at the lower right edge of the flake used as a blank. Semi invasive and abrupt edge retouching at upper left edge with abrupt edge retouching continuing along the left edge of the flake used as a blank. Semi invasive edge retouching along upper right edge. **Ventral surface:** Pronounced bulb of percussion. Semi invasive edge retouch to left and right edges of the distal end of the flake used as a blank possibly creating notches. Abrupt edge retouching to distal end of flake. Possible blank for barb and tang arrowhead.

24/19

289 ***Disc scraper*** (Type C, Class 7) L=35mm B=32mm T=16mm. Disc scraper manufactured from a cortical flake of dark grey flint. **Dorsal surface:** Corticated with four flake scars from previous removals from lower left edge. Two possible flake scars from previous removals from proximal end and lower right edge. Working edge at proximal butt of flake used as blank formed by natural abrasion. **Ventral surface:** Five flake scars from previous removals with shallow but well-defined ripples characteristic of use of soft hammer.

Other

06/04

12 ***Broad hafted scraper*** L=37mm B=54mm T=9mm. Broad hafted scraper manufactured from a burnt non-cortical flake. **Dorsal surface:** Flake scar with pronounced ripple marks from one previous removal from left edge of striking platform. Two shallow flake scars from previous removals from upper right edge. Semi-invasive edge retouching at distal end extending along lower left and lower right edges. Abrupt edge retouching along upper left and upper right edges of scraper to blunt edges in preparation for hafting. **Ventral surface:** Semi-invasive edge retouching at distal end

extending along lower left and lower right edges. Possible crude edge retouching at upper left and upper right edges in preparation for hafting.

25/13

296 ***Horseshoe scraper*** (Class 3) L=33mm B=30mm T=9mm. Horseshoe scraper manufactured from a lightly patinated flake of dark grey flint. **Dorsal surface:** Two flake scars from previous removals. Middle section of flake used as a blank retains traces of cortex. Ten shallow flakes with diffuse flake scars characteristic of use of a soft hammer struck from the circumference of the flake. Abrupt edge retouching along upper left and lower left edges to create a haft which in turn was blunted by semi invasive and abrupt edge retouching. Semi invasive and abrupt edge retouching at distal end extending along right edge to create a scraping edge. Striking platform faceted? **Ventral surface:** Unworked with a single flake scar from a parasitic removal.

27/17

312 ***Horseshoe scraper*** (Class 3) L=26mm B=28mm T=5mm. Horseshoe scraper manufactured from a non-cortical flake of light brown flint. ?Rejuvenation flake. **Dorsal surface:** One flake scar from previous removal. Semi invasive and abrupt edge retouching extending along left edge, right edge and distal end of the flake used as a blank. **Ventral surface:** Semi invasive edge retouching along upper right and lower right edges creating a blunt point for the purposes of hafting.

Broken

15/15

175 ***Broken scraper*** (Type E, Class 10) L=17mm B=15mm T=8mm. Broken scraper manufactured from a broken non-cortical flake of dark grey flint with differential patination. **Dorsal surface:** Abrupt retouch along left edge and distal end of flake, extending along lower right edge (differential patination). **Ventral surface:** Unworked.

16/16

191 ***Broken scraper*** (Type E, Class 10) L=28mm, B=20mm T=6mm. End scraper manufactured from a broken non-cortical flake of light grey flint. **Dorsal surface:** Three flake scars from previous removals. Invasive, semi-invasive and abrupt edge

retouching at distal end of flake, extending along lower left and lower right edges. Possible notch at upper right corner. **Ventral surface:** Unworked.

18/10

213 ***Broken scraper*** (Type E, Class 10) L=19mm B=26mm T=13mm. Broken scraper manufactured from a patinated flake of mid grey flint. **Dorsal surface:** Possible evidence for trimming to edge of striking platform. ?Two flake scars from previous removals. Six flakes removed from circumference to create working edge. **Ventral surface:** Unworked.

Other

Awls

07/09

21 ***Awl*** L=32mm B=15mm T=5mm. Awl manufactured from a non-cortical flake of light grey flint. **Dorsal surface:** Flake scars from five previous removals, truncated by single flake scar from removals struck from upper right edge of flake. Abrupt edge retouching from both sides of distal end creating a narrow point. Point rounded by abrasion or crude edge retouching. **Ventral surface:** Unworked.

14/11

144 ***Awl*** L=22mm B=10mm T=3mm. Awl manufactured from an irregular non-cortical blade of mid grey flint. **Dorsal surface:** Four flake scars from previous removals, truncated by a shallow flake scar from an opposed striking platform at the distal end of the blade used as a blank. Flake scar from a possible burin blow to the right edge of the proximal end with abrupt edge retouching to the left edge of the proximal end to create a well-defined point. **Ventral surface:** Unworked.

22/14

261 ***Awl*** L=30mm B=15mm T=5mm. Awl manufactured from a non-corticated lightly patinated flake of mid grey flint. **Dorsal surface:** Four flake scars from previous removals. Abrupt edge retouching to upper and middle right edge. Abrupt edge retouching to create slight notch at middle of left edge for purposes of hafting. **Ventral surface:** Single removal from right edge of distal end to create a sharp point with possible edge retouching to lower left edge.

12/09

97 ***Awl*** L=42mm B=22mm T=9mm. Crude awl manufactured from a cortical flake of mid grey flint. **Dorsal surface:** Three flake scars from previous removals. Flake struck from proximal end of blank to reduce the depth of the striking platform. Semi-invasive edge retouching to lower right edge and abrupt edge retouching to lower left edge to create a well-defined point. **Ventral surface:** Unworked with possible abrasion to lower left edge.

Burins

18/13

215 ***Burin*** L=17mm B=8mm T=2mm. Burin manufactured from non-cortical flake of light grey flint. **Dorsal surface:** Evidence for trimming of edge for striking platform. Three flake scars from previous removals. Burin spall removed from left edge of distal end. **Ventral surface:** Single flake struck from left edge of distal end.

Microliths

12/14

103 ***Microlith*** L=16mm B=12mm T=3mm. Microlith manufactured from the distal segment of a blade of light grey flint. **Dorsal surface:** Three flake scars from previous removals. Left edge of blade truncated by an oblique fracture with fine abrupt edge retouching or pressure flaking to create a well-defined point. **Ventral surface:** Unworked.

Retouched

04/03

4 ***Retouched flake*** L=53mm B=48mm T=12mm. Retouched flake manufactured from a cortical flake of heavily patinated light grey flint. **Dorsal surface:** Left margin partially corticated. Flake scar from one previous removal. Abrupt edge retouching at distal end. Possible crude edge retouching along lower left edge. **Ventral surface:** Unworked.

07/05

16 ***Retouched angular shatter*** L=42mm B=19mm T=13mm. Retouched piece of angular shatter manufactured from lightly patinated mid brown flint. **Dorsal surface:** Left

edge partially corticated. Two flake scars from previous removals. Crude abrupt/semi-invasive edge retouching along lower right edge. **Ventral surface:** Unworked.

08/04

22 ***Retouched flake*** L= 40mm B=30mm T=12mm. Retouched flake or crude end scraper manufactured from a piece of mid grey flint with a distinctive flat cortical surface characteristic of tabular flint. Lightly patinated. **Dorsal surface:** Four flake scars from previous removals, possibly isolating a point of impact above a trimmed striking platform. **Ventral surface:** Abrupt/semi-invasive edge retouching along pronounced hinge fracture along the distal end of the flake used as a blank.

08/09

35 ***Retouched flake*** L= 34mm B=15mm T=6mm. Retouched flake manufactured from a cortical flake from mid grey flint. **Dorsal surface:** Three flake scars from previous removals with pronounced step fracture from possible miss hit, fine abrupt edge retouching or pressure flaking to middle section of right edge of flake used as blank. Crushed striking platform. **Ventral surface:** Unworked with hinge fracture at distal end.

08/10

41 ***Retouched flake*** L=17mm W=18mm T=4mm. Retouched flake manufactured from a cortical flake of patinated mid grey flint, possibly a crude oblique arrowhead. **Dorsal surface:** Possible tranchet flake removed from distal end of flake used as a blank with abrupt retouch. One flake scar from previous removal or flake struck for purposes of hafting. **Ventral surface:** Unworked.

09/07

51 ***Retouched flake*** L=36mm B=30mm T=9mm. Retouched flake manufactured from a cortical flake of mid grey flint. **Dorsal surface:** Four diffuse flake scars from previous removals struck from upper right edge, fine abrupt retouching or pressure flaking at distal end of flake. **Ventral surface:** Pronounced bulb of percussion. Possible crude retouch to left edge.

09/09

62 ***Retouched flake*** L= 27mm B=14mm T=6mm. Broken retouched flake manufactured from a cortical flake of patinated dark grey flint. **Dorsal surface:** Predominately corticated with flake scars from three previous removals from right edge of flake used as blank. Possible edge retouching along left edge of flake, trimmed striking platform. **Ventral surface:** Fine edge retouching along right-hand edge.

10/09

72 ***Retouched flake*** L=25mm B=17mm T=6mm. Retouched flake manufactured from a cortical flake of light grey flint. **Dorsal surface:** Three flake scars from previous removals, fine edge retouching along lower left edge. Possible crude edge retouching along lower right edge. **Ventral surface:** Unworked with slight hinge termination.

10/11

76 ***Retouched flake*** L=46mm B=31mm T=14mm. Patinated retouched flake manufactured from a chunky cortical flake of mid grey flint. **Dorsal surface:** Left edge partially corticated, abrupt edge retouching along upper left edge. Possible semi-invasive edge retouching to right edge of striking platform. **Ventral surface:** Unworked with pronounced hinge fracture at distal end.

11/10

295 ***Retouched flake*** L=61mm B=36mm T=14mm. Retouched flake manufactured from a heavily patinated piece of mid to dark brown flint. **Dorsal surface:** Single flake scar from previous removal struck from the right edge of the flake used as a blank. Crude invasive/semi-invasive edge retouching along right edge. **Ventral surface:** Unworked.

12/14

106 ***Retouched flake*** L=34mm B=24mm T=7mm. Retouched flake or crude end scraper manufactured from a non-cortical flake of dark grey flint. **Dorsal surface:** Four flake scars from previous removals. Two flake scars possibly associated with reduction of striking platform. Crude edge retouching at distal end to create a working edge. **Ventral surface:** Unworked with possible removal from distal end to produce a pronounced hinged over overshot flake termination.

12/15

108 ***Retouched flake*** L=41mm B=13mm T=6mm. Retouched flake manufactured from an irregular cortical blade of dark grey flint with differential patination. **Dorsal surface:** Left edge corticated. Two flake flakes from previous removals struck from opposed striking platform. possible trimming of striking platform or semi-invasive retouching to proximal end of blade used as blank (patination suggests the latter). **Ventral surface:** Invasive or semi-invasive edge retouching to proximal end (unpatinated).

13/06

110 ***Retouched blade*** L=26mm B=13mm T=3mm. Retouched or serrated blade manufactured from a piece of light grey flint. **Dorsal surface:** Flake scars from four previous removals. Fine abrupt edge retouching or pressure flaking to create a notch midway along right edge of blade. Crude edge retouching or serration to left and right edges of blade. **Ventral surface:** Flake scar from burin blow to left edge of proximal end.

13/09

119 ***Retouched flake*** L=32mm B=16mm T=6mm. Retouched flake manufactured from a piece of light grey flint. **Dorsal surface:** Three flake scars from previous removals. Fine edge retouching or pressure flaking along right edge of blade. Possible crude notch midway along left edge of blade. **Ventral surface:** Flake scars from two removals struck from proximal end of blade to reduce the striking platform. Fine edge retouching or pressure flaking from proximal end of flake.

13/13

127 ***Retouched flake*** L=17mm B=13mm T=5mm. Retouched flake manufactured from a broken cortical flake of light grey flint. **Dorsal surface:** Left edge of flake partially corticated with fine abrupt edge retouching. Two flake scars from previous removals. Abrupt edge retouching along distal end of flake. **Ventral surface:** Unworked.

13/15

133 ***Retouched flake*** L=17mm B=25mm T=7mm. Retouched flake manufactured from a cortical flake of dark grey flint. **Dorsal surface:** Three flake scars from previous removals from left edge of flake. Right edge partially corticated. Crude abrupt edge

retouching at distal end along right edge of flake. **Ventral surface:** Unworked with corticated striking platform.

14/06

137 ***Retouched flake*** L=20mm B=26mm T=9mm. Retouched flake or crude end scraper manufactured from a cortical flake of mid grey flint. **Dorsal surface:** Unworked with abrasion or crude edge retouching around circumference. **Ventral surface:** Crude semi-invasive edge retouching along upper right edge.

15/09

155 ***Retouched blade*** L=29mm B=10mm T=4mm. Retouched blade manufactured from a piece of mid grey flint. **Dorsal surface:** Three flake scars from previous removals, possible crude edge retouching to left edge and upper right edge of blade. **Ventral surface:** Unworked with overshot blade termination.

15/15

174 ***Retouched flake*** L=27mm B=18mm T=7mm. Retouched flake manufactured from a cortical flake of mid grey flint. **Dorsal surface:** Three flake scars from previous removals. Crude edge retouching along left edge. **Ventral surface:** Crude edge retouching along right edge.

15/18

178 ***Retouched flake*** L=48mm B=22mm T=10mm. Retouched cortical flake manufactured from a piece of lightly patinated mid grey flint, proximal end broken. **Dorsal surface:** Three flake scars from previous removals, crude edge retouching along upper left edge. **Ventral surface:** Crude edge retouching along right edge.

16/08

181 ***Retouched flake*** L=40mm B=23mm T=8mm. Retouched cortical flake manufactured from a piece of mid grey flint. **Dorsal surface:** Five flake scars from previous removals struck from right edge of flake used as a blank (creation of a new striking platform at base of debitage surface). Two shallow flake scars from lower left edge, abrupt edge retouching to middle section of left edge. **Ventral surface:** Abrupt edge retouching along right edge.

17/13

201 ***Retouched flake*** L=19mm B=15mm T=4. Broken retouched flake manufactured from a piece of light grey flint. **Dorsal surface:** Remnants of trimmed striking platform, left edge broken. Three shallow flake scars at distal end. **Ventral surface:** Semi-invasive edge retouching along right edge, with possible notch at right edge of striking platform.

18/09

211 ***Retouched flake*** L=24mm B=19mm T=5mm. Retouched flake manufactured from a piece of light grey flint with a corticated striking platform. ?Blank for barbed and tanged arrowhead. **Dorsal surface:** Four flake scars from previous removals, truncated by fifth flake scar from a removal struck from the lower left edge of the flake. Edge of striking platform trimmed to isolated a point of impact above two of the ridges formed by the intersections of the flake scars from the previous removals. Abrupt edge retouching along the distal end to create an oblique point. **Ventral surface:** Unworked.

18/14

221 ***Retouched blade*** L=44mm T=17mm B=4mm. Retouched non-cortical blade manufactured from a piece of light grey flint. ?Awl. **Dorsal surface:** Three flake scars from previous removals, fine abrupt edge retouching to lower left edge with possible notch at left edge of distal end. Possible edge retouching along right edge. **Ventral surface:** Unworked.

18/15

225 ***Retouched blade*** L=33mm B=14mm T=8mm. Broken retouched blade manufactured from a natural ridge of mid grey flint with differential patination. **Dorsal surface:** Predominately corticated with single flake scar from previous removal at upper left edge. Invasive edge retouching at lower left edge and abrupt edge retouching at lower right edge (differential patination). **Ventral surface:** Abrupt edge retouching at lower right edge (differential patination).

18/19

228 ***Retouched flake*** L=25mm B=34mm T=9mm. Retouched non-cortical flake manufactured from a piece of lightly patinated mid grey flint. Possible unfinished

barb and tang arrowhead? **Dorsal surface:** Three flake scars from previous removals. Evidence for reduction of crushed edge of striking platform, possible crude retouch at upper left and lower left edges to create a well-defined point. Abrupt edge retouching at lower right edge to create base of tang. **Ventral surface:** Possible start of notch at lower left edge. Three flake scars from proximal end to produce pronounced striking platform.

19/13

233 ***Retouched flake*** L=25mm B=20mm T=15mm. Retouched cortical flake manufactured from a piece of mid grey flint. ?Crude oblique arrowhead. **Dorsal surface:** Fully corticated. **Ventral surface:** Semi-invasive edge retouching to right edge and crude edge retouching of right edge of proximal end to create well defined point.

234 ***Retouched flake*** L=20mm B=20mm T=6mm. Retouched non-cortical flake manufactured from a piece of patinated mid grey flint. **Dorsal surface:** Three flake scars from previous removals, upper left edge and left of striking platform abruptly retouched. **Ventral surface:** Abrupt edge retouching along upper right edge and right edge of striking platform.

19/09

231 ***Retouched flake*** L=39mm B=17mm T=8mm. Retouched cortical flake manufactured from a piece of light grey flint. **Dorsal surface:** Four flake scars from previous removals, distal end partially corticated. Fine edge retouching or pressure flaking to create a slight notch at middle section of left edge with opposed notch in middle of right edge for purposes of hafting. Semi-invasive edge retouching to right edge of proximal end, extending along lower right edge. **Ventral surface:** Possible burin spall struck from right edge of striking platform.

19/18

243 ***Retouched flake*** L=28mm B=12mm T=4mm. Retouched cortical flake manufactured from a piece of mid grey flint. **Dorsal surface:** Right edge partially corticated. Three flake scars from previous removals. Abrupt edge retouching to lower left edge to create concave working edge. **Ventral surface:** Unworked.

20/13

245 ***Retouched flake*** L=39mm B=24mm T=10mm. Retouched cortical flake manufactured from a piece of mid grey flint. **Dorsal surface:** Upper right edge broken, lower left edge partially corticated. Semi-invasive and abrupt edge retouching to distal end. **Ventral surface:** Crude abrupt edge retouching along left edge. Three shallow flake scars from removals struck from distal end of flake.

20/18

248 ***Retouched flake*** L=21m B=29mm T=9mm. Retouched non-cortical flake manufactured from a piece of light brown flint. **Dorsal surface:** Two flake scars from previous removals. Semi-invasive edge retouching at right hand of distal end. **Ventral surface:** Abrupt edge retouching at right hand edge of distal end.

20/21

249 ***Retouched flake*** L=21mm B=19mm T=4mm. Retouched non-cortical flake manufactured from a piece of mid grey flint with crushed striking platform. **Dorsal surface:** Four flake scars from previous removals, semi-invasive edge retouching to right end of striking platform, extending along upper right edge. **Ventral surface:** Unworked.

21/14

251 ***Retouched flake*** L=26mm B=17mm T=5mm. Retouched cortical flake manufactured from lightly patinated light grey flint. ?Side scraper. **Dorsal surface:** Four flake scars from previous removals, semi-invasive edge retouching along upper left edge. Abrupt edge retouching along left edge and distal end forming a continuous working edge. **Ventral surface:** Unworked.

21/18

255 ***Retouched flake*** L=54mm B=32mm T=11mm. Retouched non-cortical flake manufactured from a piece of heavily patinated mid grey flint. Possible transverse arrowhead? **Dorsal surface:** Three flake scars from previous removals, semi-invasive edge retouching along left edge with abrupt edge retouching to create possible notch at lower left edge. Invasive, semi-invasive and abrupt edge retouching along upper

and lower left edge. **Ventral surface:** Crude edge retouching along left edge with possible notch along lower left corner.

22/13

260 ***Retouched flake*** L=20mm, B=17mm T=4mm. Retouched con-cortical flake manufactured from a piece of mid grey flint. **Dorsal surface:** Two flake scars from previous removals, bifacial edge retouching to left edge. Possible edge retouching at right edge of distal end. **Ventral surface:** Abrupt edge retouching to middle and lower left edge to create concave working edge. Bifacial edge retouching to right edge.

22/14

262 ***Retouched flake*** L=40mm B=15mm T=9mm. Retouched crested blade manufactured from a piece of light grey flint. **Dorsal surface:** Five flake scars from previous removals with slightly offset central ridge (partially corticated). Abrupt edge retouching to upper and middle right edge. **Ventral surface:** Abrupt edge retouching to middle and lower left edge.

23/12

269 ***Retouched flake*** L=45mm B=24mm T=7mm. Retouched flake manufactured from a lightly patinated cortical flake of mid grey flint. **Dorsal surface:** Three flake scars from previous removals. Traces of cortex on upper left and lower left and upper right edges. Notch created by abrupt edge retouching to the middle section of the left edge. Possible abrupt edge retouching to middle section of right edge. **Ventral surface:** Unworked with pronounced bulb of percussion.

23/21

273 ***Crude retouched flake*** L=60mm B=25mm T=11mm. Crude retouched flake manufactured from a cortical flake of mid grey flint with differential patination and iron staining. **Dorsal surface:** Two flake scars from opposed removals. Single removal from upper left edge (unpatinated). Left and right edges partially corticated with crude abrupt edge retouching (unpatinated). **Ventral surface:** Heavily patinated with crude semi invasive edge retouching along lower right edge.

25/13

291 ***Retouched flake*** L=22mm B=23mm T=9mm. Retouched flake or crude oblique arrow head manufactured from a cortical flake of mid grey flint. **Dorsal surface:** Two flake scars from previous removals. Possible evidence of trimming of striking platform. Semi invasive flaking along left edge and abrupt edge retouching along right edge forming well defined point. **Ventral surface:** Unworked.

25/15

292 ***Retouched flake*** L=33mm B=31mm T=7mm. Retouched flake manufactured from a cortical flake of light to mid grey flint. **Dorsal surface:** Striking platform and upper right edge partially corticated. One flake scar from previous removal truncated by three flake scars struck from a second striking platform at the right edge of the flake with shallow but well-defined ripple marks characteristic of use of a soft hammer. Bifacial edge retouching along upper left edge. **Ventral surface:** Pronounced bulb of percussion. Bifacial edge retouching along upper right edge. Fine abrupt edge retouching and semi invasive edge retouching along lower left edge. Fine abrupt edge retouching along lower right edge. Four shallow flake scars struck from proximal end of flake used as blank to reduced pronounced bulb of percussion or striking platform.

25/16

293 ***Retouched flake*** L=34mm B=20mm T=12mm. Retouched flake manufactured from a non-cortical flake of mid grey flint with a trimmed or abraded striking platform. **Dorsal surface:** Three flake scars from previous removals struck from the same striking platform. Three flake scars from removals struck from an opposed striking platform at the distal of the flake used as a blank. Semi invasive edge retouching along right edge. **Ventral surface:** Unworked with four flake scars struck from dorsal edge of striking platform.

25/17

294 ***Retouched flake*** L=26mm B=17mm T=7mm. Retouched flake manufactured from a cortical flake of mid grey flint with a over shot flake termination. **Dorsal surface:** Two flake scars from previous removals. Abrupt edge retouching along right edge of flake. Possible notch created along middle section of left edge of flake by crude edge retouching. **Ventral surface:** Unworked.

26/12

299 ***Retouched core fragment*** L=25mm B=44mm T=19mm. Retouched core fragment manufactured from a secondary flake or core fragment with a corticated striking platform and over shot flake termination. **Dorsal surface:** Four flake scars from previous removals truncated by a single flake struck from the left edge of the striking platform. Four removals struck from right edge of the flake used as a blank with crude edge retouching or abrasion. Abrupt edge retouching along left edge of the flake used as a blank. **Ventral surface:** Flake scars from removals struck from left edge of striking platform and left edge of dorsal surface.

26/20

306 ***Retouched flake*** L=39mm B=24mm T=11mm. Retouched flake manufactured from a lightly patinated broken cortical flake of mid grey flint. **Dorsal surface:** Upper left edge broken, lower left edge corticated. Possible crude abrupt edge retouching at lower left corner. Three flake scars from previous removals. Semi invasive edge retouching along middle section and lower left edge. **Ventral surface:** Flake scar from parasitical removal. Flake used as a blank terminates in a hinged flake termination. Crude edge retouching along middle section of left edge.

26/21

307 ***Retouched flake*** L=30mm B=30mm T=7mm. Retouched flake manufactured from a broken cortical flake of mid grey flint. **Dorsal surface:** Predominately corticated with crude edge retouching along left edge and fine semi invasive and abrupt edge retouching along right edge. **Ventral surface:** Five shallow flake scars with well-defined ripple marks characteristic of flakes struck using a soft hammer removed from proximal end of flake to reduce pronounced bulb of percussion.

27/17

313 ***Retouched shatter*** L=3mm B=19mm T=16mm. Retouched shatter manufactured from a lightly patinated piece of angular shatter with differential patination. **Dorsal surface:** Eleven flake scars from previous removals (two with differential patination). Abrupt edge retouching along the three long edges and possible faceting to one end of the piece of angular shatter. **Ventral surface:** Unworked.

27/21

316 ***Retouched core fragment*** L=30mm B=34mm T=13mm. Retouched core fragment manufactured from a piece of lightly patinated mid brown flint. **Dorsal surface:** Flake scars from seven previous removals struck from at least three different directions. Three flake scars struck from ventral edge of striking platform. Semi invasive and abrupt edge retouching at distal end of core fragment. **Ventral surface:** Crude edge retouching along lower left and lower right edges.

29/22

320 ***Retouched flake*** L=28mm B=20mm T=10mm. Retouched flake manufactured from a non-cortical flake of mid grey flint with differential patination indicative of the reuse of a piece of flint from an earlier phase of activity. **Dorsal surface:** Three flake scars from previous removals (irregular scar pattern). Possible semi invasive and abrupt edge retouching to proximal end of flake. Left edge crushed with granular texture. **Ventral surface:** Possible semi invasive edge retouching along left edge and distal end. Extensive evidence of crushing.

34/21

333 ***Retouched flake*** L=27mm B=28mm T=9mm. Retouched flake manufactured from a heavily patinated flake fragment. **Dorsal surface:** Proximal end broken, two flake scars from previous removals struck from right edge of flake. Left edge partially corticated with semi invasive edge retouch both patinated and unpatinated possibly indicating reuse. **Ventral surface:** Unworked.

35/24

335 ***Retouched flake*** L=17mm B=19mm T=8mm. Retouched flake manufactured from a non-cortical flake of mid grey flint with differential patination. **Dorsal surface:** Edge of striking platform trimmed. Four flake scars from previous removals. Semi invasive edge retouching (unpatinated) along left edge extending along distal end. **Ventral surface:** Lower left edge broken (unpatinated).

Serrated

11/06

78 ***Serrated blade*** L=35mm B=13mm T=6mm. Serrated blade manufactured from a non-cortical blade of light brown flint. **Dorsal surface:** Two parallel ridges formed by flake

scars from three previous removals, struck from opposed striking platform. Fourth flake scar from a single removal from the same striking platform used to produce the blade. Striking platform isolated. Fine serration along right edge. Crude edge retouching along left edge. **Ventral surface:** Unworked with parasitic flake scar from bulb of percussion.

13/08

113 ***Serrated blade*** L=26mm B=15mm T=3mm. Serrated blade manufactured from a piece of light grey flint. **Dorsal surface:** Four flake scars from previous removals. Left and right edges slightly abraded. **Ventral surface:** Middle section of left edge finely serrated.

16/08

179 ***Serrated blade*** L=28mm B=10mm T=3mm. Non-cortical blade manufactured from piece of light brown flint. **Dorsal surface:** Two flake scars from previous removals, evidence for trimming of edge of striking platform. Both edges of blade crudely serrated. **Ventral surface:** Unworked with eraillure flake.

16/17

192 ***Serrated blade*** L=41mm B=18mm T=7mm. Serrated non-cortical blade manufactured from a piece of mid grey flint. **Dorsal surface:** Five flake scars from previous removals. Evidence for trimming or reduction of striking platform at proximal end of blade. Both edges of blade serrated. **Ventral surface:** Unworked with pronounced step fracture at distal end.

25/18

295 ***Serrated blade*** L=18mm B=12mm T=3mm. Serrated blade manufactured from the distal segment of a blade with an over shot termination. **Dorsal surface:** Three ridges formed by the intersection of flake scars from four previous removals. Right edge of blade segment finely serrated. **Ventral surface:** Unworked.

26/13

300 ***Serrated flake*** L=27mm B=19mm T=5mm. Serrated flake manufactured from a patinated flake of light grey flint with a corticated striking platform. **Dorsal surface:** Five flake scars from previous removals. Left edge of striking platform trimmed, right

edge broken (differential patination). Lower left and lower right edges finely serrated creating a point at the distal end of the flaked used as a blank. **Ventral surface:** Semi invasive edge retouching at lower right edge, possibly continuing along middle section of right edge.

Characteristics of the lithic debitage from Wharram-le-Street

Cores

ID	Sub Group	Source	Colour	Reuse	Cortication	Condition	L	B	T	Intensity	Volume	Regularity	Platform
17	Opposed Platform	-	Grey (Mid)	-	5	Patinated	44.64	30.70	20.14	12	27600.82	24.50	
31	Other	-	Grey (Mid)	-	4	Fresh	33.73	29.63	16.57	5	16560.39	17.16	
43	Single Platform	-	Grey (Mid)	-	5	Patinated	34.14	21.48	20.48	7	15018.54	13.66	Trimmed
50	Polyhedral	-	Grey (Mid)	-	6	Patinated	26.27	23.23	15.81	9	9648.09	10.46	-
71	Other	-	Grey (Mid)	Yes	5	Broken	32.87	28.95	18.88	7	17965.95	13.99	-
84	Simple	Tabular	Grey (Mid)	Yes	4	Fresh	31.56	41.87	18.68	8	24684.07	23.19	-
85	Single Platform	-	Grey (Mid)	-	6	Fresh	45.83	198.82	17.26	8	157271.75	181.56	Trimmed
86	Single Platform	-	Grey (Mid)	-	5	Patinated	24.27	32.44	31.36	12	24690.32	8.17	Isolated
91	Simple	-	Grey (Dark)	-	5	Fresh	28.22	40.68	29.82	5	34233.05	12.46	-
92	Single Platform	-	Grey (Dark)	-	5	Patinated	27.55	37.08	24.06	7	24578.59	13.02	-
115	Opposed Platform	-	Grey (Mid)	-	5	Fresh	33.60	22.25	14.09	7	10533.68	19.51	Trimmed
143	Discoidal	-	Grey (Light)	Yes	7	Patinated	44.60	37.26	15.84	8	26322.85	28.76	-
166	Polyhedral	-	Grey (Light)	-	7	Fresh	26.13	25.16	20.24	17	13306.40	5.89	-
172	Opposed Platform	-	Grey (Light)	-	7	Patinated	50.19	22.14	18.91	15	21012.92	31.28	Trimmed
189	Discoidal	-	Grey (Dark)	-	6	Patinated	44.68	33.79	22.86	11	34512.59	21.82	-
208	Polyhedral	Tabular	Grey (Mid)	Yes	5	Fresh	29.45	30.29	28.57	12	25485.60	1.72	-
217	Discoidal	-	Grey (Dark)	-	6	Fresh	41.84	35.03	19.25	21	28213.86	22.59	Trimmed
246	Single Platform	Tabular	Grey (Light)	-	5	Patinated	32.95	24.36	22.42	8	17995.68	10.53	-
252	Polyhedral	-	Grey (Mid)	-	6	Patinated	38.78	33.28	21.00	21	27102.57	17.78	-
283	Discoidal	-	Brown (Mid)	Yes	7	Patinated	34.69	56.49	24.85	14	48697.01	31.64	-
297	Other	-	Grey (Light)	-	5	Patinated	43.40	69.45	44.69	7	134701.47	26.05	-
326	Other	-	Brown (Mid)	-	7	Patinated	36.74	27.58	15.91	13	16121.43	20.83	-
336	Pyramidal	-	Grey (Mid)	-	5	Patinated	39.05	24.72	31.47	10	30378.49	14.33	Trimmed

Other

Morphology

ID	Group	Sub Group	Source	Colour	Reuse	Cortication	Condition	Platform	EPA	Termination	Removals	Directions	Pattern
1	Flake	Broken	-	White	-	7	Fresh	Crushed	80	-	3	1	Parallel
2	Flake	Non-cortical	-	White	-	7	Fresh	None	85	Feathered	2	1	n/a
3	Flake	Non-cortical	-	White	-	7	Abraded	None	50	Feathered	1	1	None
5	Flake	Fragment	-	Red	-	6	Broken	None	90	Feathered	1	1	None
6	Blade	Non-cortical	-	Grey (Mid)	-	7	Fresh	None	80	Feathered	4	1	Parallel
7	Flake	Non-cortical	Chalk	White	-	7	Fresh	None	70	Feathered	1	1	None
8	Flake	Broken	-	Brown (Mid)	-	7	Patinated	None	85	-	2	1	n/a
10	Flake	Cortical	-	Grey (Light)	-	6	Patinated	None	40	Feathered	3	2	Irregular
11	Flake	Cortical	-	Grey (Light)	-	5	Patinated	None	65	Hinged	2	1	n/a
13	Flake	Non-cortical	-	Grey (Light)	-	7	Patinated	Isolated	85	Stepped	3	1	Parallel
14	Flake	Cortical	-	Grey (Light)	-	6	Patinated	None	90	Stepped	1	1	None
15	Flake	Non-cortical	-	Grey (Light)	-	7	Patinated	None	75	Stepped	3	1	Parallel
18	Flake	Non-cortical	-	Grey (Dark)	-	7	Fresh	Abraded	80	Stepped	2	1	n/a
19	Flake	Cortical (rejuvenation)	-	Grey (Dark)	-	6	Patinated	Crushed	100	Hinged	3	2	Irregular
24	Flake	Non-cortical	-	Grey (Light)	-	7	Patinated	Faceted	80	Feathered	2	1	n/a
25	Debris	Shatter	Tabular	Grey (Mid)	-	5	Patinated	None	0	-	3	3	Irregular
26	Debris	Shatter	-	Grey (Light)	-	2	Abraded	None	0	-	3	2	Irregular
27	Blade	Fragment	-	Grey (Light)	-	7	Patinated	Abraded	75	Stepped	3	1	Parallel
29	Debris	Shatter	-	Grey (Light)	-	6	Abraded	None	0	-	6	4	Irregular
30	Flake	Cortical	-	Grey (Light)	-	5	Fresh	Faceted	75	Feathered	5	2	Opposed
32	Debris	Shatter	-	Grey (Mid)	-	3	Patinated	None	0	-	6	4	Opposed
33	Flake	Fragment	-	Grey (Light)	-	4	Fresh	-	0	Feathered	2	1	n/a
34	Flake	Fragment	-	Grey (Mid)	-	7	Patinated	-	0	Stepped	2	1	n/a
37	Flake	Fragment	-	Brown (Light)	-	6	Patinated	-	0	Stepped	2	1	n/a
38	Flake	Cortical	-	Grey (Mid)	-	6	Burnt	None	65	Feathered	3	1	Parallel

ID	Group	Sub Group	Source	Colour	Reuse	Cortication	Condition	Platform	EPA	Termination	Removals	Directions	Pattern
39	Flake	Cortical	-	Grey (Mid)	-	6	Fresh	None	70	Feathered	2	2	n/a
40	Flake	Non-cortical	-	Grey (Mid)	-	7	Fresh	None	85	Feathered	4	1	Parallel
44	Flake	Cortical	-	Grey (Light)	-	5	Patinated	None	75	Overshot	4	1	Parallel
45	Flake	Fragment	-	Grey (Light)	-	7	Patinated	-	0	Feathered	2	1	n/a
47	Flake	Non-cortical (rejuvenation)	-	Grey (Light)	-	7	Fresh	Faceted	70	Overshot	15	6	Opposed
48	Flake	Cortical	-	Grey (Light)	-	4	Abraded	Abraded	60	Feathered	1	1	None
49	Flake	Non-cortical	-	Grey (Light)	-	7	Fresh	Abraded	70	Feathered	4	1	Parallel
52	Flake	Cortical	-	Grey (Mid)	-	5	Patinated	None	80	Hinged	3	1	Parallel
53	Blade	Segment	-	Grey (Mid)	-	7	Patinated	Trimmed	85	-	5	1	Parallel
54	Flake	Non-cortical	-	Grey (Mid)	-	7	Fresh	Crushed	80	Hinged	1	1	None
55	Flake	Cortical (rejuvenation)	-	Grey (Dark)	-	6	Fresh	None	95	Overshot	9	2	Opposed
56	Flake	Cortical	-	Grey (Light)	-	5	Fresh	None	85	Feathered	2	1	n/a
58	Flake	Non-cortical	-	Brown (Light)	-	7	Patinated	None	80	Overshot	2	1	n/a
59	Flake	Non-cortical	-	Brown (Light)	-	7	Patinated	None	60	Stepped	3	1	Parallel
60	Flake	Non-cortical	-	Grey (Light)	-	7	Fresh	Trimmed	55	Feathered	3	1	Parallel
61	Flake	Non-cortical	-	Grey (Dark)	-	7	Fresh	None	85	Stepped	3	1	Irregular
63	Flake	Cortical	-	Grey (Light)	-	3	Patinated	Abraded	80	Overshot	3	1	Parallel
64	Flake	Non-cortical	-	Grey (Mid)	-	7	Fresh	Crushed	80	Feathered	2	1	n/a
66	Flake	Cortical	-	Grey (Light)	-	6	Patinated	None	80	Stepped	4	1	Parallel
67	Flake	Non-cortical	-	Grey (Light)	-	7	Fresh	None	80	Stepped	2	1	n/a
69	Debris	Shatter	-	Grey (Light)	-	1	Abraded	None	0	-	3	2	Irregular
70	Flake	Cortical	Tabular	Grey (Mid)	-	5	Fresh	Trimmed	70	Hinged	4	3	Irregular
73	Flake	Cortical	-	Grey (Light)	-	4	Fresh	None	90	Stepped	2	2	n/a
74	Flake	Cortical	-	Grey (Light)	-	1	Fresh	Trimmed	65	Hinged	0	0	None
75	Flake	Non-cortical	-	Grey (Light)	-	7	Patinated	None	80	Feathered	2	1	n/a
77	Flake	Non-cortical	-	Grey (Mid)	-	7	Patinated	None	75	Overshot	5	3	Irregular
79	Flake	Cortical	-	Grey (Light)	-	5	Fresh	Abraded	90	Feathered	4	2	Opposed

ID	Group	Sub Group	Source	Colour	Reuse	Cortication	Condition	Platform	EPA	Termination	Removals	Directions	Pattern
80	Blade	Fragment	-	Grey (Mid)	-	7	Fresh	-	0	Feathered	3	1	Parallel
81	Flake	Cortical	-	Grey (Light)	-	5	Fresh	Crushed	85	Stepped	2	1	n/a
82	Flake	Cortical	-	Grey (Mid)	-	6	Fresh	Corticated	80	Feathered	3	3	Irregular
83	Flake	Cortical	-	Grey (Light)	-	4	Patinated	Abraded	75	Overshot	3	3	Irregular
87	Flake	Cortical	Tabular	Grey (Mid)	-	5	Fresh	Corticated	80	Overshot	3	1	Irregular
89	Debris	Shatter	Tabular	Grey (Mid)	-	3	Patinated	None	0	-	4	4	Irregular
90	Flake	Fragment	-	Grey (Light)	-	4	Patinated	-	0	Stepped	2	1	n/a
93	Flake	Cortical	-	Grey (Light)	-	4	Patinated	None	85	Overshot	2	1	n/a
94	Blade	Non-cortical	-	Grey (Light)	-	7	Fresh	Trimmed	65	Stepped	1	1	None
95	Flake	Broken	-	Grey (Light)	-	7	Fresh	None	80	-	2	1	n/a
96	Debris	Shatter	-	Grey (Light)	-	5	Fresh	None	0	-	7	5	Irregular
98	Flake	Non-cortical	-	Grey (Light)	-	6	Patinated	Abraded	85	Hinged	2	1	n/a
100	Debris	Shatter	-	Grey (Mid)	-	6	Fresh	None	0	-	6	1	Parallel
101	Flake	Cortical	-	Grey (Light)	-	3	Patinated	None	75	Overshot	3	2	Opposed
102	Flake	Non-cortical	-	Grey (Light)	-	7	Fresh	None	90	Feathered	1	1	None
104	Blade	Fragment	-	Grey (Dark)	-	6	Fresh	-	0	Stepped	3	1	Parallel
105	Debris	Shatter	-	Grey (Dark)	-	5	Patinated	None	0	-	7	7	Irregular
107	Flake	Non-cortical	-	Grey (Light)	-	7	Patinated	Faceted	90	Stepped	6	3	Irregular
109	Flake	Cortical	-	Grey (Light)	-	6	Fresh	None	85	Stepped	2	1	n/a
111	Flake	Cortical	Tabular	Grey (Light)	-	6	Patinated	Crushed	90	Overshot	4	2	Irregular
112	Flake	Non-cortical	-	Grey (Light)	-	7	Patinated	Faceted	85	Stepped	2	1	n/a
114	Flake	Non-cortical	-	Grey (Light)	-	7	Patinated	Trimmed	80	Stepped	2	1	n/a
116	Flake	Fragment	-	Grey (Light)	-	7	Fresh	-	0	Feathered	1	1	None
117	Flake	Cortical	-	Grey (Dark)	-	4	Fresh	Faceted	85	Feathered	3	2	Irregular
118	Flake	Non-cortical	-	Brown (Light)	-	7	Patinated	None	85	Stepped	4	2	Parallel
120	Debris	Shatter	-	Black	-	1	Fresh	None	0	-	4	2	Irregular
121	Flake	Broken	-	Grey (Light)	-	7	Patinated	Abraded	70	-	3	1	Parallel
122	Flake	Non-cortical	-	Grey (Light)	-	7	Patinated	Faceted	60	Feathered	4	1	Parallel
123	Flake	Fragment	-	Grey (Light)	-	7	Fresh	None	80	Feathered	3	1	Parallel

ID	Group	Sub Group	Source	Colour	Reuse	Cortication	Condition	Platform	EPA	Termination	Removals	Directions	Pattern
124	Flake	Fragment	-	Grey (Light)	-	7	Patinated	-	0	Feathered	3	1	Parallel
125	Blade	Broken	-	Grey (Light)	-	7	Patinated	Trimmed	75	-	4	1	Parallel
126	Flake	Fragment	-	Grey (Light)	-	7	Fresh	None	85	Feathered	3	1	Parallel
128	Flake	Cortical	-	Grey (Light)	-	4	Abraded	None	90	Hinged	2	1	n/a
129	Debris	Shatter	-	Grey (Light)	-	2	Patinated	None	0	-	5	4	Irregular
130	Debris	Shatter	-	Grey (Dark)	-	5	Fresh	None	0	-	7	7	Irregular
132	Blade	Broken	-	Grey (Light)	-	5	Patinated	None	90	-	2	1	n/a
134	Flake	Non-cortical	-	n/a	-	7	Burnt	None	85	Feathered	1	1	None
135	Flake	Fragment	-	Brown (Light)	-	7	Patinated	-	0	Feathered	2	1	n/a
136	Flake	Non-cortical	-	Grey (Dark)	-	7	Patinated	None	70	Feathered	3	2	Irregular
138	Blade	Fragment	-	n/a	-	7	Burnt	None	90	Overshot	3	1	Parallel
139	Flake	Fragment	-	Grey (Light)	-	6	Abraded	-	0	Feathered	1	1	None
140	Flake	Non-cortical	-	Brown (Light)	-	7	Patinated	None	80	Feathered	4	2	Opposed
141	Flake	Cortical	-	Grey (Mid)	-	6	Patinated	Trimmed	70	Hinged	2	2	n/a
142	Debris	Shatter	-	Grey (Dark)	-	2	Patinated	None	0	-	5	4	Irregular
145	Debris	Shatter	-	White	-	5	Patinated	None	0	-	3	3	Irregular
146	Debris	Shatter	-	Grey (Light)	-	6	Patinated	None	0	-	4	3	Irregular
147	Flake	Fragment	-	Grey (Mid)	-	5	Fresh	-	0	Overshot	3	2	Parallel
148	Flake	Cortical	-	Grey (Light)	-	6	Patinated	Abraded	80	Stepped	5	2	Irregular
149	Flake	Non-cortical	-	White	-	7	Fresh	None	65	Feathered	2	1	n/a
150	Flake	Non-cortical	-	White	-	7	Abraded	None	90	Stepped	2	1	n/a
151	Flake	Cortical	-	Grey (Mid)	-	5	Fresh	None	90	Stepped	1	1	None
152	Flake	Non-cortical	-	White	-	7	Fresh	None	80	Hinged	1	1	None
153	Flake	Fragment	-	n/a	-	2	Burnt	None	90	Hinged	1	1	None
154	Flake	Non-cortical	-	Grey (Light)	-	7	Patinated	Faceted	90	Feathered	2	1	n/a
156	Flake	Non-cortical	-	Grey (Light)	-	7	Patinated	None	80	Feathered	2	1	n/a
157	Flake	Fragment	-	Grey (Light)	-	7	Fresh	None	90	Feathered	2	1	n/a
159	Flake	Cortical	-	Grey (Light)	-	5	Patinated	None	75	Feathered	2	1	n/a
160	Flake	Non-cortical	-	Grey (Light)	-	7	Patinated	Crushed	85	Feathered	3	2	Parallel

ID	Group	Sub Group	Source	Colour	Reuse	Cortication	Condition	Platform	EPA	Termination	Removals	Directions	Pattern
162	Flake	Non-cortical	-	Grey (Light)	-	7	Fresh	None	60	Stepped	3	1	Parallel
163	Flake	Non-cortical	-	Grey (Light)	-	7	Fresh	Trimmed	70	Stepped	1	1	None
164	Flake	Cortical	-	Grey (Light)	-	6	Patinated	Trimmed	85	Feathered	2	1	n/a
165	Debris	Shatter	-	Grey (Light)	-	5	Abraded	None	0	-	4	2	Opposed
167	Flake	Non-cortical	-	Grey (Light)	-	7	Patinated	Trimmed	80	Stepped	3	1	Parallel
168	Flake	Fragment	-	Grey (Light)	-	5	Patinated	Faceted	60	Overshot	4	2	Opposed
169	Flake	Non-cortical	-	Grey (Light)	-	7	Patinated	None	85	Overshot	3	1	Parallel
170	Blade	Fragment	-	Grey (Dark)	-	7	Patinated	-	0	Stepped	3	1	Parallel
171	Debris	Shatter	-	Grey (Mid)	-	3	Fresh	None	0	-	3	3	Irregular
173	Flake	Non-cortical	-	White	-	7	Fresh	None	90	Feathered	2	1	n/a
176	Blade	Broken	-	Grey (Light)	-	7	Fresh	Trimmed	80	-	2	1	n/a
177	Flake	Cortical	-	Grey (Light)	-	6	Patinated	Abraded	90	Hinged	1	1	None
180	Flake	Non-cortical	-	Grey (Light)	-	7	Fresh	None	90	Feathered	1	1	None
182	Flake	Cortical	-	Grey (Mid)	-	5	Patinated	Abraded	90	Hinged	2	1	n/a
183	Flake	Non-cortical	-	Grey (Dark)	-	7	Patinated	Trimmed	80	Stepped	4	1	Parallel
184	Flake	Non-cortical	-	Grey (Light)	-	7	Fresh	None	80	Feathered	4	2	Irregular
185	Flake	Cortical	-	Grey (Light)	-	5	Patinated	Faceted	55	Stepped	5	2	Parallel
186	Flake	Non-cortical	-	Grey (Light)	-	7	Patinated	None	85	Overshot	2	1	n/a
187	Flake	Cortical	-	Grey (Dark)	-	5	Fresh	Abraded	80	Feathered	1	1	None
188	Flake	Broken	-	Grey (Light)	-	7	Patinated	None	90	-	2	1	n/a
190	Debris	Shatter	-	Grey (Light)	-	7	Patinated	None	0	-	4	4	Irregular
193	Flake	Non-cortical	-	Grey (Light)	-	7	Abraded	None	80	Feathered	4	2	Opposed
194	Flake	Cortical	-	Grey (Light)	-	6	Fresh	None	85	Feathered	2	1	n/a
195	Debris	Shatter	-	n/a	-	7	Burnt	None	0	-	7	2	Opposed
196	Debris	Shatter	-	Brown (Light)	-	7	Patinated	None	0	-	4	4	Irregular
197	Flake	Non-cortical	-	Grey (Light)	-	7	Fresh	None	70	Hinged	2	1	n/a
198	Flake	Non-cortical	Chalk	White	-	7	Fresh	None	90	Overshot	2	1	n/a
199	Flake	Non-cortical	-	Grey (Light)	-	7	Fresh	Abraded	90	Feathered	4	2	Irregular
200	Flake	Broken	-	Grey (Dark)	-	5	Patinated	Abraded	85	-	3	2	Opposed

ID	Group	Sub Group	Source	Colour	Reuse	Cortication	Condition	Platform	EPA	Termination	Removals	Directions	Pattern
202	Flake	Cortical	-	Grey (Dark)	-	3	Patinated	Faceted	90	Feathered	4	2	Opposed
203	Flake	Cortical	-	Grey (Dark)	-	4	Abraded	Trimmed	55	Stepped	5	1	Parallel
204	Flake	Cortical	-	Grey (Light)	-	4	Patinated	Trimmed	80	Overshot	3	1	Parallel
205	Flake	Fragment	-	n/a	-	7	Burnt	-	0	Overshot	3	2	Irregular
206	Flake	Fragment	-	Grey (Light)	-	7	Patinated	-	0	Feathered	4	1	Parallel
207	Flake	Non-cortical	Chalk	White	-	7	Abraded	None	85	Feathered	2	1	n/a
209	Debris	Shatter	-	n/a	-	7	Burnt	None	0	-	4	4	Irregular
210	Debris	Shatter	-	Grey (Dark)	-	3	Burnt	None	0	-	12	7	Irregular
212	Flake	Non-cortical	-	Grey (Light)	-	7	Fresh	Faceted	75	Feathered	3	1	Parallel
214	Flake	Non-cortical	-	Grey (Light)	-	6	Patinated	None	70	Feathered	1	1	None
216	Blade	Broken	-	Grey (Mid)	-	7	Fresh	None	85	-	2	1	n/a
218	Flake	Cortical	-	Grey (Dark)	-	6	Fresh	None	85	Stepped	3	2	Irregular
219	Flake	Non-cortical	-	Grey (Light)	-	7	Fresh	Abraded	80	Hinged	1	1	None
220	Flake	Non-cortical	-	Grey (Mid)	-	7	Patinated	Abraded	80	Overshot	4	2	Parallel
222	Flake	Non-cortical	-	Brown (Light)	-	7	Patinated	None	90	Feathered	1	1	None
223	Flake	Non-cortical	-	Grey (Light)	-	7	Patinated	None	90	Feathered	2	2	n/a
226	Blade	Broken	-	Grey (Mid)	-	7	Patinated	Abraded	75	-	3	2	Parallel
229	Flake	Non-cortical	-	Brown (Light)	-	7	Fresh	None	90	Stepped	3	1	Parallel
230	Debris	Shatter	-	n/a	-	7	Burnt	None	0	-	7	6	Irregular
232	Flake	Non-cortical	-	Grey (Light)	-	7	Fresh	Faceted	90	Stepped	2	1	n/a
235	Flake	Non-cortical	-	n/a	-	7	Burnt	None	80	Stepped	2	1	n/a
236	Flake	Cortical	-	Grey (Mid)	-	2	Fresh	None	90	Stepped	2	1	n/a
237	Flake	Fragment	-	Grey (Light)	-	6	Fresh	-	0	Stepped	2	2	n/a
238	Flake	Non-cortical	-	Grey (Light)	-	7	Fresh	None	85	Feathered	2	1	n/a
239	Flake	Cortical	-	Grey (Light)	-	6	Patinated	None	90	Feathered	2	2	n/a
240	Flake	Fragment	-	Grey (Dark)	-	2	Abraded	-	0	Feathered	0	0	None
241	Blade	Non-cortical	-	Grey (Light)	-	7	Patinated	Trimmed	80	Overshot	3	1	Parallel
242	Flake	Non-cortical	-	Grey (Light)	-	7	Fresh	Trimmed	80	Stepped	3	1	Parallel
244	Flake	Non-cortical	-	Brown (Light)	-	7	Fresh	Trimmed	60	Overshot	3	1	Parallel

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247	Flake	Non-cortical	-	n/a	-	7	Burnt	None	85	Stepped	2	1	n/a
250	Flake	Cortical	-	n/a	-	2	Burnt	Crushed	80	Feathered	1	1	None
253	Flake	Non-cortical	-	Grey (Mid)	-	7	Fresh	Faceted	90	Feathered	3	1	Parallel
254	Flake	Non-cortical	-	Grey (Light)	-	7	Fresh	None	90	Feathered	4	2	Parallel
257	Debris	Shatter	-	n/a	-	7	Burnt	None	0	-	3	2	Irregular
258	Blade	Fragment	-	Grey (Light)	-	7	Patinated	-	0	Stepped	3	1	Parallel
259	Flake	Non-cortical	-	Grey (Light)	-	7	Fresh	None	90	Feathered	2	1	n/a
263	Flake	Cortical	-	Grey (Light)	-	6	Patinated	None	90	Feathered	3	2	Irregular
264	Flake	Non-cortical	-	Grey (Light)	-	7	Patinated	Trimmed	65	Feathered	2	1	n/a
265	Flake	Cortical	-	Grey (Light)	-	5	Fresh	Faceted	85	Feathered	3	1	Parallel
266	Flake	Cortical	-	Grey (Light)	-	7	Patinated	None	90	Stepped	2	1	n/a
267	Flake	Fragment	-	Grey (Mid)	-	7	Patinated	-	0	Stepped	3	2	Irregular
268	Flake	Cortical	-	Grey (Light)	-	5	Fresh	Abraded	70	Feathered	3	2	Irregular
270	Flake	Non-cortical	-	Grey (Mid)	Yes	7	Patinated	Crushed	85	Feathered	2	1	n/a
271	Flake	Non-cortical (crested)	-	Grey (Light)	-	7	Patinated	Abraded	90	Overshot	9	2	Opposed
274	Debris	Shatter	-	Grey (Light)	-	7	Patinated	None	0	-	3	3	Irregular
275	Flake	Cortical	-	Grey (Light)	-	6	Fresh	Abraded	90	Overshot	3	1	Parallel
276	Flake	Fragment	-	Grey (Light)	-	7	Broken	-	0	Feathered	3	1	Parallel
277	Debris	Shatter	-	Grey (Light)	-	7	Fresh	None	0	-	4	4	Irregular
278	Debris	Shatter	-	White	-	7	Fresh	None	0	-	7	7	Irregular
280	Debris	Shatter	-	Grey (Light)	Yes	5	Abraded	None	0	-	10	6	Parallel
281	Debris	Shatter	-	n/a	-	7	Burnt	None	0	-	2	2	n/a
282	Flake	Cortical	-	Grey (Dark)	-	2	Abraded	Isolated	70	Hinged	4	2	Irregular
284	Debris	Shatter	-	Grey (Light)	-	7	Patinated	None	0	-	6	5	Irregular
285	Debris	Shatter	-	Grey (Dark)	-	7	Patinated	None	0	-	6	4	Irregular
287	Debris	Shatter	-	Grey (Light)	-	7	Patinated	None	0	-	5	4	Irregular
288	Debris	Shatter	-	n/a	-	7	Burnt	None	0	-	5	5	Irregular
290	Debris	Shatter	-	Grey (Light)	-	7	Patinated	None	0	-	5	2	Parallel

ID	Group	Sub Group	Source	Colour	Reuse	Cortication	Condition	Platform	EPA	Termination	Removals	Directions	Pattern
298	Debris	Shatter	-	Brown (Light)	-	7	Fresh	None	0	-	6	6	Irregular
301	Debris	Shatter	-	Grey (Dark)	-	5	Patinated	None	0	-	7	7	Irregular
302	Flake	Cortical	-	Grey (Dark)	-	5	Patinated	Crushed	80	Overshot	4	1	Parallel
303	Debris	Shatter	-	Grey (Dark)	-	7	Patinated	None	0	-	8	7	Irregular
304	Flake	Cortical	Chalk	White	-	3	Fresh	None	70	Overshot	3	1	Parallel
305	Flake	Non-cortical	-	Grey (Mid)	-	7	Fresh	Faceted	90	Stepped	1	1	None
308	Flake	Non-cortical	-	Grey (Light)	-	7	Patinated	None	80	Stepped	3	1	Parallel
309	Flake	Cortical	Chalk	Grey (Light)	-	3	Patinated	None	70	Stepped	1	1	None
310	Flake	Non-cortical	-	n/a	-	7	Burnt	None	65	Feathered	3	1	Irregular
311	Debris	Shatter	-	n/a	-	7	Burnt	None	0	-	5	5	Irregular
314	Debris	Shatter	-	White	-	7	Fresh	None	0	-	10	10	Irregular
315	Debris	Shatter	-	White	-	7	Abraded	None	0	-	9	6	Irregular
318	Flake	Cortical	Gravel	Grey (Dark)	-	1	Rolled	None	80	Stepped	0	0	None
319	Flake	Cortical	-	Grey (Light)	-	4	Patinated	None	55	Overshot	4	2	Irregular
321	Debris	Shatter	-	Grey (Light)	-	7	Abraded	None	0	-	5	5	Irregular
322	Debris	Shatter	-	White	-	5	Fresh	None	0	-	6	4	Parallel
323	Flake	Cortical	-	Grey (Light)	-	3	Fresh	Abraded	80	Stepped	1	1	None
324	Flake	Non-cortical	-	Grey (Light)	-	7	Patinated	Abraded	80	Stepped	3	1	Irregular
325	Debris	Shatter	-	n/a	-	3	Burnt	None	0	-	4	4	Irregular
329	Flake	Fragment	-	Grey (Mid)	-	3	Patinated	-	0	Overshot	3	2	Irregular
330	Flake	Fragment	-	White	-	7	Abraded	-	0	Feathered	0	0	None
332	Flake	Non-cortical	-	Grey (Dark)	-	7	Patinated	None	85	Stepped	3	1	Opposed
334	Flake	Fragment	-	Grey (Mid)	-	7	Patinated	None	85	Hinged	4	1	Parallel
337	Flake	Non-cortical	-	Grey (Light)	-	7	Patinated	Corticated	50	Stepped	2	1	n/a
338	Debris	Shatter	-	Grey (Light)	-	7	Patinated	None	0	-	4	4	Irregular
339	Flake	Broken	-	Grey (Light)	-	7	Patinated	None	80	-	2	2	n/a
340	Debris	Shatter	-	Brown (Light)	-	7	Patinated	None	0	-	9	7	Irregular

Metric Properties

ID	Group	Sub Group	L1	B1	B2	B3	T1	T2	T3	Lmax	Bmax	Tmax	Surface	Ratio	Depth	Area	Bulb	Variation
1	Flake	Broken	22.88	10.88	10.58	9.30	3.37	3.70	4.45	-	-	-	-	-	-	-	-	-
2	Flake	Non-cortical	23.06	4.18	15.86	5.96	1.78	3.26	4.13	23.06	15.86	4.13	365.73	1.45	1.78	7.44	1.10	11.68
3	Flake	Non-cortical	10.41	8.68	14.47	7.39	2.36	2.52	2.06	10.41	14.47	2.52	150.63	0.72	2.36	20.48	1.14	7.08
5	Flake	Fragment	14.16	8.12	9.99	8.37	2.41	2.85	1.79	-	-	-	-	-	-	-	-	-
6	Blade	Non-cortical	29.16	5.84	8.76	3.02	1.78	3.42	3.48	29.16	8.76	3.48	255.44	3.33	1.78	10.40	1.30	5.74
7	Flake	Non-cortical	14.62	8.21	12.68	8.74	3.26	3.53	3.06	14.62	12.68	3.53	185.38	1.15	3.26	26.76	1.12	4.47
8	Flake	Broken	15.77	9.36	12.41	2.96	2.31	3.13	3.72	-	-	-	-	-	-	-	-	-
10	Flake	Cortical	15.63	7.58	11.57	3.15	3.58	3.22	2.36	15.63	11.57	3.58	180.84	1.35	3.58	27.14	1.08	8.42
11	Flake	Cortical	21.50	10.21	16.29	15.44	6.80	7.38	5.01	21.50	16.29	7.38	350.24	1.32	6.80	69.43	1.25	6.08
13	Flake	Non-cortical	42.95	7.99	11.88	4.73	4.69	6.09	5.95	42.95	11.88	6.09	510.25	3.62	4.69	37.47	1.14	7.15
14	Flake	Cortical	28.89	5.52	11.58	11.87	3.42	5.14	3.62	28.89	11.87	5.14	342.92	2.43	3.42	18.88	1.46	6.35
15	Flake	Non-cortical	64.55	23.51	30.75	6.01	10.40	13.89	10.55	64.55	30.75	13.89	1984.91	2.10	10.40	244.50	1.33	24.74
18	Flake	Non-cortical	21.96	14.63	22.37	23.08	8.19	8.19	6.04	21.96	23.08	8.19	506.84	0.95	8.19	119.82	1.15	8.45
19	Flake	Cortical (rejuvenation)	37.82	27.91	31.71	26.42	12.58	15.57	15.36	37.82	31.71	15.57	1199.27	1.19	12.58	351.11	1.11	5.29
24	Flake	Non-cortical	21.23	9.59	19.16	2.54	4.07	3.77	1.66	21.23	19.16	4.07	406.77	1.11	4.07	39.03	1.32	16.62
25	Debris	Shatter	48.22	-	24.35	-	-	-	14.74	-	-	-	-	-	-	-	-	-
26	Debris	Shatter	32.41	-	25.44	-	-	-	11.56	-	-	-	-	-	-	-	-	-
27	Blade	Fragment	17.75	11.14	12.61	12.88	3.66	4.34	3.92	-	-	-	-	-	-	-	-	-
29	Debris	Shatter	16.30	-	11.65	-	-	-	3.87	-	-	-	-	-	-	-	-	-
30	Flake	Cortical	32.87	3.50	16.68	10.30	2.09	2.88	2.86	32.87	16.68	2.88	548.27	1.97	2.09	7.32	1.16	13.18
32	Debris	Shatter	37.28	-	13.95	-	-	-	10.94	-	-	-	-	-	-	-	-	-
33	Flake	Fragment	22.21	-	16.77	10.07	-	-	6.48	-	-	-	-	-	-	-	-	-
34	Flake	Fragment	23.89	-	16.01	9.99	-	-	2.83	-	-	-	-	-	-	-	-	-
37	Flake	Fragment	17.42	-	8.87	9.60	-	-	3.81	-	-	-	-	-	-	-	-	-
38	Flake	Cortical	26.76	6.58	10.11	9.49	3.36	4.14	3.17	26.76	10.11	4.14	270.54	2.65	3.36	22.11	1.27	3.53
39	Flake	Cortical	17.98	10.95	12.40	9.09	3.16	4.08	4.17	17.98	12.40	4.17	222.95	1.45	3.16	34.60	1.11	3.31

ID	Group	Sub Group	L1	B1	B2	B3	T1	T2	T3	Lmax	Bmax	Tmax	Surface	Ratio	Depth	Area	Bulb	Variation
40	Flake	Non-cortical	25.42	7.46	13.45	13.65	2.87	3.66	3.15	25.42	13.65	3.66	346.98	1.86	2.87	21.41	1.22	6.19
44	Flake	Cortical	27.79	8.12	12.07	11.54	2.89	3.78	3.42	27.79	12.07	3.78	335.43	2.30	2.89	23.47	1.20	3.95
45	Flake	Fragment	13.74	-	7.92	6.83	-	-	2.79	-	-	-	-	-	-	-	-	-
47	Flake	Non-cortical (rejuvenation)	37.61	6.64	30.73	2.12	5.21	6.04	10.71	37.61	30.73	10.71	1155.76	1.22	5.21	34.59	0.76	28.61
48	Flake	Cortical	19.29	8.38	14.04	8.10	7.89	7.82	5.68	19.29	14.04	7.89	270.83	1.37	7.89	66.12	1.15	5.94
49	Flake	Non-cortical	22.60	6.68	13.12	8.27	3.21	5.44	4.71	22.60	13.12	5.44	296.51	1.72	3.21	21.44	1.37	6.44
52	Flake	Cortical	50.83	19.12	25.26	17.07	7.88	14.67	10.01	50.83	25.26	14.67	1283.97	2.01	7.88	150.67	1.64	8.19
53	Blade	Segment	13.88	-	8.20	-	-	-	2.57	-	-	-	-	-	-	-	-	-
54	Flake	Non-cortical	17.00	4.10	14.19	12.01	2.13	6.15	4.93	17.00	14.19	6.15	241.23	1.20	2.13	8.73	1.74	10.09
55	Flake	Cortical (rejuvenation)	40.63	5.03	18.55	17.97	2.54	4.42	5.38	40.63	18.55	5.38	753.69	2.19	2.54	12.78	1.12	13.52
56	Flake	Cortical	41.31	4.40	18.77	16.35	1.64	3.30	2.52	41.31	18.77	3.30	775.39	2.20	1.64	7.22	1.59	14.37
58	Flake	Non-cortical	21.26	8.26	10.89	7.78	2.88	3.47	3.16	21.26	10.89	3.47	231.52	1.95	2.88	23.79	1.15	3.11
59	Flake	Non-cortical	18.72	2.64	13.02	9.55	1.20	2.16	1.01	18.72	13.02	2.16	243.73	1.44	1.20	3.17	1.95	10.38
60	Flake	Non-cortical	14.86	12.18	13.03	5.44	3.65	3.96	2.82	14.86	13.03	3.96	193.63	1.14	3.65	44.46	1.22	7.59
61	Flake	Non-cortical	11.63	15.33	14.51	13.91	3.16	3.60	3.51	11.63	15.33	3.60	178.29	0.76	3.16	48.44	1.08	1.42
63	Flake	Cortical	30.91	5.53	11.97	17.49	2.64	4.15	5.16	30.91	17.49	5.16	540.62	1.77	2.64	14.60	1.06	11.96
64	Flake	Non-cortical	43.53	4.99	11.55	4.67	3.04	4.68	5.83	43.53	11.55	5.83	502.77	3.77	3.04	15.17	1.06	6.88
66	Flake	Cortical	33.80	26.10	17.18	15.76	10.13	-	7.72	33.80	26.10	10.13	882.18	1.30	10.13	264.39	-	10.34
67	Flake	Non-cortical	29.55	15.11	9.56	6.02	2.55	4.27	4.09	29.55	15.11	4.27	446.50	1.96	2.55	38.53	1.29	9.09
69	Debris	Shatter	29.61	-	27.52	-	-	-	12.48	-	-	-	-	-	-	-	-	-
70	Flake	Cortical	50.54	16.43	24.22	16.08	4.74	6.50	7.02	50.54	24.22	7.02	1224.08	2.09	4.74	77.88	1.11	8.14
73	Flake	Cortical	24.62	13.08	22.45	24.57	2.91	5.02	10.29	24.62	24.57	10.29	604.91	1.00	2.91	38.06	0.76	11.49
74	Flake	Cortical	29.02	9.72	26.14	16.12	5.28	6.47	5.11	29.02	26.14	6.47	758.58	1.11	5.28	51.32	1.25	16.42
75	Flake	Non-cortical	18.01	3.40	7.09	6.63	1.49	2.42	2.45	18.01	7.09	2.45	127.69	2.54	1.49	5.07	1.23	3.69
77	Flake	Non-cortical	57.59	6.26	30.35	2.78	3.47	11.77	12.57	57.59	30.35	12.57	1747.86	1.90	3.47	21.72	1.47	27.57
79	Flake	Cortical	31.21	13.75	22.76	11.68	7.67	9.21	7.46	31.21	22.76	9.21	710.34	1.37	7.67	105.46	1.22	11.08
80	Blade	Fragment	22.36	-	8.76	5.23	-	-	3.16	-	-	-	-	-	-	-	-	-

ID	Group	Sub Group	L1	B1	B2	B3	T1	T2	T3	Lmax	Bmax	Tmax	Surface	Ratio	Depth	Area	Bulb	Variation
81	Flake	Cortical	32.64	6.00	11.92	12.59	2.80	2.90	3.09	32.64	12.59	3.09	410.94	2.59	2.80	16.80	0.98	6.59
82	Flake	Cortical	21.96	8.17	22.02	12.47	3.43	9.08	9.36	21.96	22.02	9.36	483.56	1.00	3.43	28.02	1.42	13.85
83	Flake	Cortical	29.99	3.04	19.92	16.06	2.16	5.49	9.74	29.99	19.92	9.74	597.40	1.51	2.16	6.57	0.92	16.88
87	Flake	Cortical	28.24	19.89	32.80	37.33	7.03	12.35	12.48	28.24	37.33	12.48	1054.20	0.76	7.03	139.83	1.27	17.44
89	Debris	Shatter	26.64	-	35.16	-	-	-	22.94	-	-	-	-	-	-	-	-	-
90	Flake	Fragment	26.89	-	26.76	29.25	-	6.09	3.58	-	-	-	-	-	-	-	-	-
93	Flake	Cortical	23.85	5.37	10.59	14.86	2.01	3.16	4.97	23.85	14.86	4.97	354.41	1.60	2.01	10.79	0.91	9.49
94	Blade	Non-cortical	33.29	8.46	9.61	7.87	1.59	3.27	3.98	33.29	9.61	3.98	319.92	3.46	1.59	13.45	1.17	1.74
95	Flake	Broken	20.11	8.02	15.69	19.21	3.48	4.38	5.05	-	-	-	-	-	-	-	-	-
96	Debris	Shatter	39.53	-	38.84	-	-	-	18.25	-	-	-	-	-	-	-	-	-
98	Flake	Non-cortical	26.78	11.04	18.97	16.78	3.17	5.45	4.11	26.78	18.97	5.45	508.02	1.41	3.17	35.00	1.50	7.93
100	Debris	Shatter	18.25	-	12.68	-	-	-	5.60	-	-	-	-	-	-	-	-	-
101	Flake	Cortical	39.73	10.03	16.99	8.64	5.33	6.31	3.62	39.73	16.99	6.31	675.01	2.34	5.33	53.46	1.41	8.35
102	Flake	Non-cortical	17.03	5.35	10.19	7.54	3.69	4.68	4.81	17.03	10.19	4.81	173.54	1.67	3.69	19.74	1.10	4.84
104	Blade	Fragment	15.70	-	14.37	13.94	-	-	4.28	-	-	-	-	-	-	-	-	-
105	Debris	Shatter	29.13	-	21.63	-	-	-	12.38	-	-	-	-	-	-	-	-	-
107	Flake	Non-cortical	34.27	15.09	22.96	12.22	5.30	5.60	3.01	34.27	22.96	5.60	786.84	1.49	5.30	79.98	1.35	10.74
109	Flake	Cortical	24.61	5.53	15.48	14.26	2.64	2.43	2.57	24.61	15.48	2.64	380.96	1.59	2.64	14.60	0.93	9.95
111	Flake	Cortical	39.01	8.65	31.08	4.23	3.35	6.72	6.26	39.01	31.08	6.72	1212.43	1.26	3.35	28.98	1.40	26.85
112	Flake	Non-cortical	16.06	13.29	18.49	11.62	4.27	4.36	3.89	16.06	18.49	4.36	296.95	0.87	4.27	56.75	1.07	6.87
114	Flake	Non-cortical	12.56	7.53	10.05	10.13	2.59	3.48	3.80	12.56	10.13	3.80	127.23	1.24	2.59	19.50	1.09	2.60
116	Flake	Fragment	9.76	-	13.42	-	-	-	2.98	-	-	-	-	-	-	-	-	-
117	Flake	Cortical	24.71	4.02	17.24	15.28	3.43	4.14	6.90	24.71	17.24	6.90	426.00	1.43	3.43	13.79	0.80	13.22
118	Flake	Non-cortical	16.42	6.81	11.27	11.35	2.78	2.83	3.55	16.42	11.35	3.55	186.37	1.45	2.78	18.93	0.89	4.54
120	Debris	Shatter	15.58	-	13.82	-	-	-	3.67	-	-	-	-	-	-	-	-	-
121	Flake	Broken	18.54	10.26	15.98	15.12	4.89	5.87	4.15	-	-	-	-	-	-	-	-	-
122	Flake	Non-cortical	14.37	5.69	18.30	14.25	5.21	5.06	4.11	14.37	18.30	5.21	262.97	0.79	5.21	29.64	1.09	12.61
123	Flake	Fragment	21.65	16.78	19.11	11.58	3.43	-	3.78	-	-	-	-	-	-	-	-	-
124	Flake	Fragment	14.70	-	8.83	8.40	-	-	4.01	-	-	-	-	-	-	-	-	-

ID	Group	Sub Group	L1	B1	B2	B3	T1	T2	T3	Lmax	Bmax	Tmax	Surface	Ratio	Depth	Area	Bulb	Variation
125	Blade	Broken	14.50	4.53	8.89	7.58	1.29	3.16	3.79	-	-	-	-	-	-	-	-	-
126	Flake	Fragment	14.46	11.63	11.85	11.61	1.24	-	1.31	-	-	-	-	-	-	-	-	-
128	Flake	Cortical	30.95	3.61	20.87	8.97	0.80	7.73	4.04	30.95	20.87	7.73	645.93	1.48	0.80	2.89	3.19	17.26
129	Debris	Shatter	37.50	-	31.45	-	-	-	14.91	-	-	-	-	-	-	-	-	-
130	Debris	Shatter	24.08	-	37.89	-	-	-	16.53	-	-	-	-	-	-	-	-	-
132	Blade	Broken	22.11	7.79	10.47	11.20	2.94	3.61	2.82	-	-	-	-	-	-	-	-	-
134	Flake	Non-cortical	8.71	12.22	17.63	8.74	1.32	2.28	2.61	8.71	17.63	2.61	153.56	0.49	1.32	16.13	1.16	8.89
135	Flake	Fragment	22.46	-	22.16	23.06	-	-	3.75	-	-	-	-	-	-	-	-	-
136	Flake	Non-cortical	17.59	13.56	20.65	15.41	5.59	4.99	3.40	17.59	20.65	5.59	363.23	0.85	5.59	75.80	1.11	7.09
138	Blade	Fragment	31.72	7.63	10.62	13.17	1.98	2.54	4.16	-	-	-	-	-	-	-	-	-
139	Flake	Fragment	17.59	-	13.18	3.77	-	-	2.95	-	-	-	-	-	-	-	-	-
140	Flake	Non-cortical	28.34	6.99	15.98	11.33	3.07	3.45	3.05	28.34	15.98	3.45	452.87	1.77	3.07	21.46	1.13	8.99
141	Flake	Cortical	33.97	11.38	18.12	15.70	5.72	6.53	3.74	33.97	18.12	6.53	615.54	1.87	5.72	65.09	1.38	6.74
142	Debris	Shatter	23.94	-	23.46	-	-	-	6.20	-	-	-	-	-	-	-	-	-
145	Debris	Shatter	43.51	-	47.72	-	-	-	9.48	-	-	-	-	-	-	-	-	-
146	Debris	Shatter	17.34	-	8.93	-	-	-	2.92	-	-	-	-	-	-	-	-	-
147	Flake	Fragment	19.77	-	16.51	14.56	-	-	3.50	-	-	-	-	-	-	-	-	-
148	Flake	Cortical	21.44	17.08	18.15	9.80	3.59	4.53	2.82	21.44	18.15	4.53	389.14	1.18	3.59	61.32	1.41	8.35
149	Flake	Non-cortical	12.67	16.99	20.55	13.41	4.14	3.86	2.65	12.67	20.55	4.14	260.37	0.62	4.14	70.34	1.14	7.14
150	Flake	Non-cortical	21.56	6.42	10.04	1-	2.70	4.43	5.41	21.56	10.04	5.41	216.46	2.15	2.70	17.33	1.09	3.62
151	Flake	Cortical	21.74	6.76	32.90	25.62	6.48	7.73	4.13	21.74	32.90	7.73	715.25	0.66	6.48	43.80	1.46	26.14
152	Flake	Non-cortical	31.81	14.00	28.80	27.59	5.69	7.91	4.41	31.81	28.80	7.91	916.13	1.10	5.69	79.66	1.57	14.80
153	Flake	Fragment	14.20	9.18	14.78	5.67	3.40	-	3.68	-	-	-	-	-	-	-	-	-
154	Flake	Non-cortical	18.07	7.38	13.96	9.39	2.86	4.74	2.42	18.07	13.96	4.74	252.26	1.29	2.86	21.11	1.80	6.58
156	Flake	Non-cortical	12.24	7.05	6.97	5.78	1.19	1.49	1.58	12.24	7.05	1.58	86.29	1.74	1.19	8.39	1.08	1.27
157	Flake	Fragment	8.84	7.90	8.10	4.26	2.68	3.64	2.95	-	-	-	-	-	-	-	-	-
159	Flake	Cortical	14.41	5.90	10.25	13.20	1.44	1.96	2.61	14.41	13.20	2.61	190.21	1.09	1.44	8.50	0.97	7.30
160	Flake	Non-cortical	23.50	6.49	12.76	3.41	2.13	2.90	2.91	23.50	12.76	2.91	299.86	1.84	2.13	13.82	1.15	9.35
162	Flake	Non-cortical	12.68	4.16	10.91	10.62	1.52	2.88	1.97	12.68	10.91	2.88	138.34	1.16	1.52	6.32	1.65	6.75

ID	Group	Sub Group	L1	B1	B2	B3	T1	T2	T3	Lmax	Bmax	Tmax	Surface	Ratio	Depth	Area	Bulb	Variation
163	Flake	Non-cortical	12.75	6.12	9.47	9.54	2.75	3.09	1.98	12.75	9.54	3.09	121.64	1.34	2.75	16.83	1.31	3.42
164	Flake	Cortical	12.69	7.87	14.52	10.53	2.60	3.15	1.54	12.69	14.52	3.15	184.26	0.87	2.60	20.46	1.52	6.65
165	Debris	Shatter	25.76	-	19.96	-	-	-	9.19	-	-	-	-	-	-	-	-	-
167	Flake	Non-cortical	19.49	8.51	13.62	13.59	3.30	4.13	3.52	19.49	13.62	4.13	265.45	1.43	3.30	28.08	1.21	5.11
168	Flake	Fragment	31.80	20.96	19.53	12.57	6.39	-	7.37	-	-	-	-	-	-	-	-	-
169	Flake	Non-cortical	23.10	11.20	11.78	9.68	2.96	3.11	4.08	23.10	11.78	4.08	272.12	1.96	2.96	33.15	0.88	2.10
170	Blade	Fragment	12.14	-	13.70	10.91	-	-	3.67	-	-	-	-	-	-	-	-	-
171	Debris	Shatter	34.01	-	8.32	-	-	-	6.18	-	-	-	-	-	-	-	-	-
173	Flake	Non-cortical	10.06	5.50	5.71	4.15	2.03	1.83	1.46	10.06	5.71	2.03	57.44	1.76	2.03	11.16	1.05	1.56
176	Blade	Broken	15.69	5.43	10.93	11.33	1.49	2.46	2.02	-	-	-	-	-	-	-	-	-
177	Flake	Cortical	21.92	10.85	11.54	7.63	2.64	4.59	5.04	21.92	11.54	5.04	252.96	1.90	2.64	28.64	1.20	3.91
180	Flake	Non-cortical	15.74	15.20	12.28	7.68	3.66	5.50	2.50	15.74	15.20	5.50	239.25	1.04	3.66	55.63	1.79	7.52
182	Flake	Cortical	35.72	5.14	11.21	16.35	2.29	5.87	4.72	35.72	16.35	5.87	584.02	2.18	2.29	11.77	1.67	11.21
183	Flake	Non-cortical	19.99	14.75	15.87	17.12	5.99	6.02	3.61	19.99	17.12	6.02	342.23	1.17	5.99	88.35	1.25	2.37
184	Flake	Non-cortical	21.52	11.98	15.85	8.84	2.66	2.73	2.51	21.52	15.85	2.73	341.09	1.36	2.66	31.87	1.06	7.01
185	Flake	Cortical	30.09	7.45	19.23	16.09	1.60	3.44	6.79	30.09	19.23	6.79	578.63	1.56	1.60	11.92	0.82	11.78
186	Flake	Non-cortical	44.79	7.14	19.16	23.56	3.29	4.33	6.14	44.79	23.56	6.14	1055.25	1.90	3.29	23.49	0.92	16.42
187	Flake	Cortical	24.73	10.76	17.65	17.68	4.63	5.12	4.25	24.73	17.68	5.12	437.23	1.40	4.63	49.82	1.15	6.92
188	Flake	Broken	17.62	16.50	20.70	22.82	4.65	4.81	4.90	-	-	-	-	-	-	-	-	-
190	Debris	Shatter	48.10	-	25.26	-	-	-	16.61	-	-	-	-	-	-	-	-	-
193	Flake	Non-cortical	11.63	5.59	17.61	15.18	2.30	3.80	3.58	11.63	17.61	3.80	204.80	0.66	2.30	12.86	1.29	12.02
194	Flake	Cortical	21.97	13.10	17.71	13.63	2.42	2.38	2.34	21.97	17.71	2.42	389.09	1.24	2.42	31.70	1.00	4.61
195	Debris	Shatter	38.58	-	22.11	-	-	-	10.05	-	-	-	-	-	-	-	-	-
196	Debris	Shatter	24.61	-	12.46	-	-	-	9.33	-	-	-	-	-	-	-	-	-
197	Flake	Non-cortical	27.50	8.00	16.27	13.91	3.01	3.74	5.45	27.50	16.27	5.45	447.43	1.69	3.01	24.08	0.88	8.27
198	Flake	Non-cortical	19.46	9.39	10.99	11.04	3.73	4.37	4.41	19.46	11.04	4.41	214.84	1.76	3.73	35.02	1.07	1.65
199	Flake	Non-cortical	36.38	6.86	23.10	13.13	2.49	3.65	9.56	36.38	23.10	9.56	840.38	1.57	2.49	17.08	0.61	16.24
200	Flake	Broken	26.88	9.65	13.01	15.37	3.76	4.82	3.87	-	-	-	-	-	-	-	-	-
202	Flake	Cortical	30.74	7.37	11.38	3.40	6.72	4.98	11.02	30.74	11.38	11.02	349.82	2.70	6.72	49.53	0.56	7.98

ID	Group	Sub Group	L1	B1	B2	B3	T1	T2	T3	Lmax	Bmax	Tmax	Surface	Ratio	Depth	Area	Bulb	Variation
203	Flake	Cortical	22.98	7.00	18.39	14.03	2.58	2.80	2.72	22.98	18.39	2.80	422.60	1.25	2.58	18.06	1.06	11.39
204	Flake	Cortical	24.01	9.40	15.27	10.61	4.04	5.25	4.11	24.01	15.27	5.25	366.63	1.57	4.04	37.98	1.29	5.87
205	Flake	Fragment	25.56	-	16.33	-	-	-	7.18	-	-	-	-	-	-	-	-	-
206	Flake	Fragment	22.84	-	12.67	4.68	-	-	2.09	-	-	-	-	-	-	-	-	-
207	Flake	Non-cortical	32.83	21.87	20.95	13.84	7.20	7.62	4.18	32.83	21.87	7.62	717.99	1.50	7.20	157.46	1.34	8.03
209	Debris	Shatter	27.09	-	21.48	-	-	-	7.77	-	-	-	-	-	-	-	-	-
210	Debris	Shatter	51.14	-	36.80	-	-	-	16.45	-	-	-	-	-	-	-	-	-
212	Flake	Non-cortical	12.25	5.80	6.39	6.34	2.18	2.07	1.04	12.25	6.39	2.18	78.28	1.92	2.18	12.64	1.29	0.59
214	Flake	Non-cortical	17.28	3.66	8.00	2.93	1.57	1.65	3.18	17.28	8.00	3.18	138.24	2.16	1.57	5.75	0.69	5.07
216	Blade	Broken	16.92	8.79	9.74	8.98	2.12	2.39	2.50	-	-	-	-	-	-	-	-	-
218	Flake	Cortical	29.35	15.16	26.14	11.13	7.21	6.77	4.49	29.35	26.14	7.21	767.21	1.12	7.21	109.30	1.16	15.01
219	Flake	Non-cortical	9.63	5.80	13.61	11.45	1.25	2.78	2.78	9.63	13.61	2.78	131.06	0.71	1.25	7.25	1.38	7.81
220	Flake	Non-cortical	23.53	3.76	9.17	11.73	1.44	2.52	2.89	23.53	11.73	2.89	276.01	2.01	1.44	5.41	1.16	7.97
222	Flake	Non-cortical	16.52	6.79	26.34	6.55	1.77	2.71	3.31	16.52	26.34	3.31	435.14	0.63	1.77	12.02	1.07	19.79
223	Flake	Non-cortical	13.74	7.54	10.31	11.03	3.45	4.71	3.36	13.74	11.03	4.71	151.55	1.25	3.45	26.01	1.38	3.49
226	Blade	Broken	19.05	6.01	12.29	10.91	2.15	3.35	3.11	-	-	-	-	-	-	-	-	-
229	Flake	Non-cortical	23.73	6.66	7.05	5.20	1.78	2.09	2.16	23.73	7.05	2.16	167.30	3.37	1.78	11.85	1.06	1.85
230	Debris	Shatter	27.49	-	40.58	-	-	-	11.79	-	-	-	-	-	-	-	-	-
232	Flake	Non-cortical	20.51	9.60	14.23	10.97	3.36	3.52	2.43	20.51	14.23	3.52	291.86	1.44	3.36	32.26	1.22	4.63
235	Flake	Non-cortical	21.57	8.87	13.26	13.27	2.38	2.73	2.18	21.57	13.27	2.73	286.23	1.63	2.38	21.11	1.20	4.40
236	Flake	Cortical	25.84	7.90	22.32	25.31	2.61	5.88	6.81	25.84	25.31	6.81	654.01	1.02	2.61	20.62	1.25	17.41
237	Flake	Fragment	12.58	4.89	22.17	22.17	1.00	4.65	5.02	-	-	-	-	-	-	-	-	17.28
238	Flake	Non-cortical	17.45	9.85	10.78	2.55	2.28	2.29	1.95	17.45	10.78	2.29	188.11	1.62	2.28	22.46	1.08	8.23
239	Flake	Cortical	17.26	5.08	15.64	8.11	2.23	1.56	1.03	17.26	15.64	2.23	269.95	1.10	2.23	11.33	0.96	10.56
240	Flake	Fragment	15.60	2.98	22.06	-	-	-	5.44	-	-	-	-	-	-	-	-	-
241	Blade	Non-cortical	26.78	7.45	12.52	8.26	2.00	2.84	3.06	26.78	12.52	3.06	335.29	2.14	2.00	14.90	1.12	5.07
242	Flake	Non-cortical	27.28	3.67	8.28	8.42	1.48	2.06	1.78	27.28	8.42	2.06	229.70	3.24	1.48	5.43	1.26	4.75
244	Flake	Non-cortical	17.42	3.76	7.41	7.32	1.39	2.27	2.05	17.42	7.41	2.27	129.08	2.35	1.39	5.23	1.32	3.65
247	Flake	Non-cortical	18.69	14.58	18.97	15.15	4.22	4.58	4.73	18.69	18.97	4.73	354.55	0.99	4.22	61.53	1.02	4.39

ID	Group	Sub Group	L1	B1	B2	B3	T1	T2	T3	Lmax	Bmax	Tmax	Surface	Ratio	Depth	Area	Bulb	Variation
250	Flake	Cortical	24.29	12.50	31.56	14.57	4.63	6.46	9.42	24.29	31.56	9.42	766.59	0.77	4.63	57.88	0.92	19.06
253	Flake	Non-cortical	15.04	2.64	20.42	5.88	2.07	3.09	3.58	15.04	20.42	3.58	307.12	0.74	2.07	5.46	1.09	17.78
254	Flake	Non-cortical	27.13	9.49	13.07	1-	4.26	4.55	3.61	27.13	13.07	4.55	354.59	2.08	4.26	40.43	1.16	3.58
257	Debris	Shatter	19.89	-	19.08	-	-	-	5.88	-	-	-	-	-	-	-	-	-
258	Blade	Fragment	12.46	-	10.50	10.53	-	-	2.53	-	-	-	-	-	-	-	-	-
259	Flake	Non-cortical	35.73	5.69	15.39	9.86	2.32	7.58	4.16	35.73	15.39	7.58	549.88	2.32	2.32	13.20	2.34	9.70
263	Flake	Cortical	34.57	10.52	28.34	10.37	5.11	5.85	5.67	34.57	28.34	5.85	979.71	1.22	5.11	53.76	1.09	17.97
264	Flake	Non-cortical	17.78	9.54	13.02	5.15	2.68	2.92	1.64	17.78	13.02	2.92	231.50	1.37	2.68	25.57	1.35	7.87
265	Flake	Cortical	28.22	10.49	13.16	6.35	4.76	4.96	4.51	28.22	13.16	4.96	371.38	2.14	4.76	49.93	1.07	6.81
266	Flake	Cortical	16.27	7.20	18.80	10.22	3.05	3.01	1.84	16.27	18.80	3.05	305.88	0.87	3.05	21.96	1.23	11.60
267	Flake	Fragment	19.99	-	29.57	3.43	-	-	3.78	-	-	-	-	-	-	-	-	-
268	Flake	Cortical	21.68	6.31	11.70	9.53	3.36	4.54	5.13	21.68	11.70	5.13	253.66	1.85	3.36	21.20	1.07	5.39
270	Flake	Non-cortical	30.31	8.32	17.04	6.04	3.72	6.57	5.38	30.31	17.04	6.57	516.48	1.78	3.72	30.95	1.44	11.00
271	Flake	Non-cortical (crested)	25.41	5.21	8.81	7.22	2.07	2.94	7.68	25.41	8.81	7.68	223.86	2.88	2.07	10.78	0.60	3.60
274	Debris	Shatter	15.13	-	13.93	-	-	-	6.06	-	-	-	-	-	-	-	-	-
275	Flake	Cortical	25.88	13.56	6.02	7.64	4.34	5.16	6.06	25.88	13.56	6.06	350.93	1.91	4.34	58.85	0.99	7.54
276	Flake	Fragment	20.90	-	11.15	9.25	-	-	2.75	-	-	-	-	-	-	-	-	-
277	Debris	Shatter	22.21	-	16.08	-	-	-	9.54	-	-	-	-	-	-	-	-	-
278	Debris	Shatter	30.64	-	43.10	-	-	-	10.52	-	-	-	-	-	-	-	-	-
280	Debris	Shatter	34.23	-	20.06	-	-	-	12.59	-	-	-	-	-	-	-	-	-
281	Debris	Shatter	15.12	-	14.46	-	-	-	3.60	-	-	-	-	-	-	-	-	-
282	Flake	Cortical	26.38	11.46	20.76	12.10	7.97	8.44	8.55	26.38	20.76	8.55	547.65	1.27	7.97	91.34	1.02	9.30
284	Debris	Shatter	17.76	-	9.75	-	-	-	7.18	-	-	-	-	-	-	-	-	-
285	Debris	Shatter	47.90	-	25.08	-	-	-	17.71	-	-	-	-	-	-	-	-	-
287	Debris	Shatter	16.19	-	11.98	-	-	-	8.36	-	-	-	-	-	-	-	-	-
288	Debris	Shatter	31.32	-	46.12	-	-	-	17.56	-	-	-	-	-	-	-	-	-
290	Debris	Shatter	34.98	-	20.88	-	-	-	20.03	-	-	-	-	-	-	-	-	-
298	Debris	Shatter	12.36	-	12.04	-	-	-	5.36	-	-	-	-	-	-	-	-	-

ID	Group	Sub Group	L1	B1	B2	B3	T1	T2	T3	Lmax	Bmax	Tmax	Surface	Ratio	Depth	Area	Bulb	Variation
301	Debris	Shatter	42.79	-	22.72	-	-	-	15.85	-	-	-	-	-	-	-	-	-
302	Flake	Cortical	24.36	7.67	15.19	10.31	3.89	4.87	4.71	24.36	15.19	4.87	370.03	1.60	3.89	29.84	1.13	7.52
303	Debris	Shatter	26.25	-	22.43	-	-	-	14.53	-	-	-	-	-	-	-	-	-
304	Flake	Cortical	32.07	17.03	22.27	24.50	7.26	7.79	7.51	32.07	24.50	7.79	785.72	1.31	7.26	123.64	1.05	7.47
305	Flake	Non-cortical	22.05	12.44	16.85	16.11	3.64	3.66	2.22	22.05	16.85	3.66	371.54	1.31	3.64	45.28	1.25	4.41
308	Flake	Non-cortical	23.16	5.21	10.21	14.49	1.96	2.01	2.74	23.16	14.49	2.74	335.59	1.60	1.96	10.21	0.86	9.28
309	Flake	Cortical	28.63	5.10	19.62	12.59	1.82	2.86	6.15	28.63	19.62	6.15	561.72	1.46	1.82	9.28	0.72	14.52
310	Flake	Non-cortical	11.42	13.41	16.80	7.23	4.25	4.05	2.52	11.42	16.80	4.25	191.86	0.68	4.25	56.99	1.20	9.57
311	Debris	Shatter	26.46	-	20.46	-	-	-	10.69	-	-	-	-	-	-	-	-	-
314	Debris	Shatter	45.36	-	45.75	-	-	-	14.04	-	-	-	-	-	-	-	-	-
315	Debris	Shatter	83.82	-	40.82	-	-	-	14.08	-	-	-	-	-	-	-	-	-
318	Flake	Cortical	29.03	18.33	35.64	4.03	9.18	10.50	8.91	29.03	35.64	10.50	1034.63	0.81	9.18	168.27	1.16	31.61
319	Flake	Cortical	20.59	4.29	16.01	9.62	2.53	3.88	5.47	20.59	16.01	5.47	329.65	1.29	2.53	10.85	0.97	11.72
321	Debris	Shatter	17.37	-	10.39	-	-	-	6.88	-	-	-	-	-	-	-	-	-
322	Debris	Shatter	26.46	-	13.40	-	-	-	6.92	-	-	-	-	-	-	-	-	-
323	Flake	Cortical	19.63	7.61	10.69	8.44	3.84	4.14	4.06	19.63	10.69	4.14	209.84	1.84	3.84	29.22	1.05	3.08
324	Flake	Non-cortical	14.23	11.73	12.45	9.87	3.39	3.45	2.06	14.23	12.45	3.45	177.16	1.14	3.39	39.76	1.27	2.58
325	Debris	Shatter	34.62	-	26.68	-	-	-	10.20	-	-	-	-	-	-	-	-	-
329	Flake	Fragment	23.56	-	15.72	-	-	-	7.06	-	-	-	-	-	-	-	-	-
330	Flake	Fragment	16.76	-	18.69	10.08	-	-	3.51	-	-	-	-	-	-	-	-	-
332	Flake	Non-cortical	14.42	9.43	15.92	10.75	3.68	3.96	2.80	14.42	15.92	3.96	229.57	0.91	3.68	34.70	1.22	6.49
334	Flake	Fragment	23.54	8.78	11.11	5.59	2.56	-	2.51	-	-	-	-	-	-	-	-	-
337	Flake	Non-cortical	15.63	9.64	12.57	7.79	4.62	5.81	3.28	15.63	12.57	5.81	196.47	1.24	4.62	44.54	1.47	4.78
338	Debris	Shatter	13.99	-	11.60	-	-	-	4.16	-	-	-	-	-	-	-	-	-
339	Flake	Broken	15.61	16.97	16.78	5.91	1.80	3.06	3.03	-	-	-	-	-	-	-	-	-
340	Debris	Shatter	29.60	-	27.81	-	-	-	11.93	-	-	-	-	-	-	-	-	-

Neolithic occupation and stone working on the Yorkshire Wolds

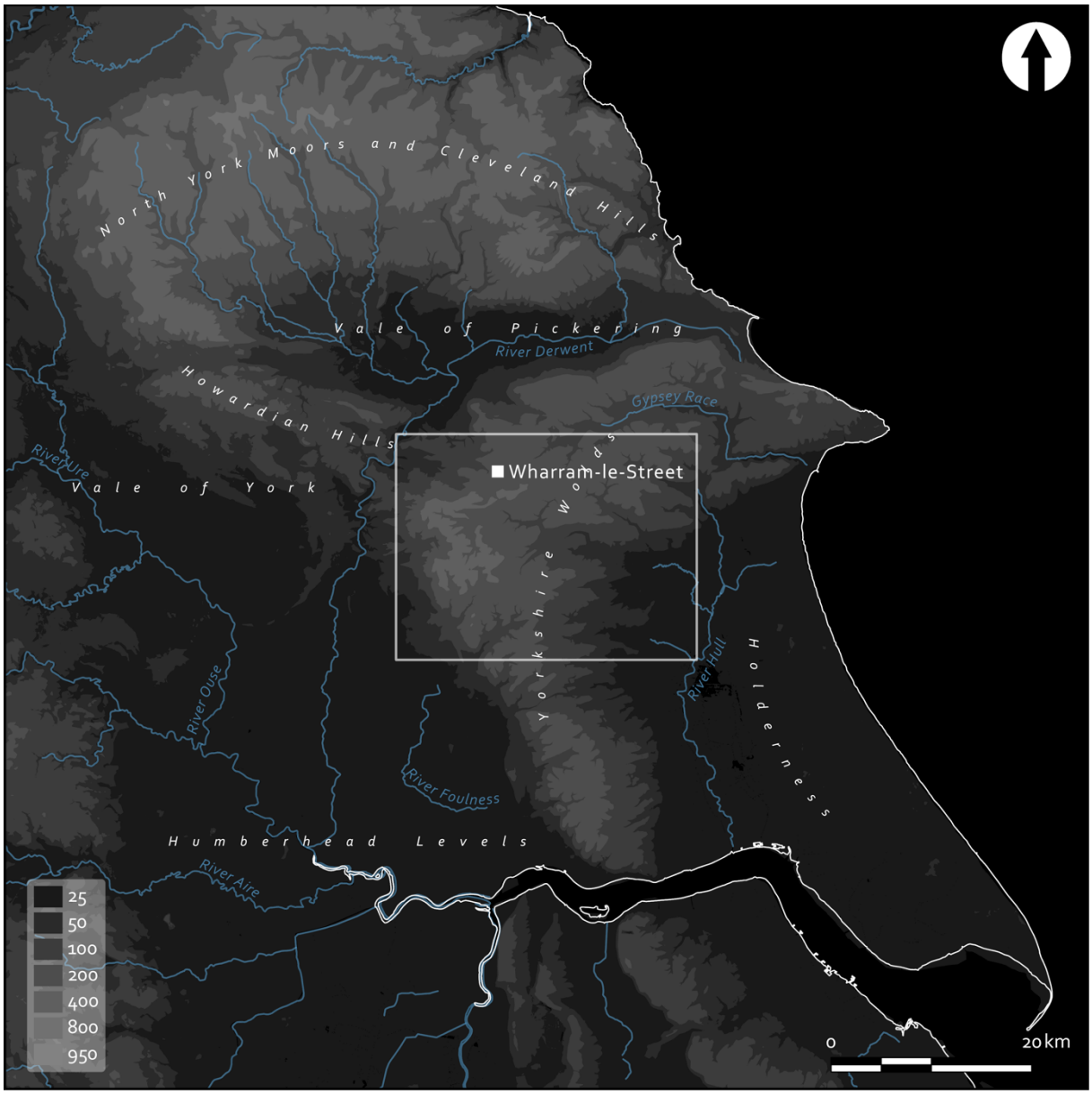


Figure 1. Map showing the locations of the study area and the Wharram-le-Street case study.

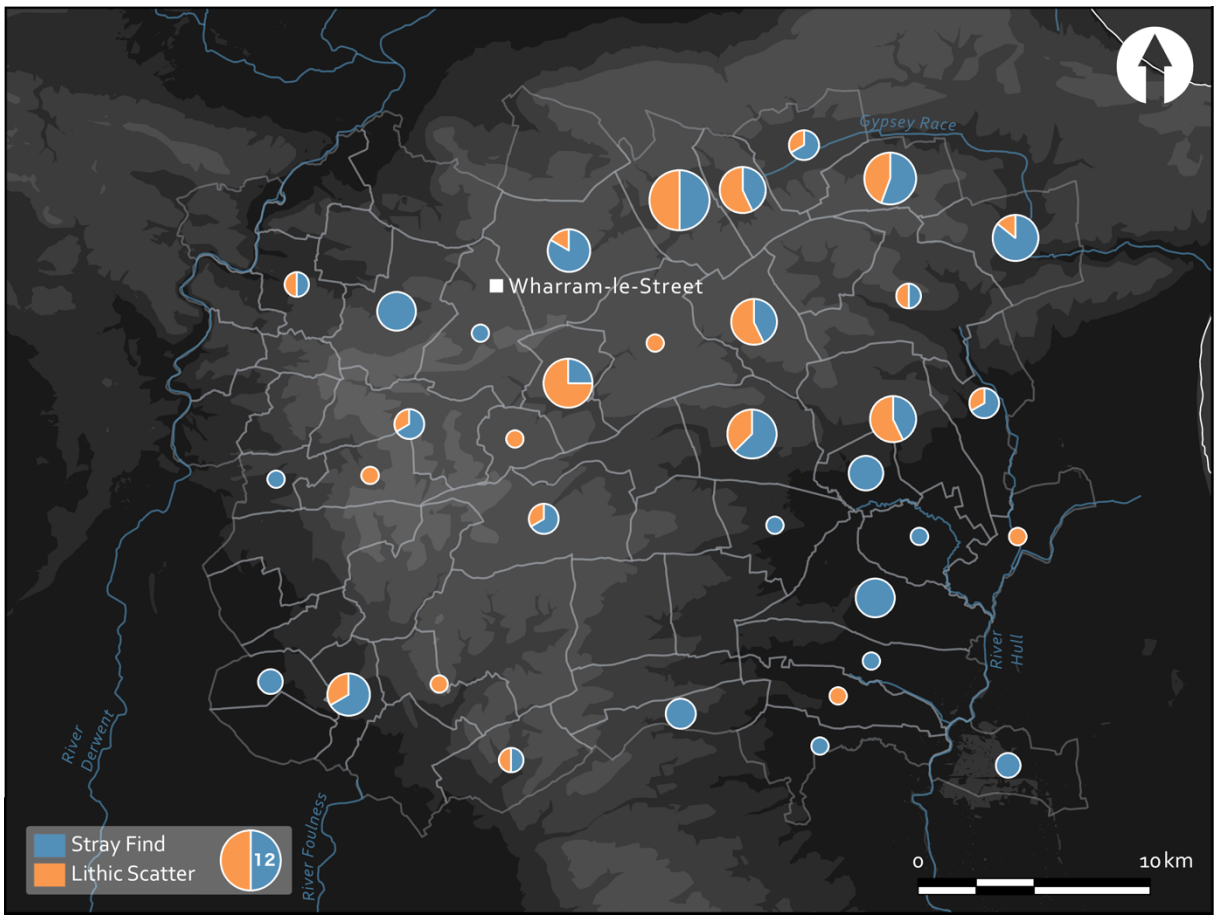


Figure 2. Map showing the distribution of stray finds and lithic scatters within the Wolds study area.

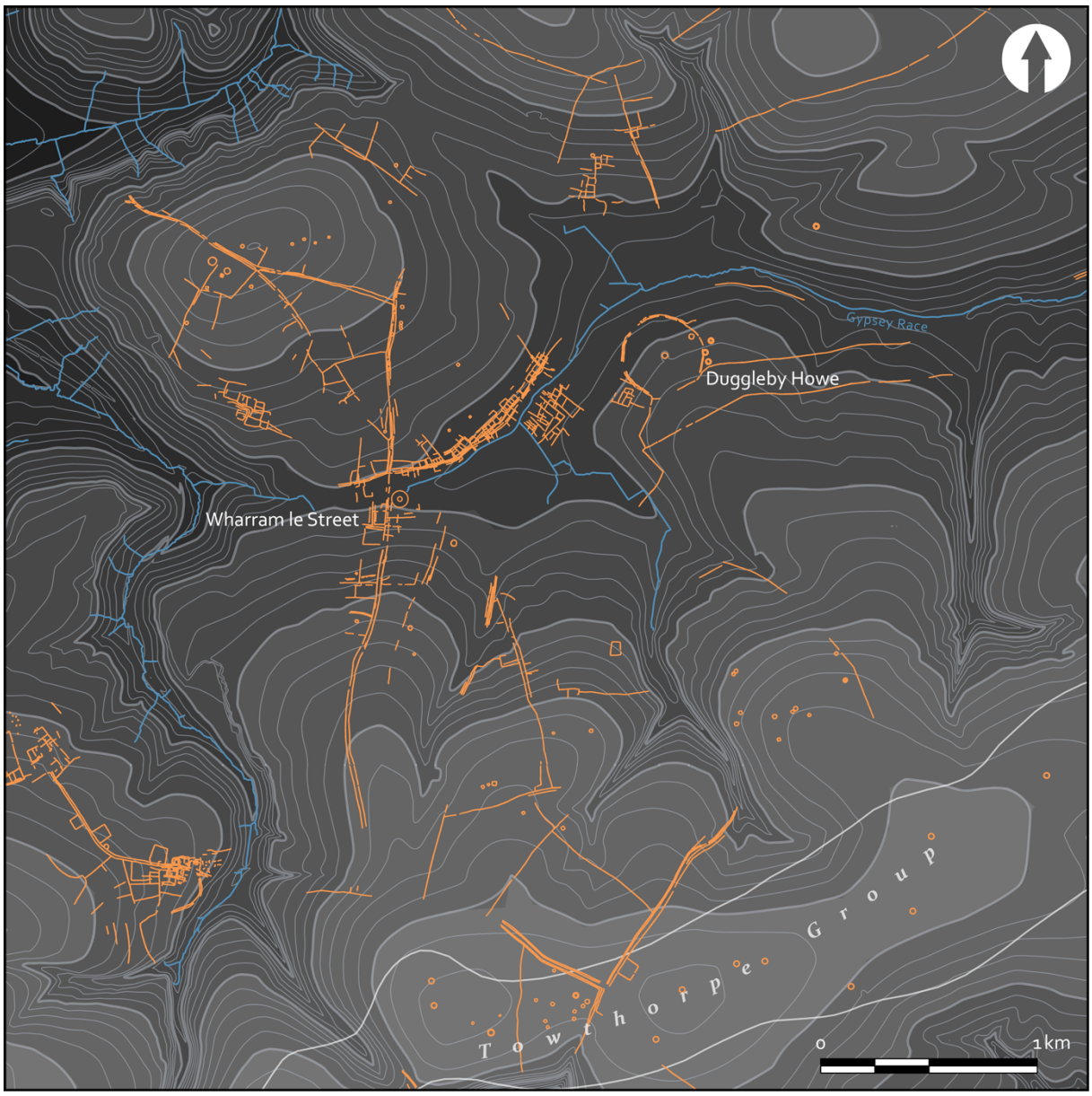


Figure 3. Map showing the locations of archaeological features identified from aerial photographs at Wharram-le-Street (after Stoertz 1997, Map 1).



Figure 4. Aerial photograph showing the complex of cropmarks at Wharram-le-Street (Historic England NRHE SE 8666 33).

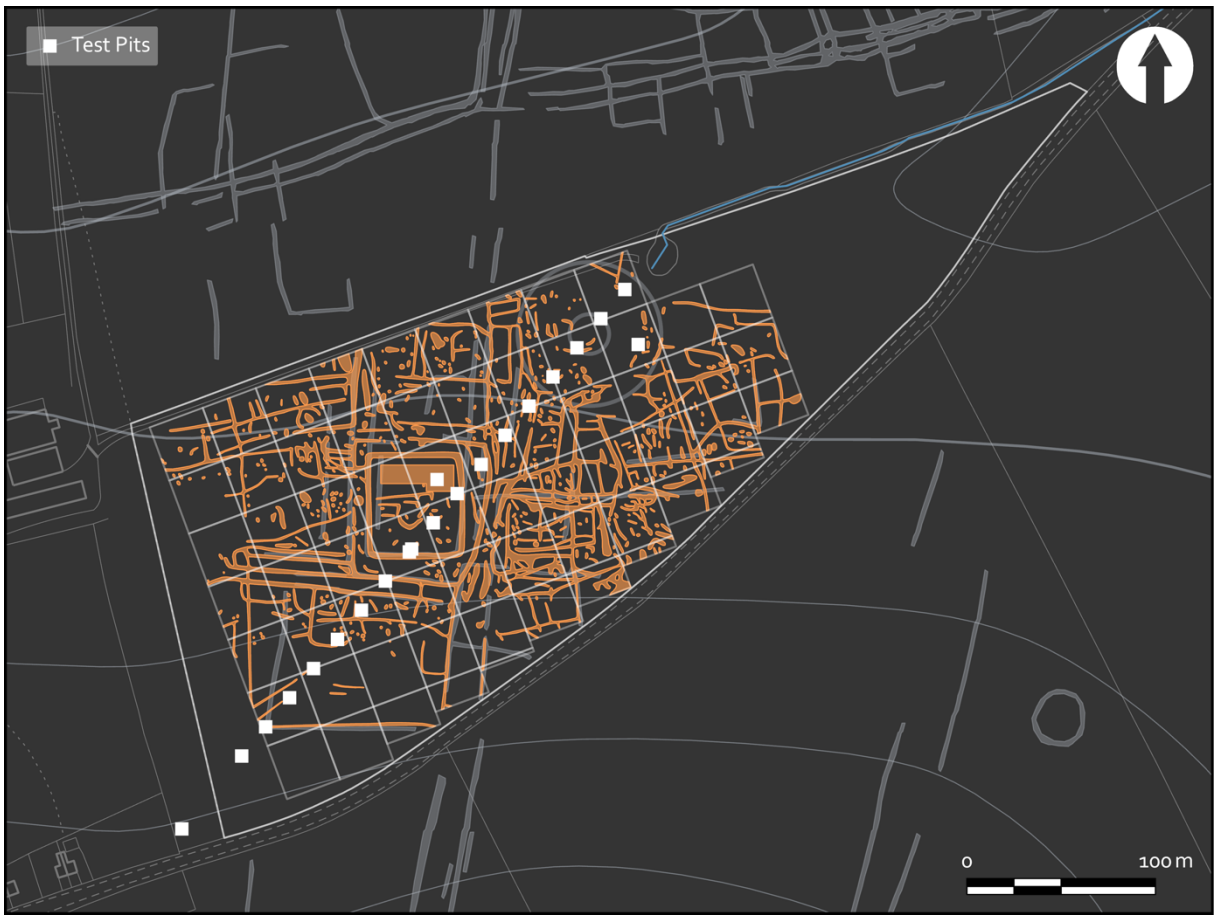


Figure 5. Magnetometer survey carried out at Wharram-le-Street by the Ancient Monuments Laboratory in 1979 (after Rahtz and Bateman 1986, Figures 4, 6 and 7).

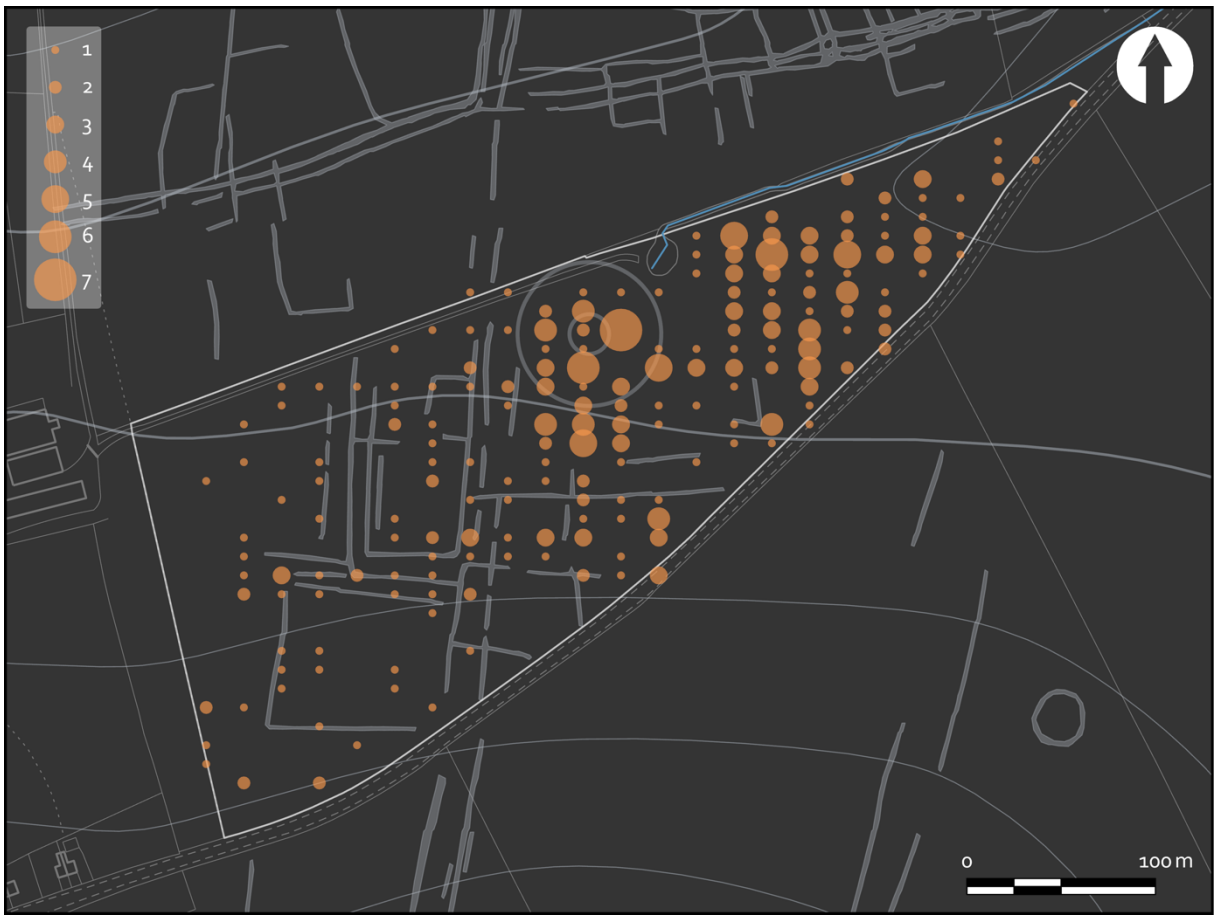


Figure 6. Distribution of lithic artefacts from the Wharram-le-Street case study, with graduated symbols showing the frequency of artefacts per collection unit.

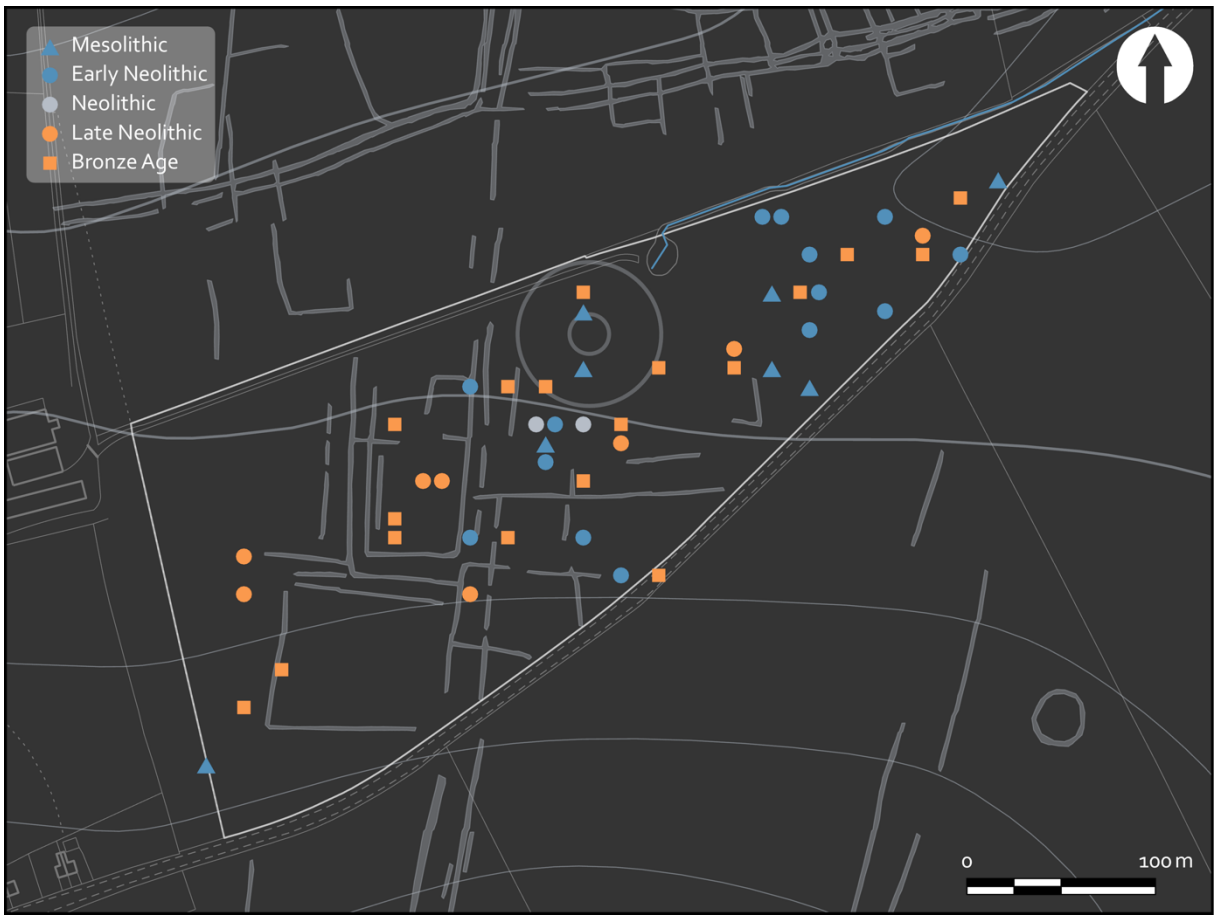


Figure 7. Distribution of chronologically diagnostic artefacts for the Wharram-le-Street case study.

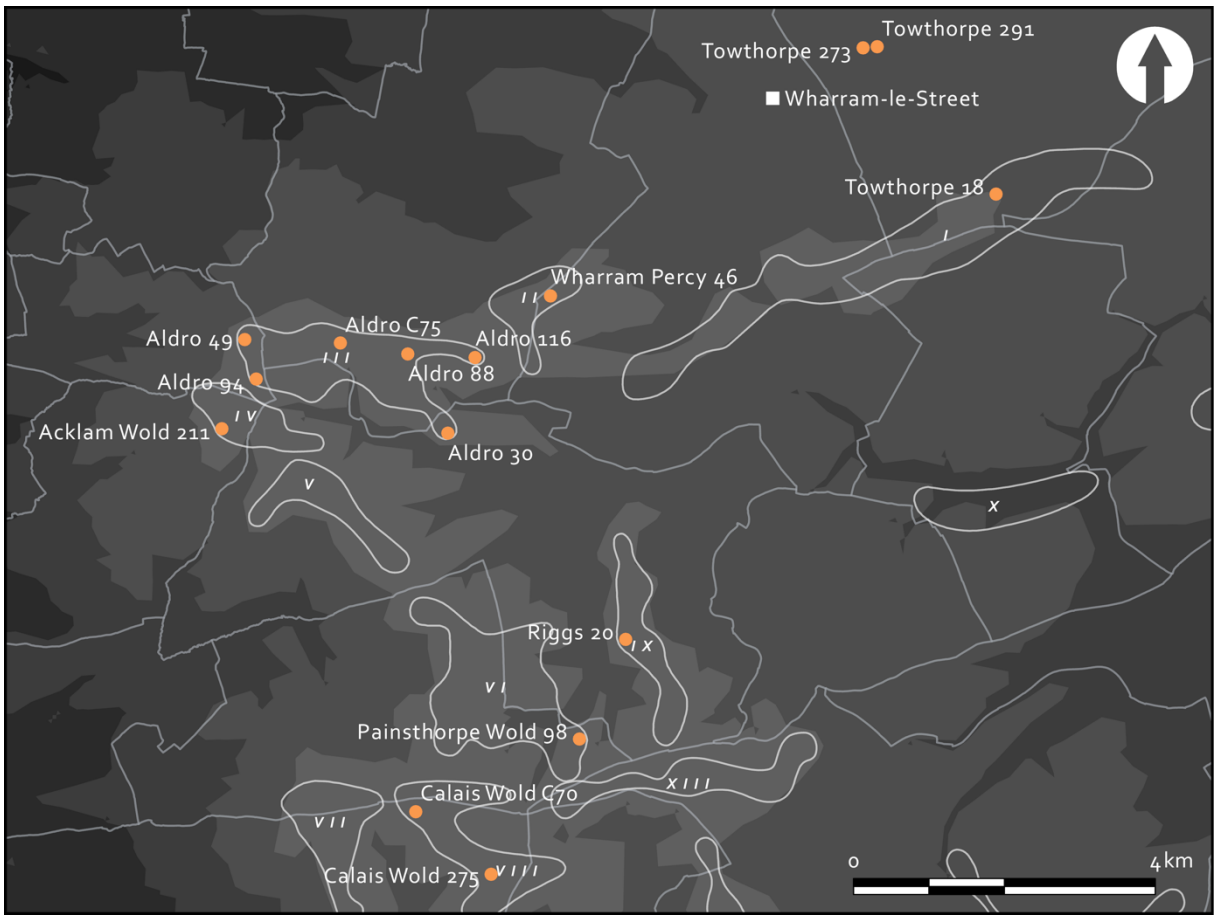


Figure 8. Map showing the locations of the Neolithic burial mounds with analysed lithic assemblages.

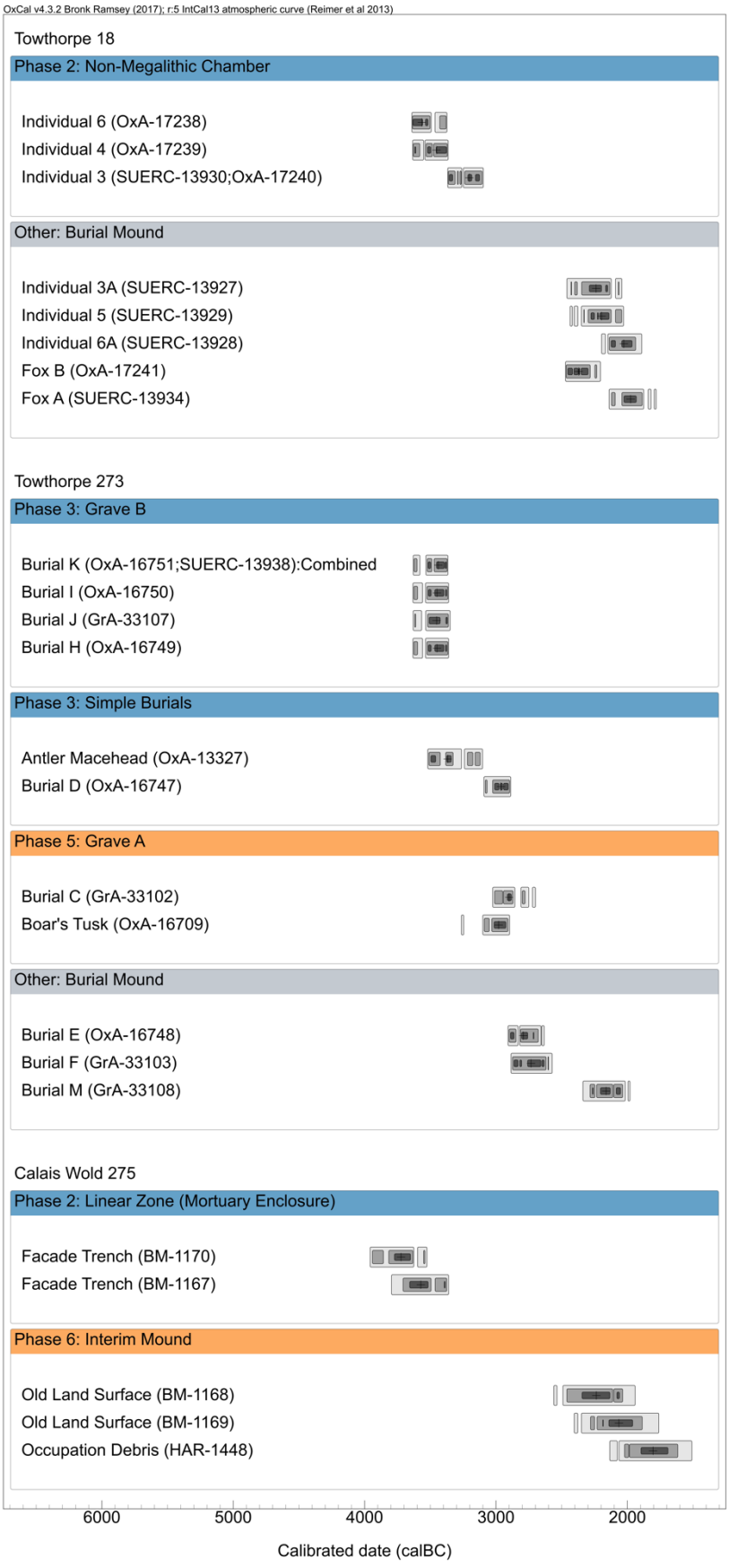


Figure 9. Radiocarbon dates for the burials and associated structures at Towthorpe 18, Duggleby Howe (Towthorpe 273) and Calais Wold 275.

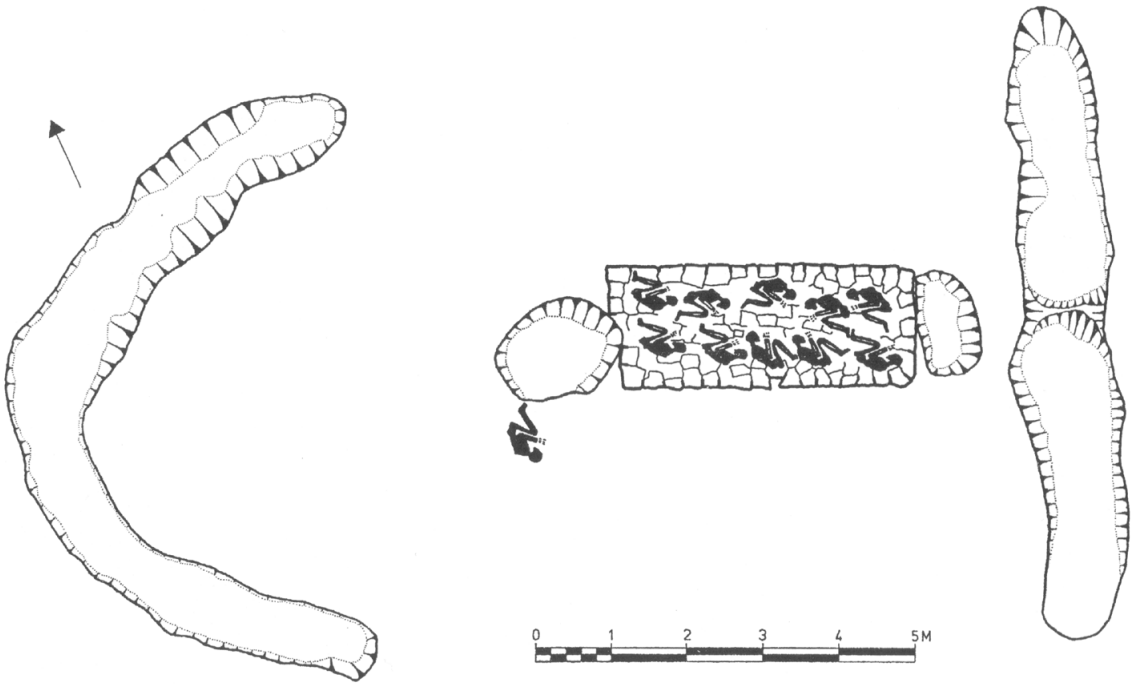


Figure 10. Plan showing the mortuary enclosure at Calais Wold 275 (Coombs 1976b).

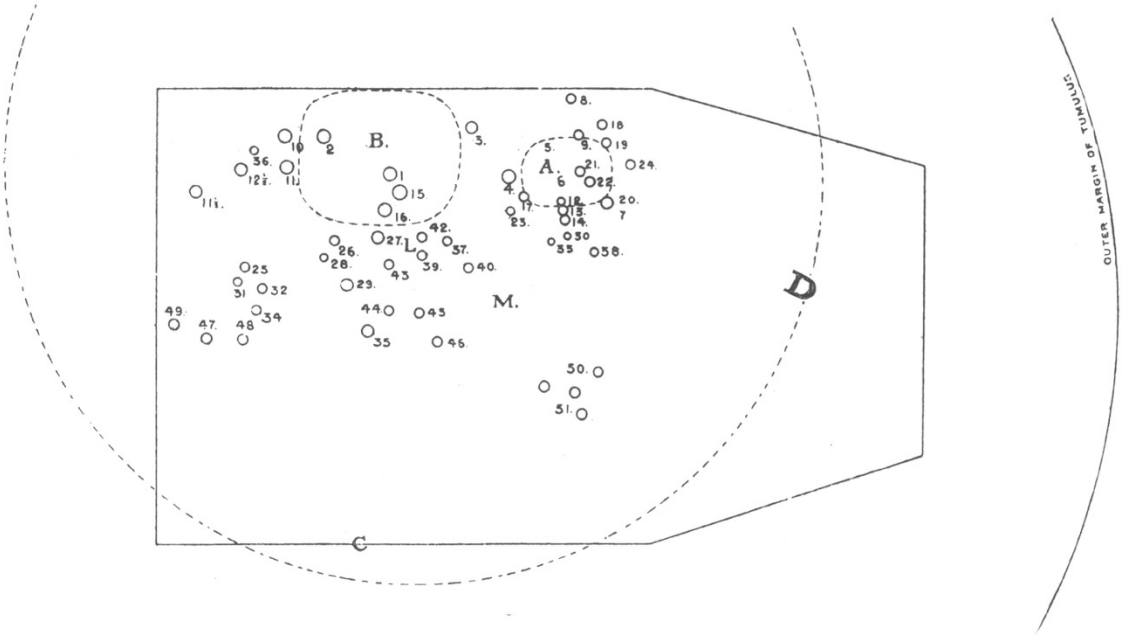
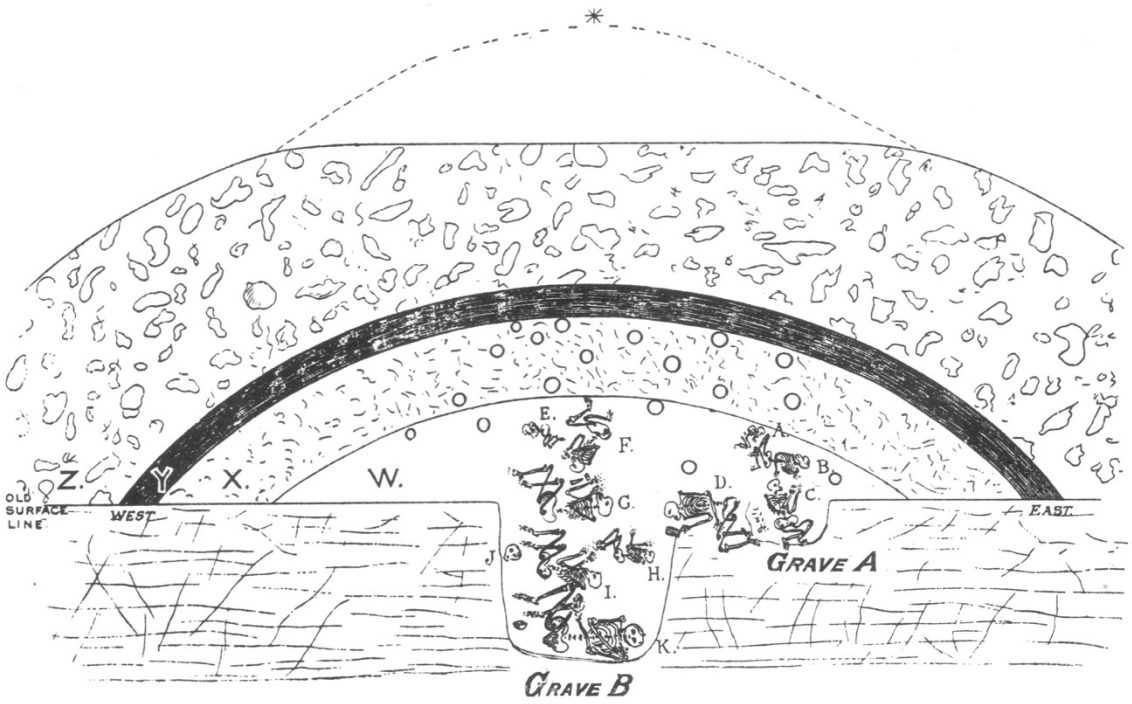


Figure 11. Plan showing the inhumations and cremations at Duggleby Howe (Mortimer 1905).



W. The inner mound of a clayey or earthy matter, $5\frac{1}{2}$ feet in thickness.
X. A bed of small chalk grit, $4\frac{1}{2}$ feet thick, in which were most of the cremated bodies.
Y. Blue Kimeridge clay, 12 inches in thickness, sealing up all the inhumed bodies, as well as the cremated interments, which were found at various elevations, as shown by the small circles; but only a few were vertically over the grave.
Z. Roughly quarried chalk, $9\frac{1}{2}$ feet in thickness, in the centre of the mound.
* Marks the assumed original height of the barrow, which was probably 8 or 10 feet higher than the present flat top.
o. Indicates cremated interments.

Figure 12. Section showing the inhumations and cremations at Duggleby Howe (Mortimer 1905).

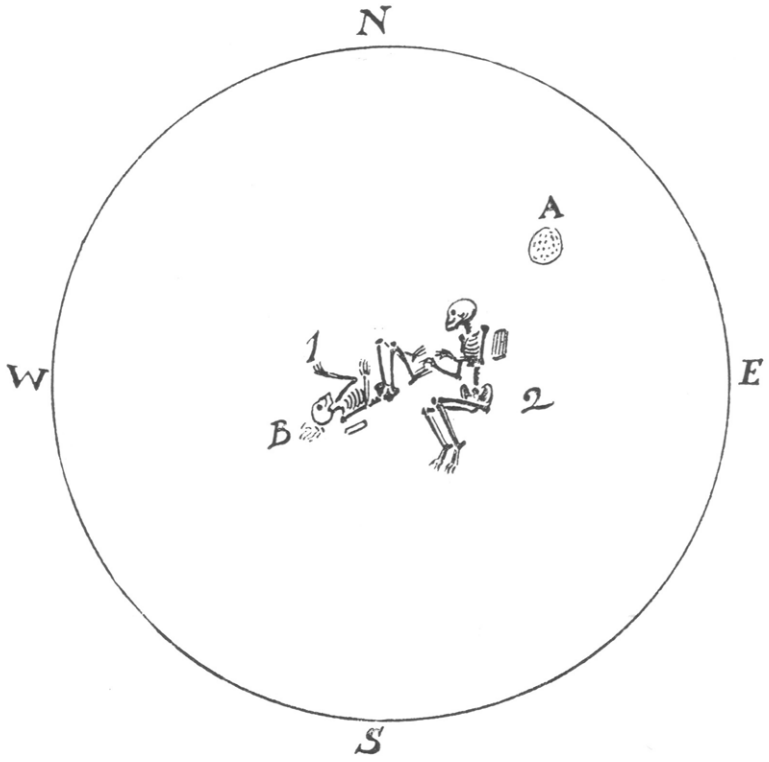


Figure 13. Plan showing the cache of worked flint found with Burial 1 at Aldro C75 (Mortimer 1905).

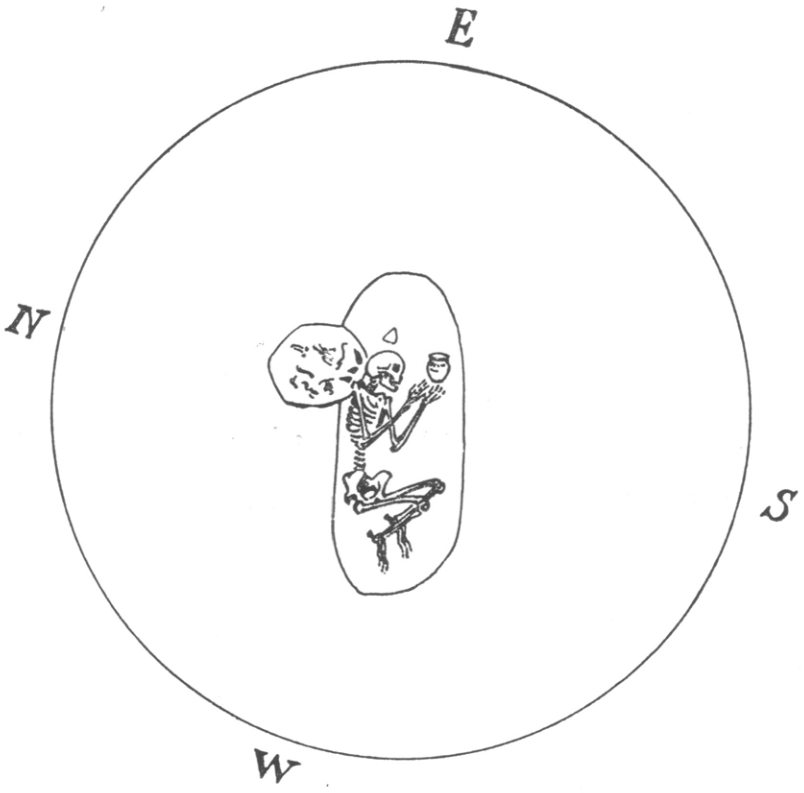


Figure 14. Plan showing the circular pit at Acklam Wold 211 (Mortimer 1905).

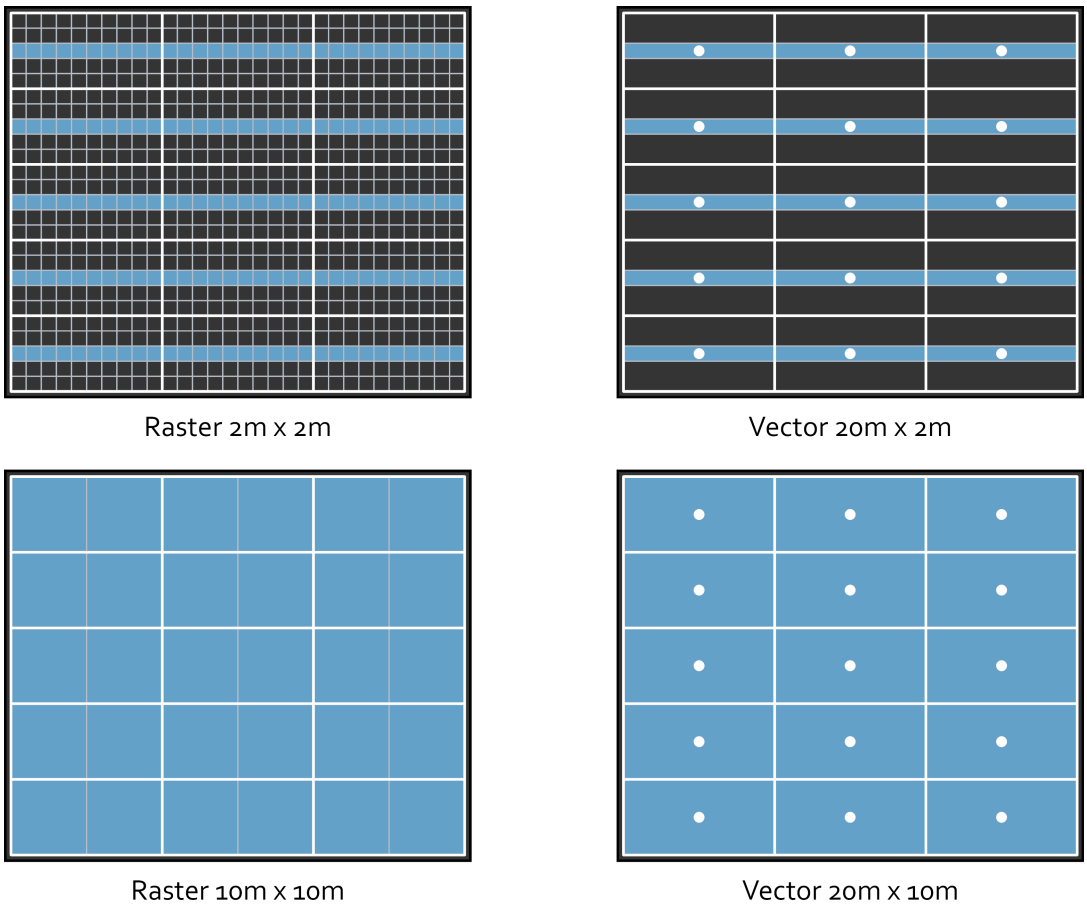


Figure 15. Raster (left) and vector (right) representations of the collection units for the Wharram-le-Street case study, with collection units shaded in blue and feature centroids shown as points.

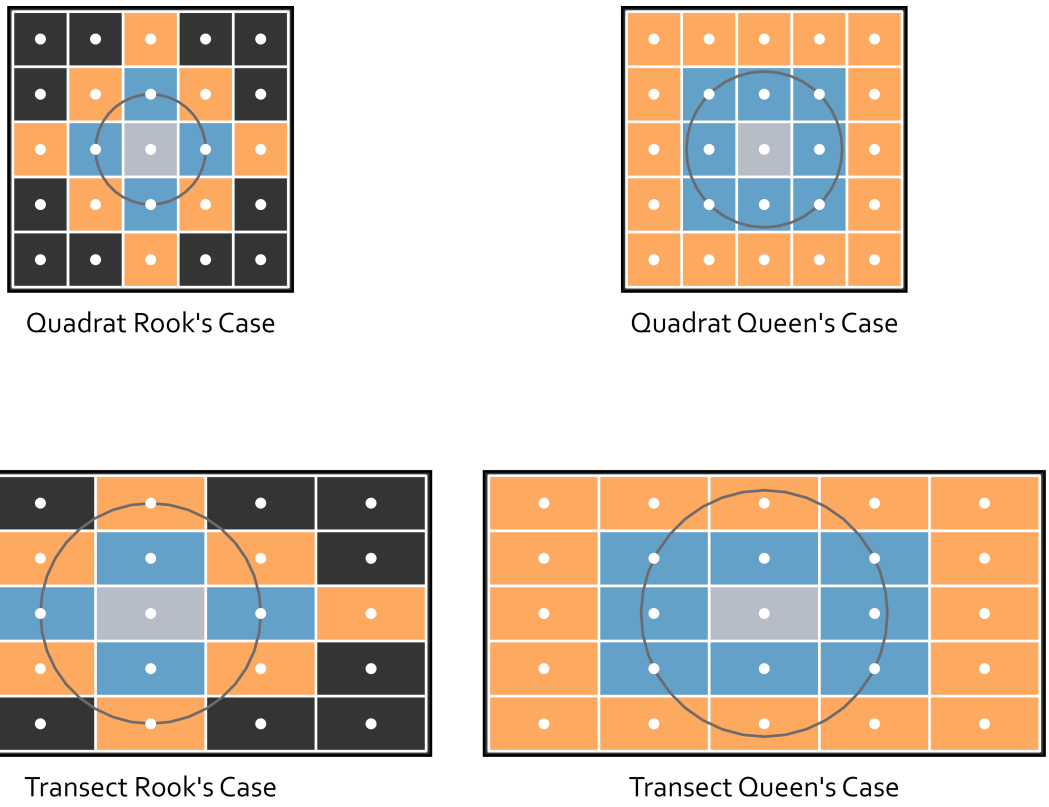


Figure 16. Search radii required to identify the first neighbours of the collection units for the Wharram-le-Street case study using the Rook's case (left) and Queen's case (right), with first neighbours shown in blue and second neighbours shown in orange.

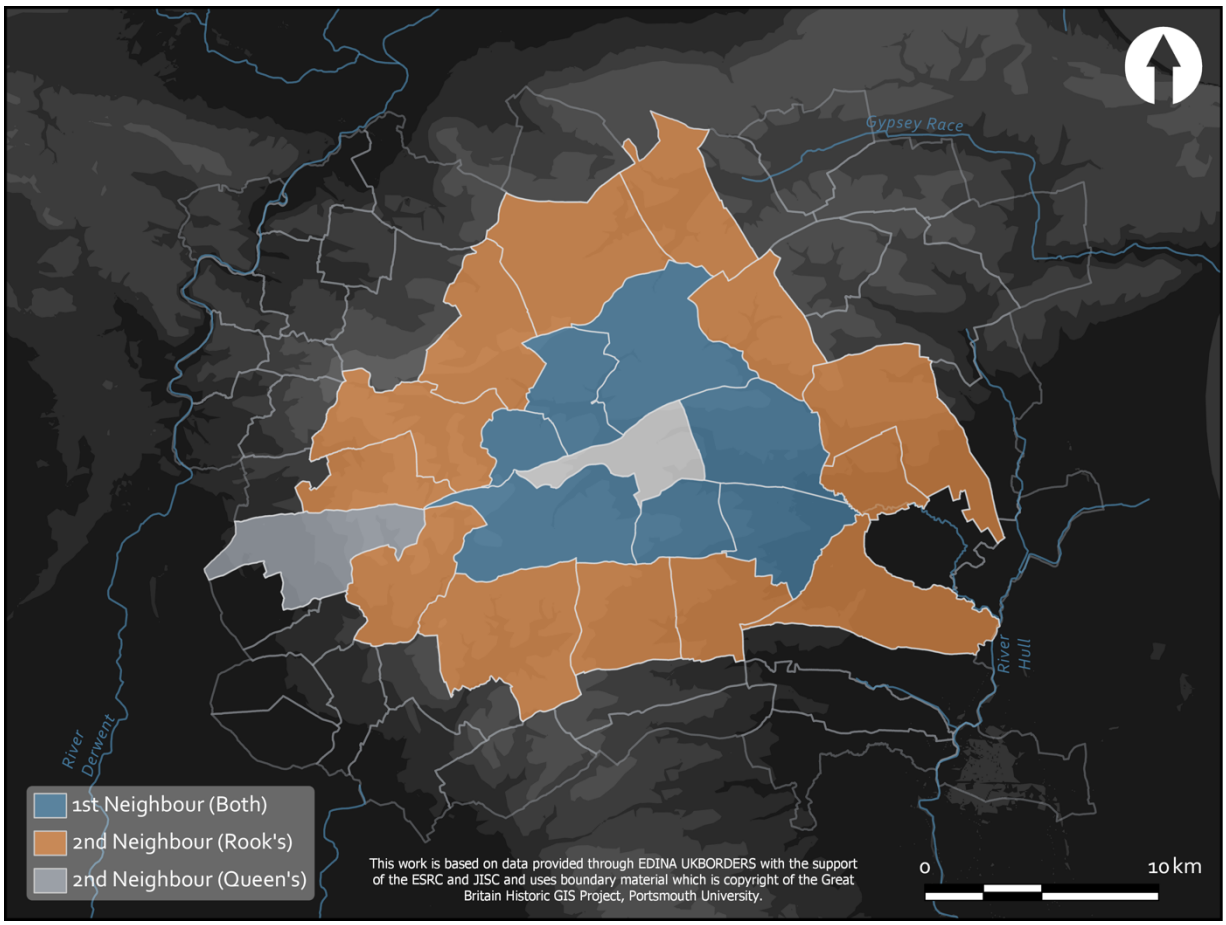


Figure 17. The first and second neighbours of the parish of Wetwang close to the centre of the study area using the Rook's case, with first neighbours shown in blue, second neighbours shown in orange and the additional neighbour for the Queen's case shown in grey.

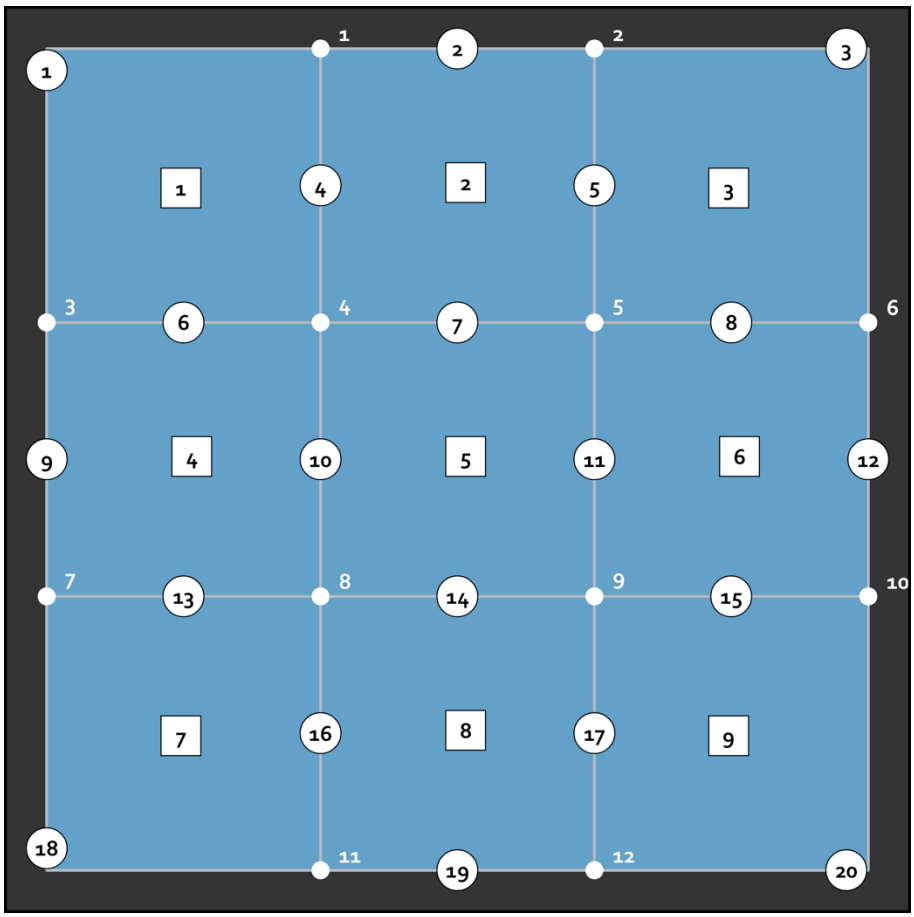


Figure 18. Cells in a 3 x 3 window represented as topological elements, with labels for area/annotation shown in squares, arcs shown in circles and nodes shown as points.

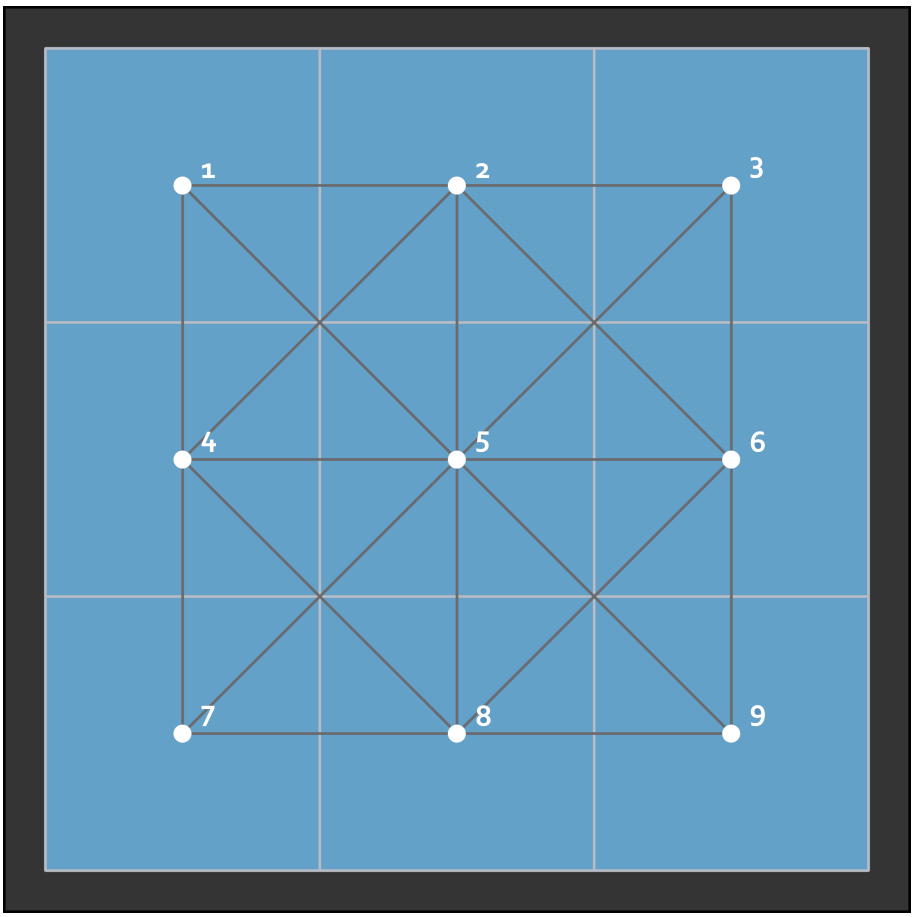
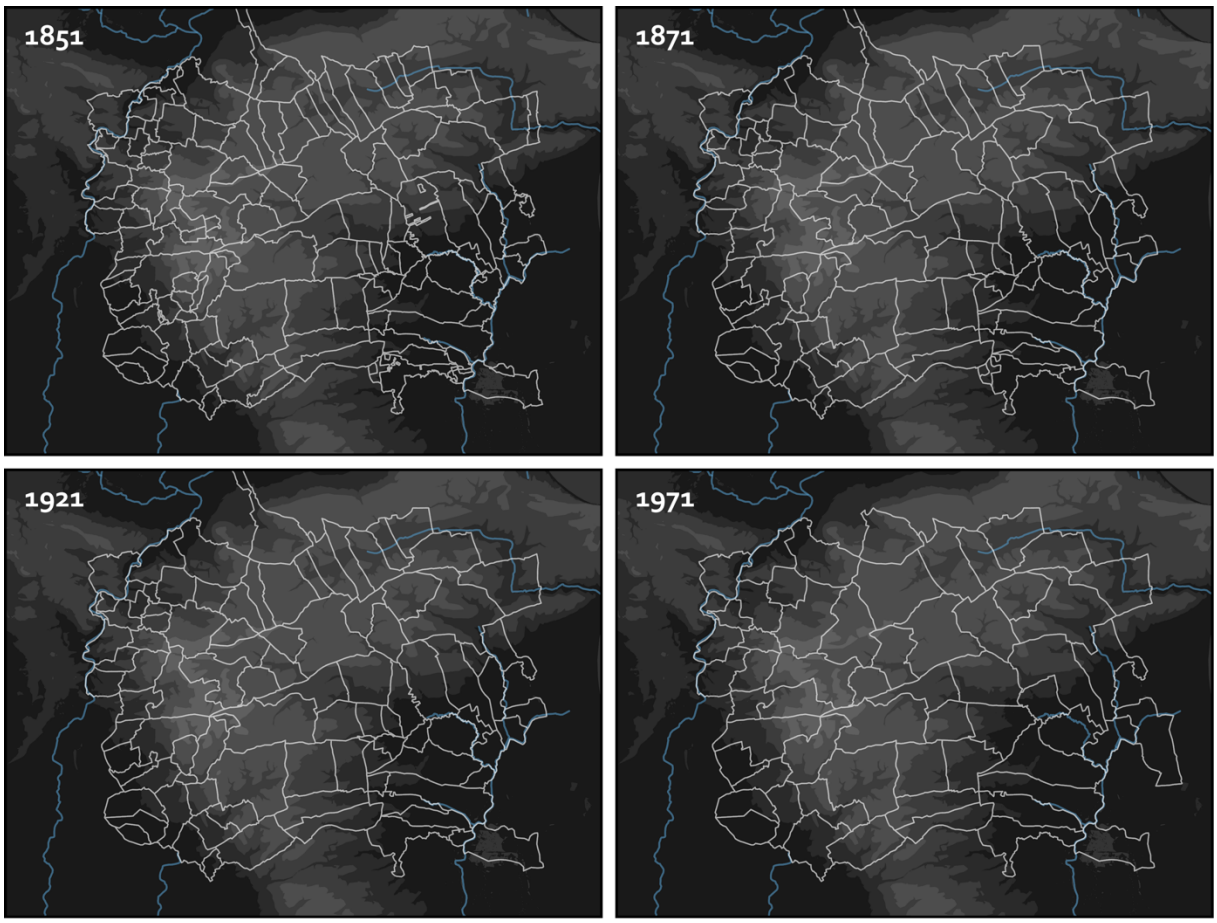


Figure 19. Cells in 3 x 3 window represented as a network dataset, with vertices shown as labelled points and edges shown as dark grey lines.



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Figure 20. Ancient and civil parishes for the Wolds study area, showing a decrease in the frequency and an increase in the size of parishes during the 19th and 20th centuries.

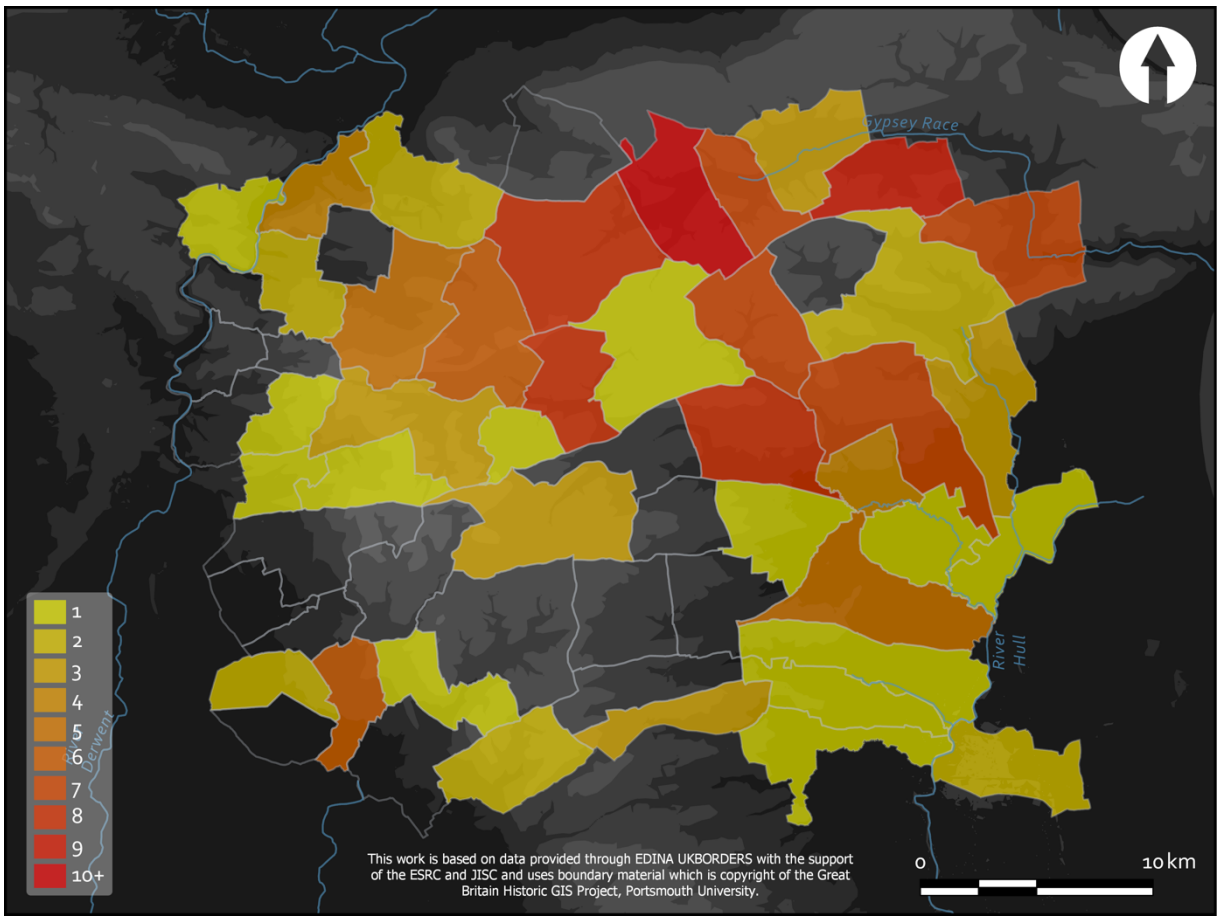
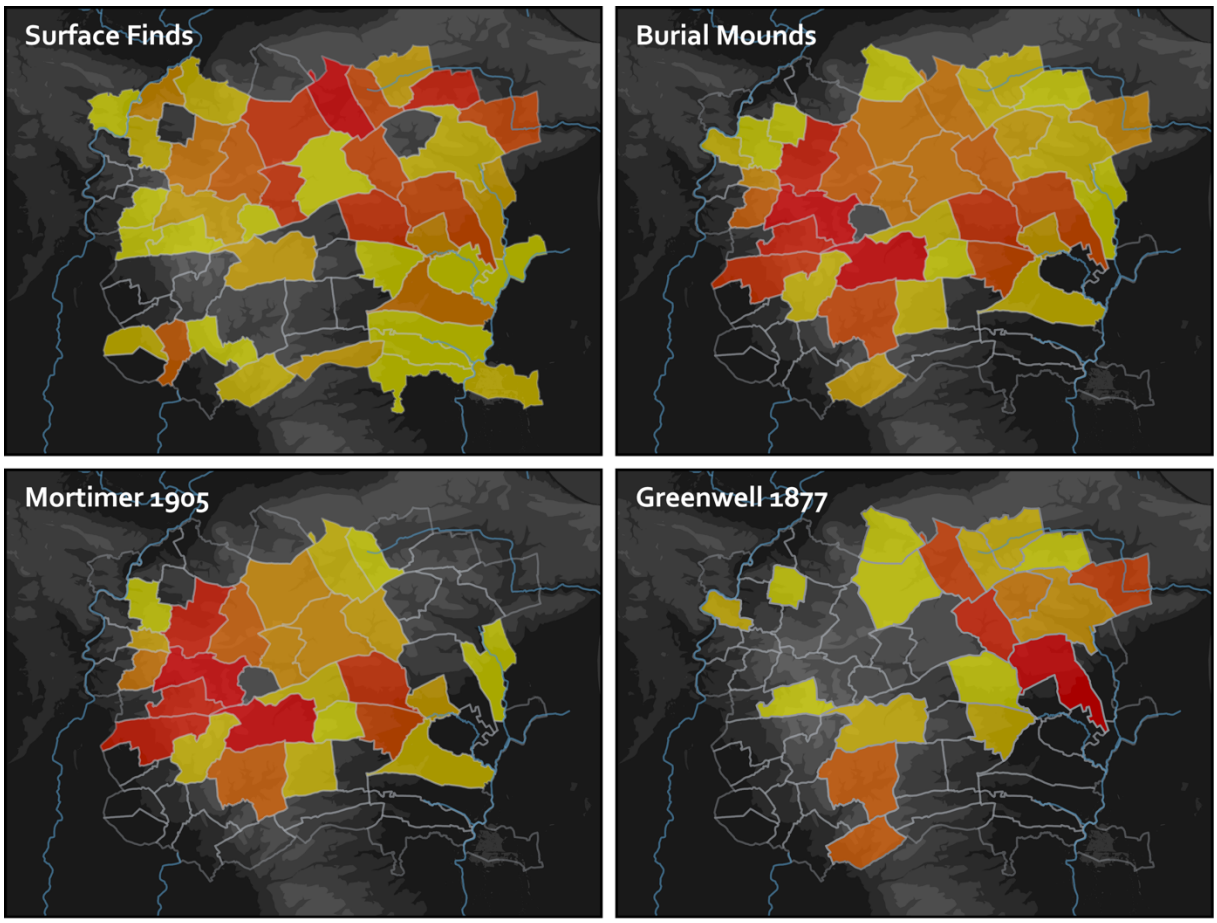


Figure 21. Distribution of stray finds and lithic scatters from the Wolds study area aggregated by civil parish, with high frequencies of stray finds and lithic scatters from the parishes in the north-east corner of the study area.



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Figure 22. Distributions of surface finds and burial mounds in the Wolds study area, showing the correlation between the surface finds and the burial mounds excavated by Greenwell.

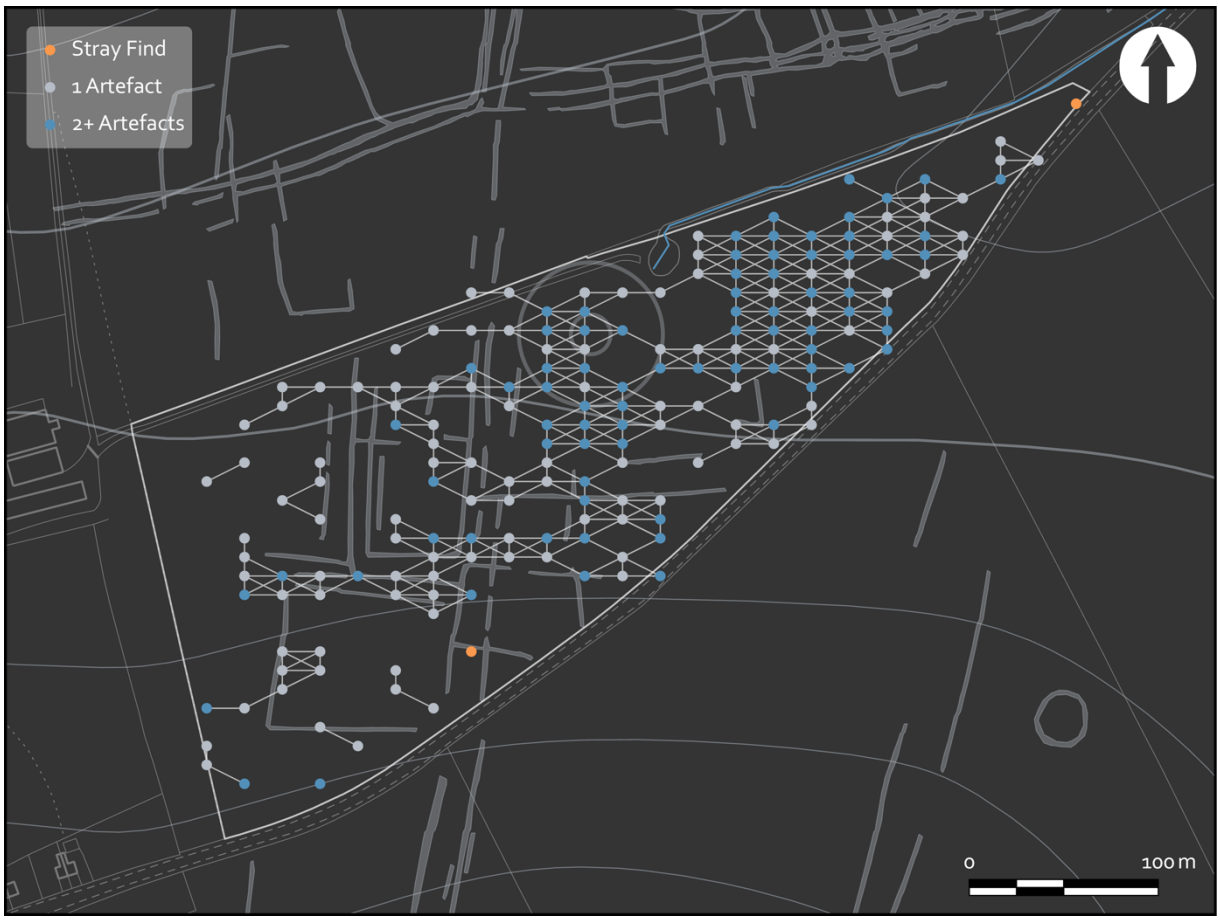


Figure 23. Distribution of lithic artefacts from the Wharram-le-Street case study, with non-zero values classified using the degree of the vertices for the collection unit centroids.

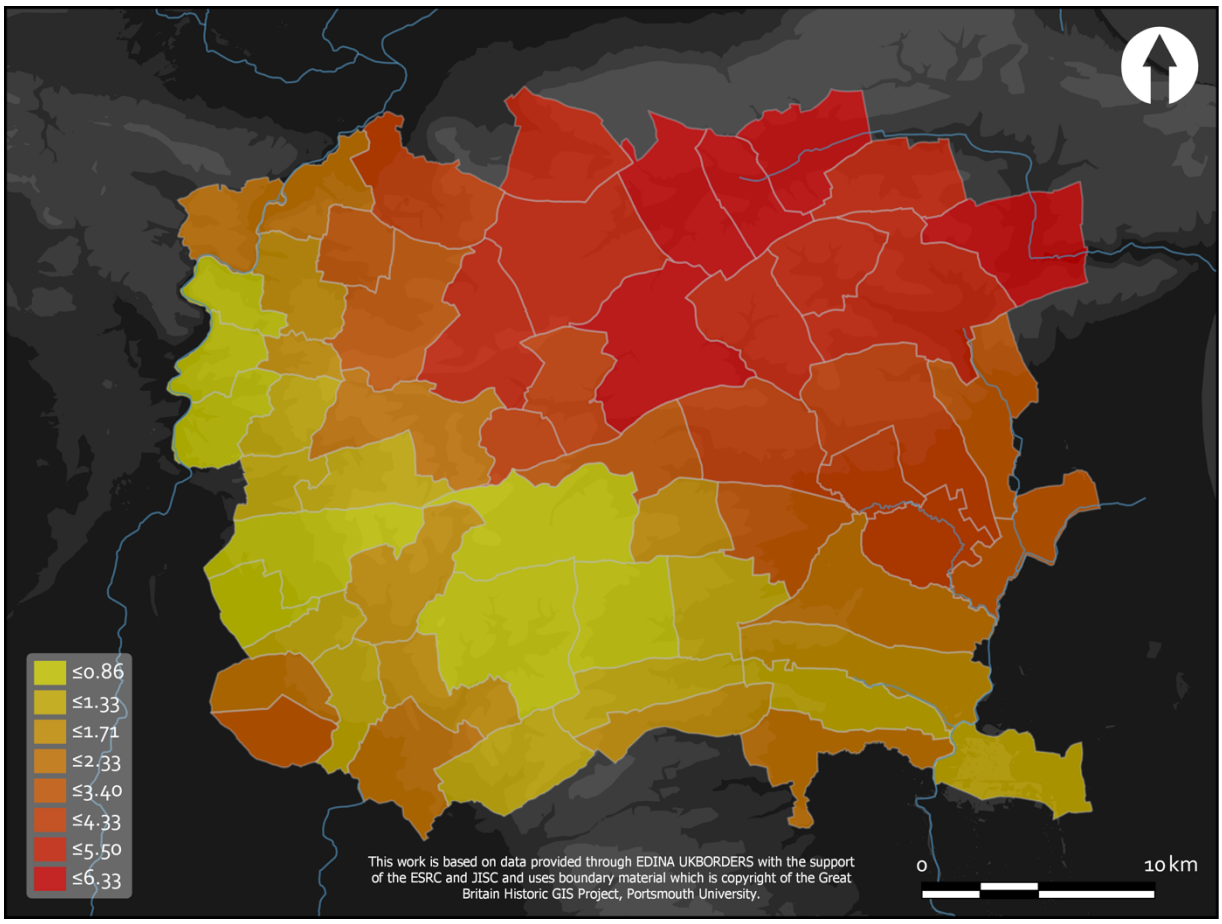


Figure 24. Focal mean of stray finds and lithic scatters from the Wolds study area aggregated by civil parish, with values classified using octiles.

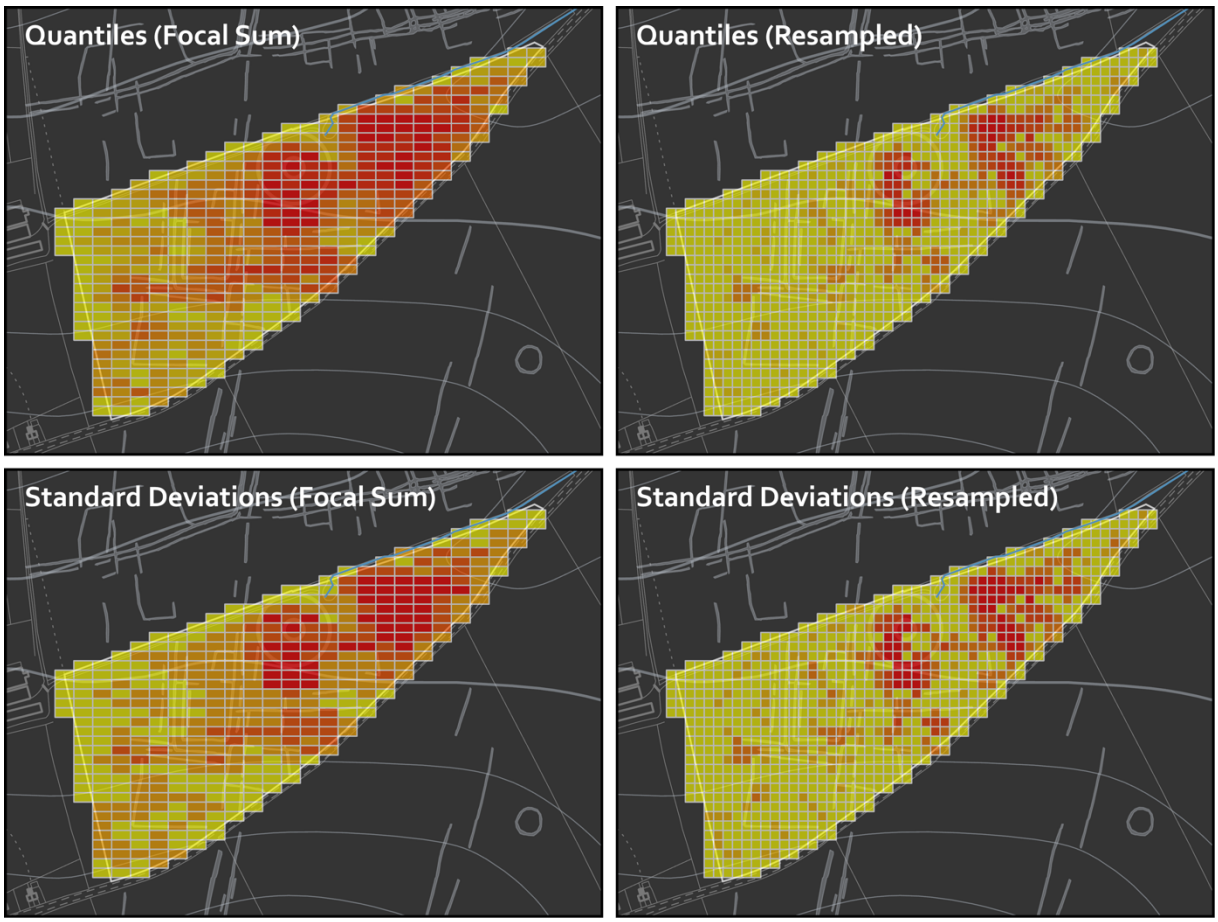


Figure 25. Focal sum and resampled artefact frequencies for the Wharram-le-Street case study, with values classified by quantiles (top) and standard deviations (bottom).

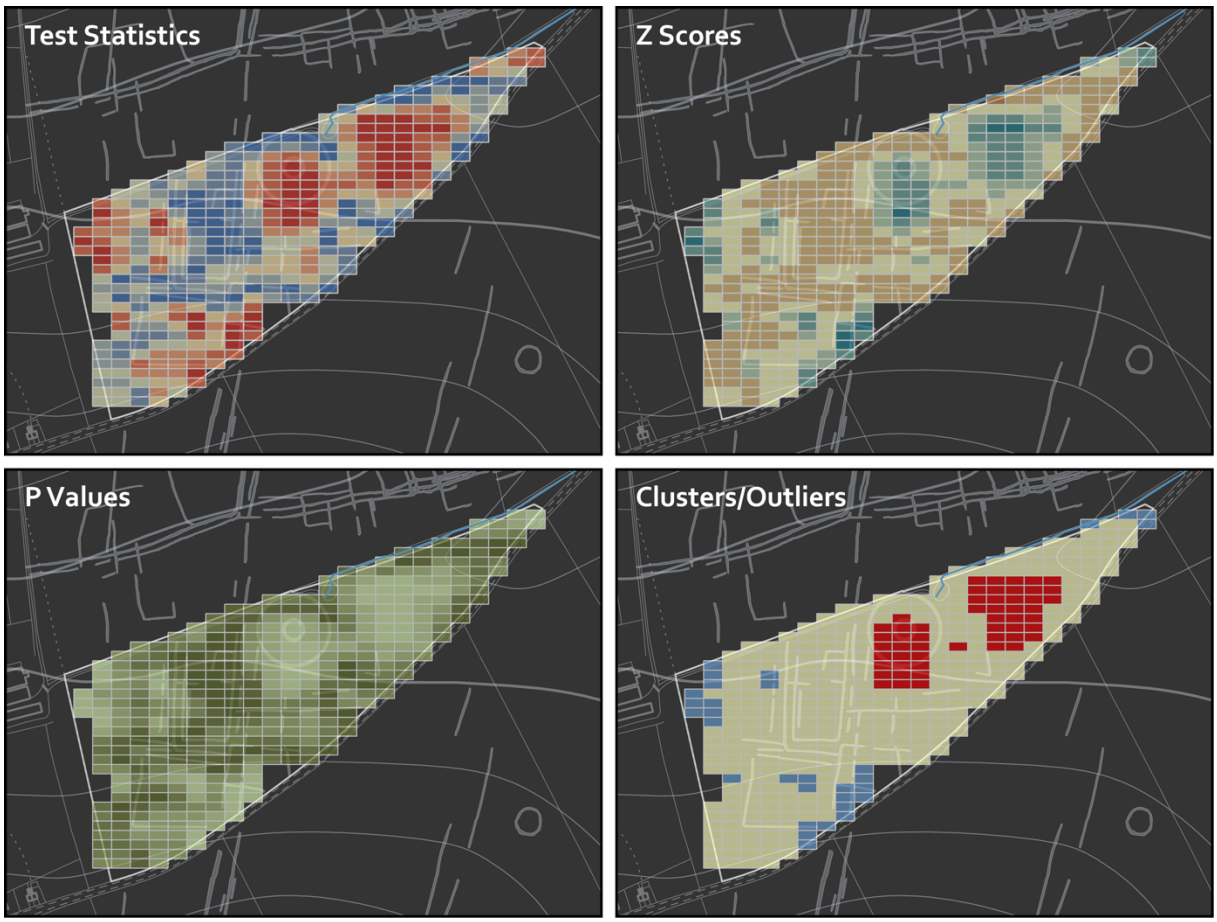


Figure 26. Anselin Local Moran's I test statistics, z scores, p values and clusters/outliers for the focal sum of the artefact frequencies from the Wharram-le-Street case study, with high values for the test statistics shown in red and low values shown in blue (top left), high values for the z scores shown in blue/green and low values shown in brown (top right), high values for the p value shown in dark green and low values shown in light green (bottom left), and clusters of high values shown in red and clusters of low values shown in blue (bottom right).



Figure 27. Blunted-back knife from the burial mound at Aldro 116.

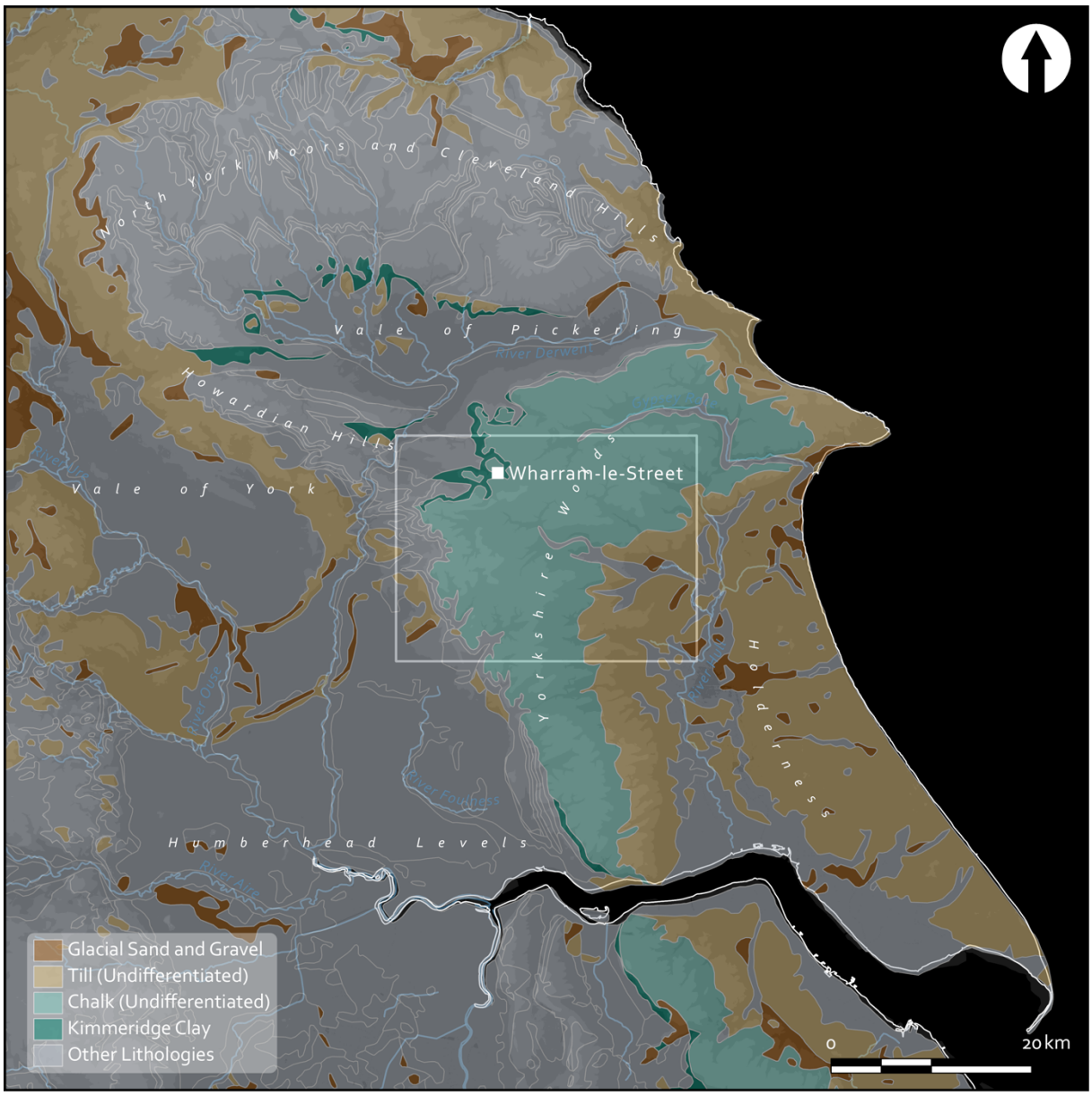


Figure 28. Surface geology of Eastern Yorkshire showing the key bedrock and superficial deposits.



Figure 29. Exposures of boulder clay along the Holderness coastline.



Figure 30. Edge-retouched flake knife from the cache of worked flint found with Burial 1 at Aldro C75.

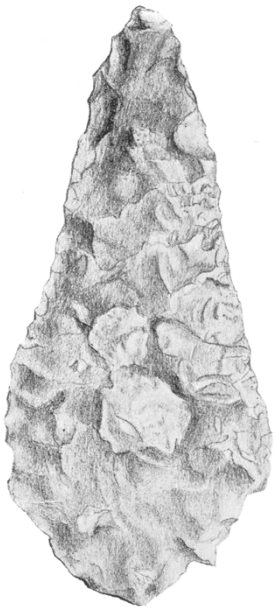


Figure 31. Leaf point from the old land surface beneath the burial mound at Towthorpe 291.

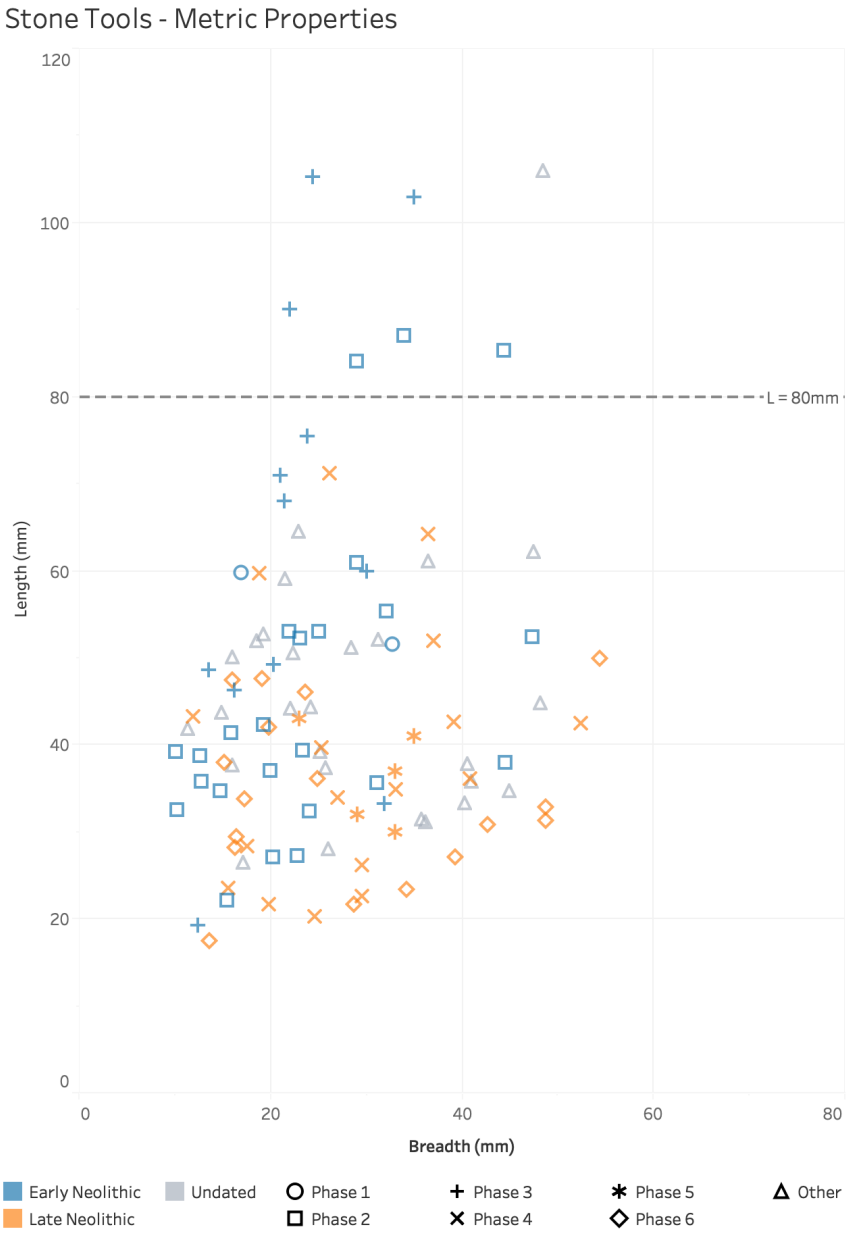


Figure 32. Metric properties of the stone tools from the Neolithic burial mounds (n = 122).

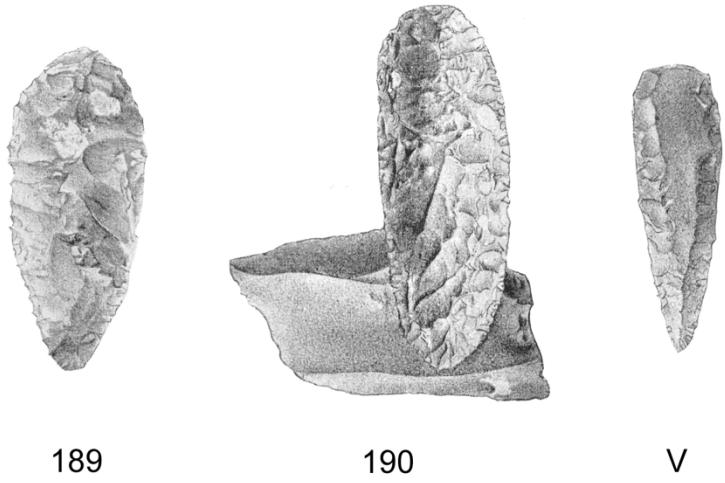


Figure 33. Plano-convex knives from Cremation 3 and Grave C at Painsthorpe Wold 98.

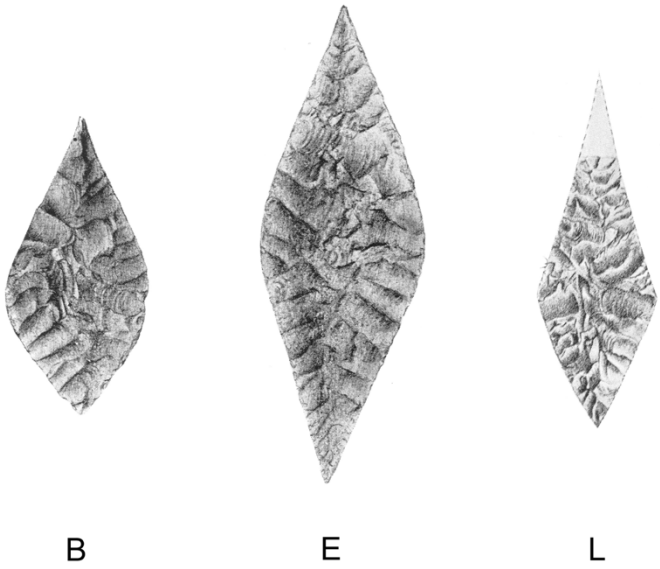


Figure 34. Leaf-shaped arrowheads from the non-megalithic chamber at Towthorpe 18 and one of the simple burials (Burial G) at Towthorpe 273.

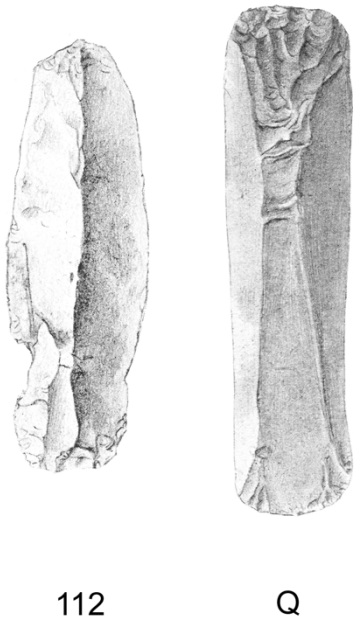


Figure 35. Polished edge knives from one of the simple burials (Burial 1) at Aldro C75 and the linear zone at Aldro 94.

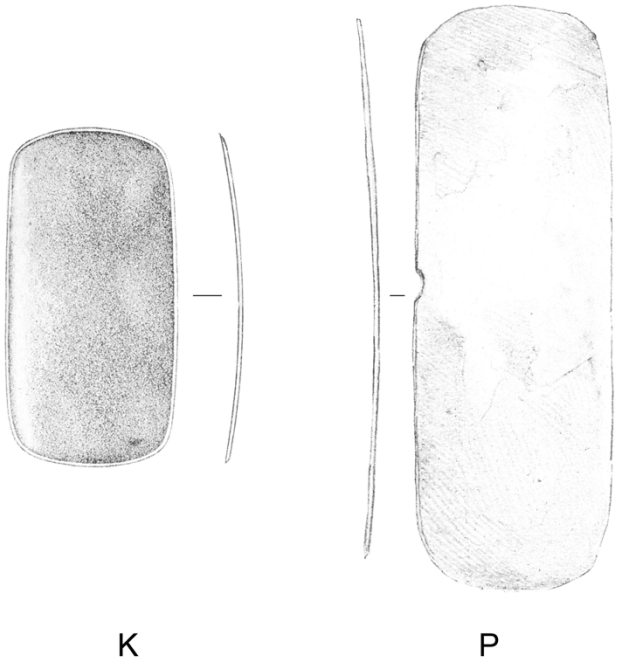


Figure 36. Polished knives from the simple burials on the old land surfaces beneath the burial mounds at Towthorpe 273 (Burial D) and Aldro C75 (Burial 2).

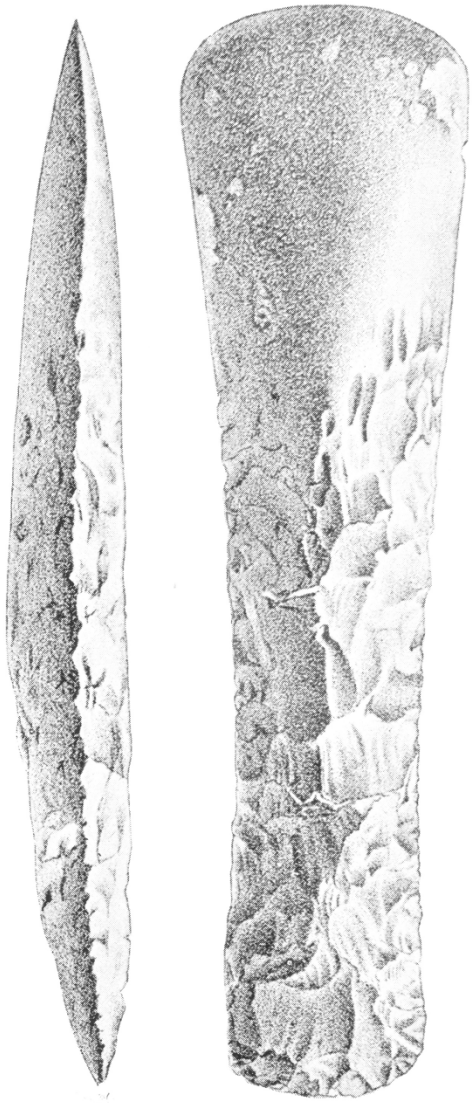


Figure 37. Polished Duggleby-type adze from one of the simple burials (Burial G) at Towthorpe 273.



Figure 38. Barbed and tanged arrowhead from the upper levels of the burial mound at Calais Wold 275.

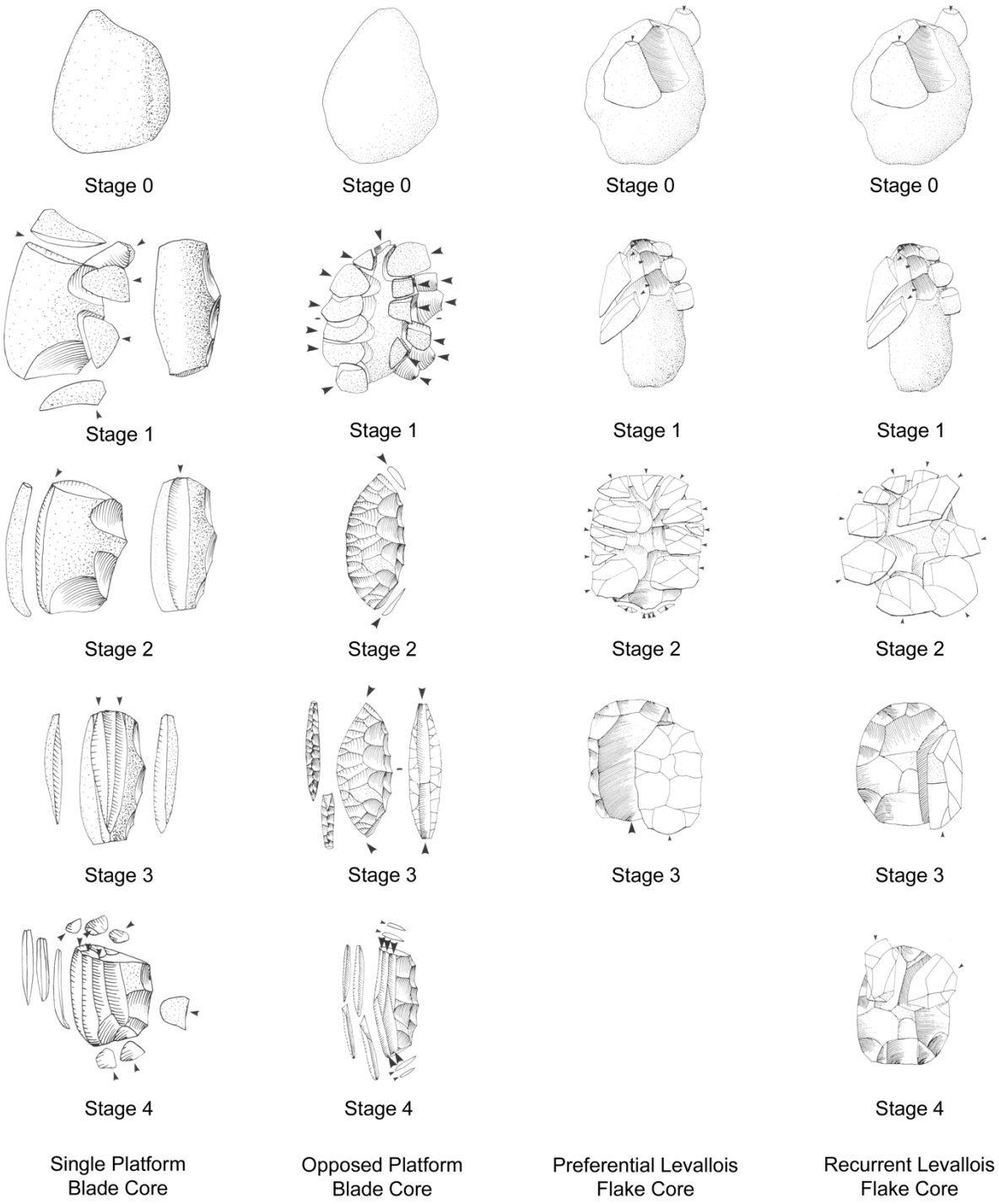


Figure 39. Core preparation (after Inizan et al 1999, Figures 9, 10, 23 and 24).

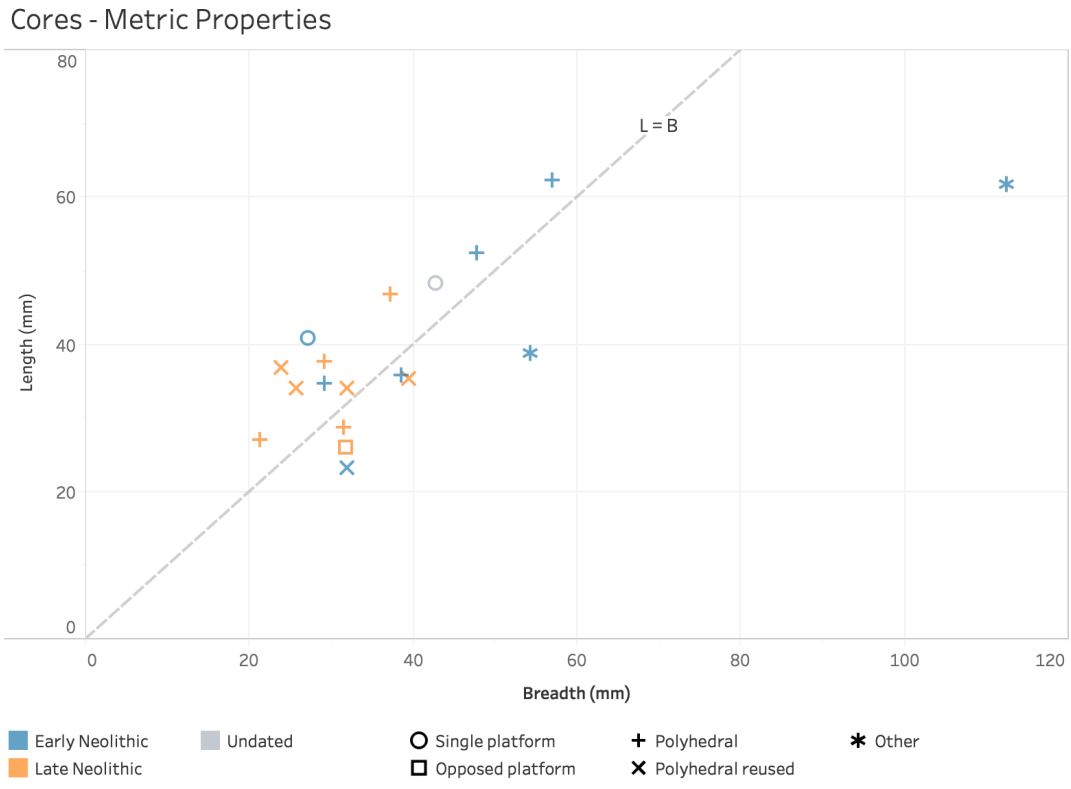


Figure 40. Metric properties of the cores from the Neolithic burial mounds (n=18).

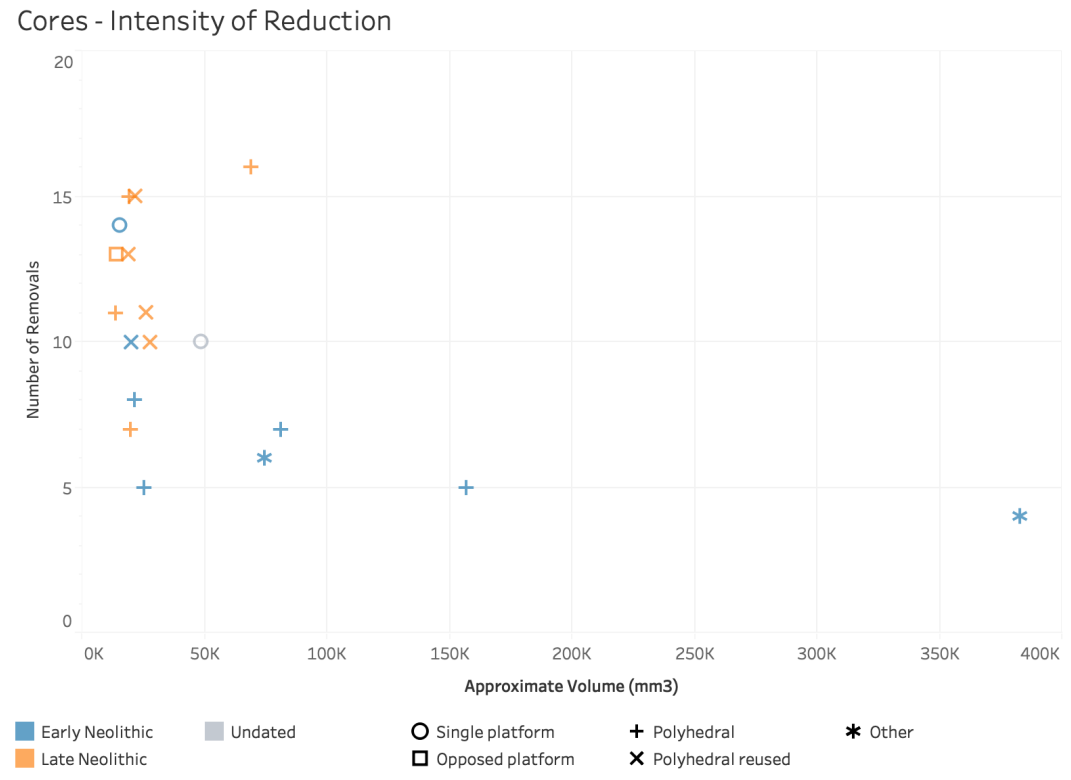


Figure 41. Intensity of reduction of the cores from the Neolithic burial mounds (n=18).

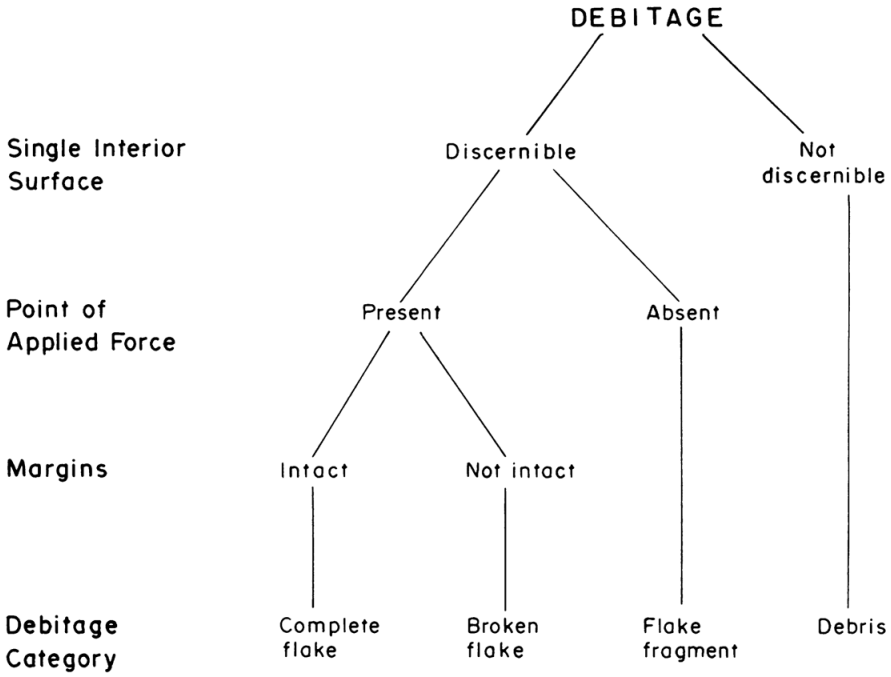


Figure 42. Classification of debitage (after Sullivan and Rozen, 1985, Figure 2).



Figure 43. Refitting blades and flakes from the cache of worked flint found with Burial 1 at Aldro C75.

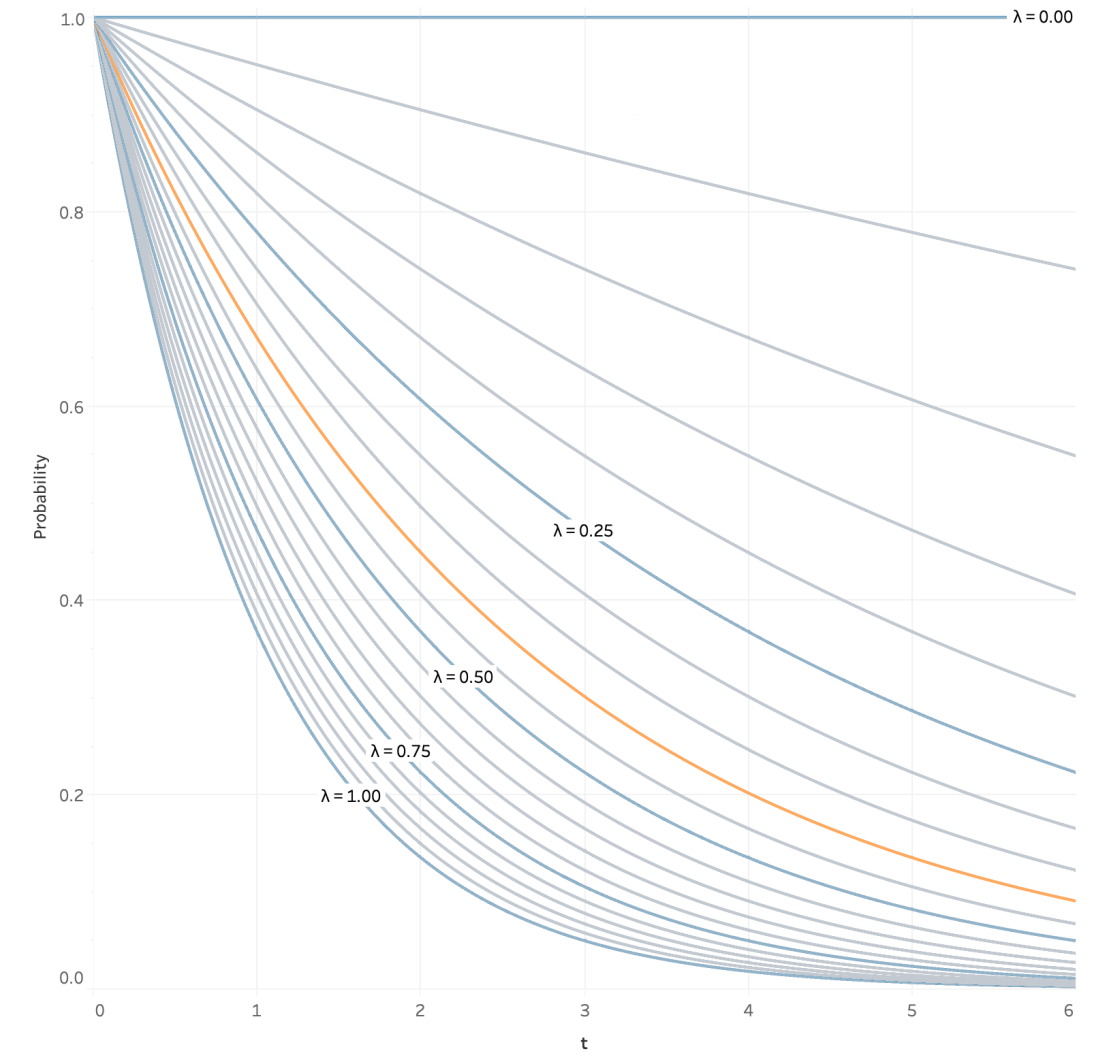


Figure 44. Decay curves showing the probability that the dorsal surface of a complete removal will bear cortex after equal increments of time have elapsed.

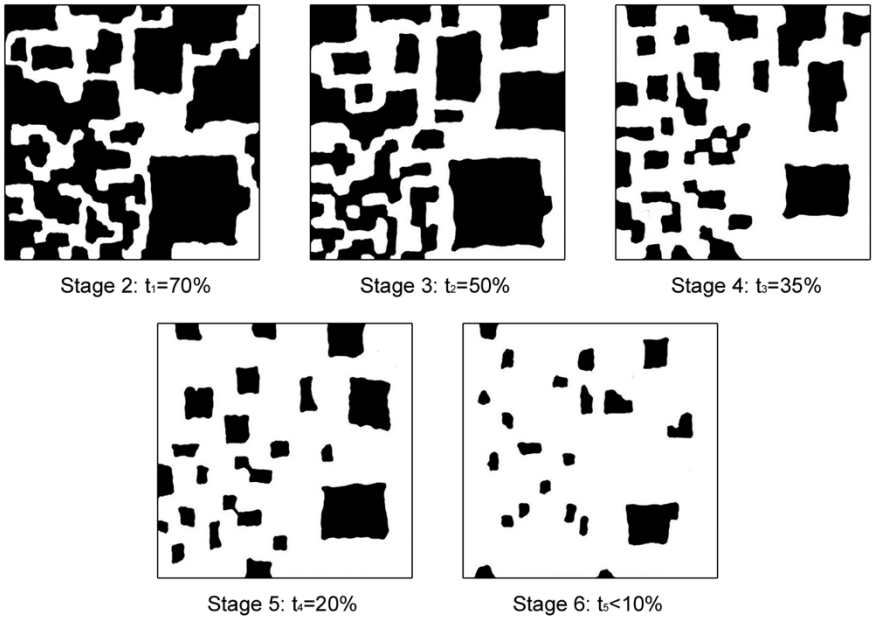


Figure 45. Standardised percentage chart showing the approximate degree of cortication for intermediate cortical removals (after Hodgson 1974).

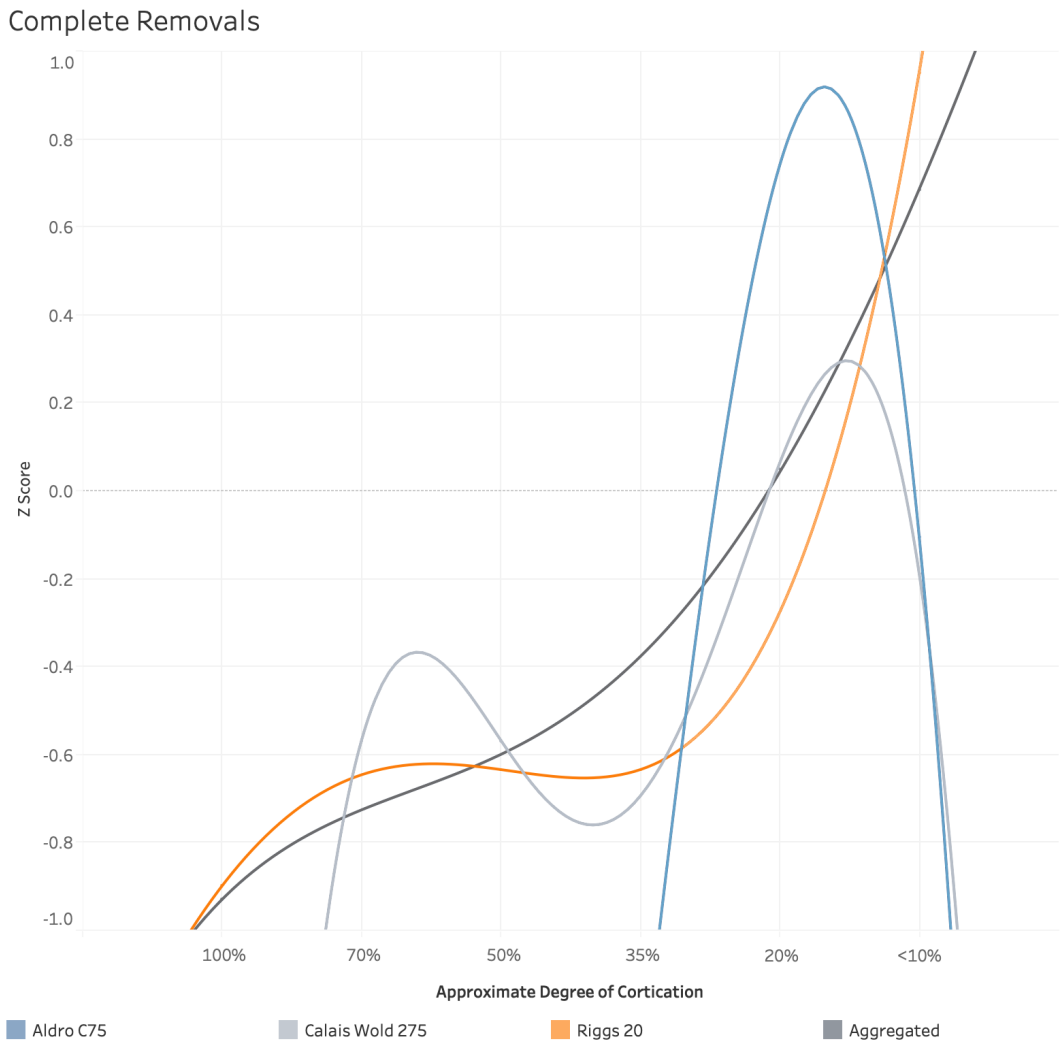


Figure 46. Frequency diagrams showing the standardised frequencies of complete removals from the individual assemblages of worked flint from the Neolithic burial mounds by approximate degree of cortication (n=90).

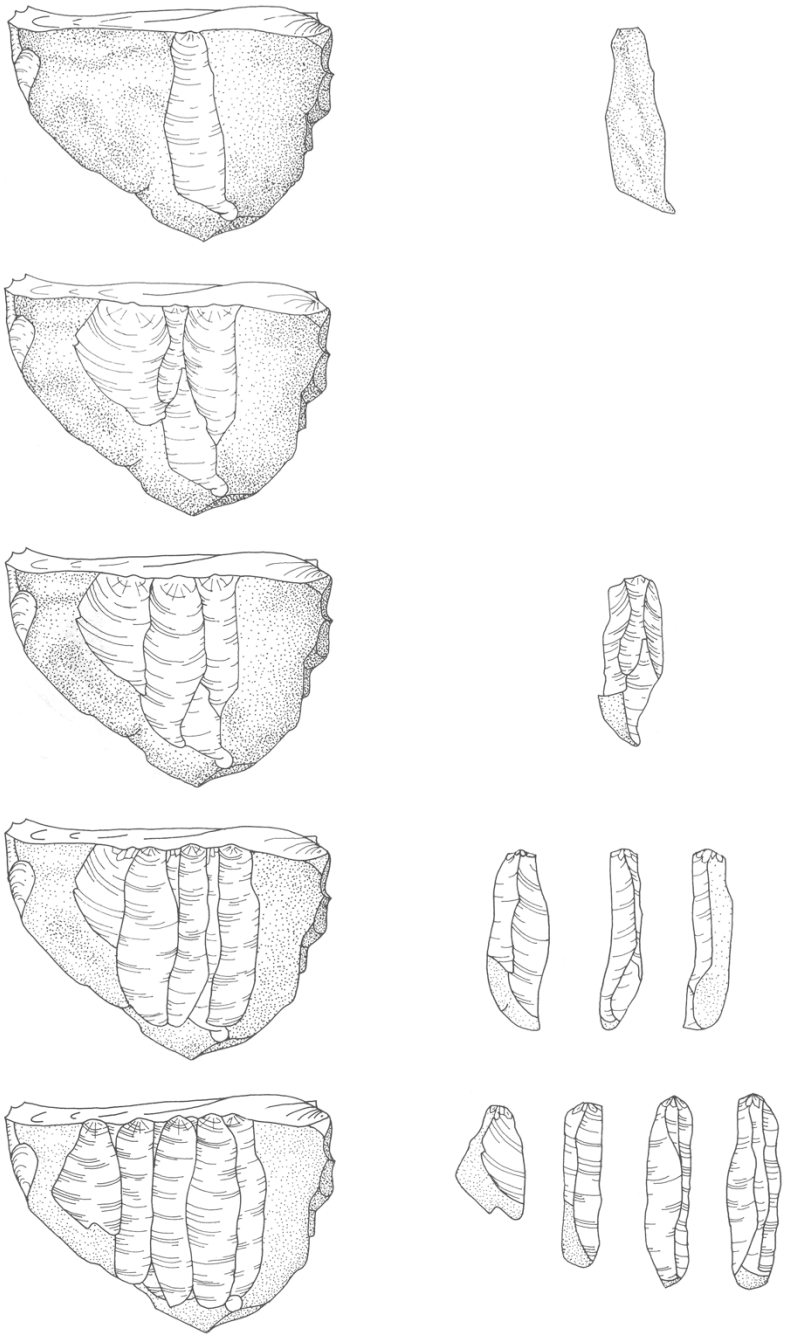


Figure 47. Initial stages of blade manufacture initiated using a natural crest (after Whittaker, 1994, Figures 9.7 to 9.11).

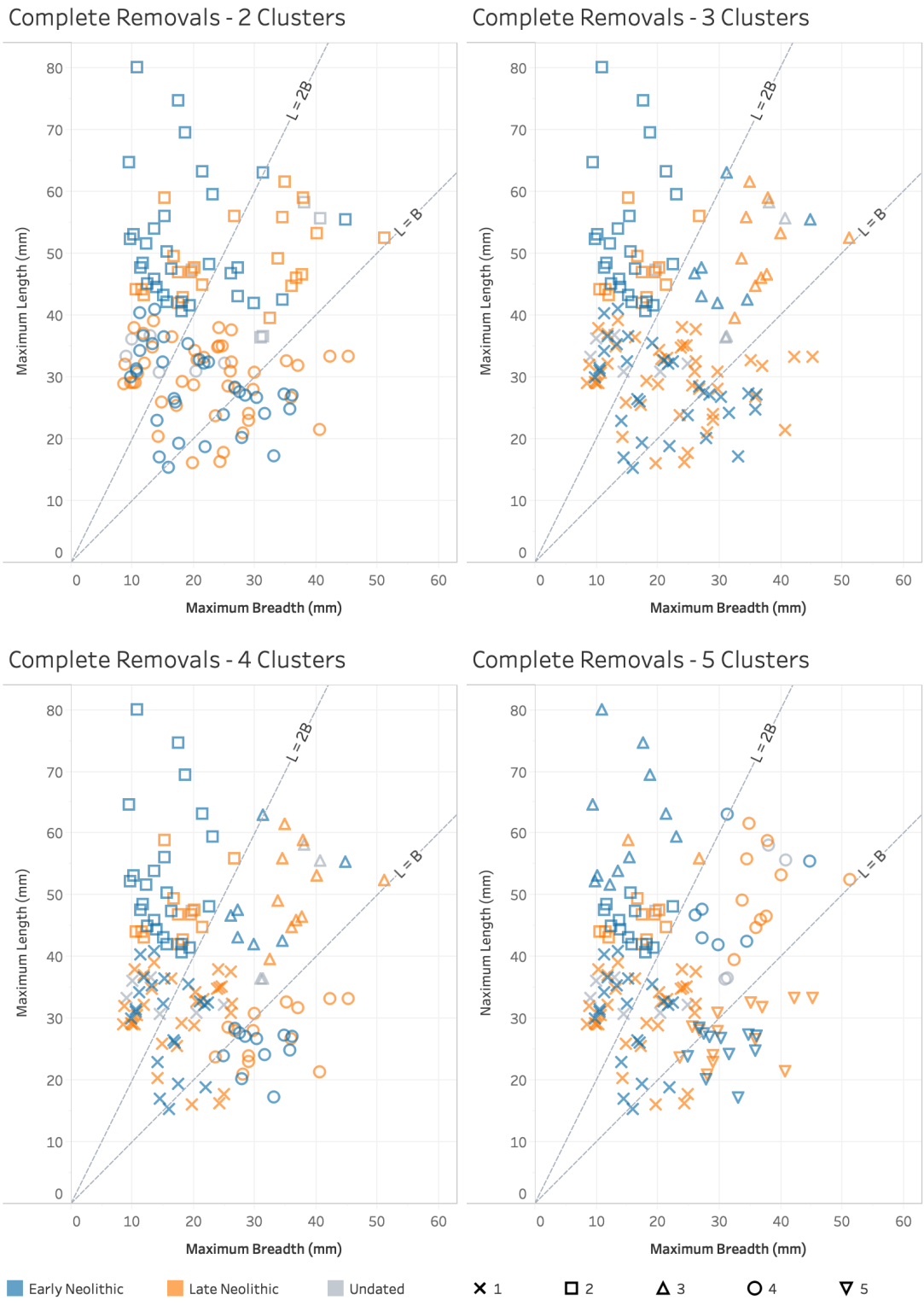


Figure 48. Hierarchical Cluster Analysis (Ward's Method) of the metric properties of the complete removals from the Neolithic burial mounds (n=140).

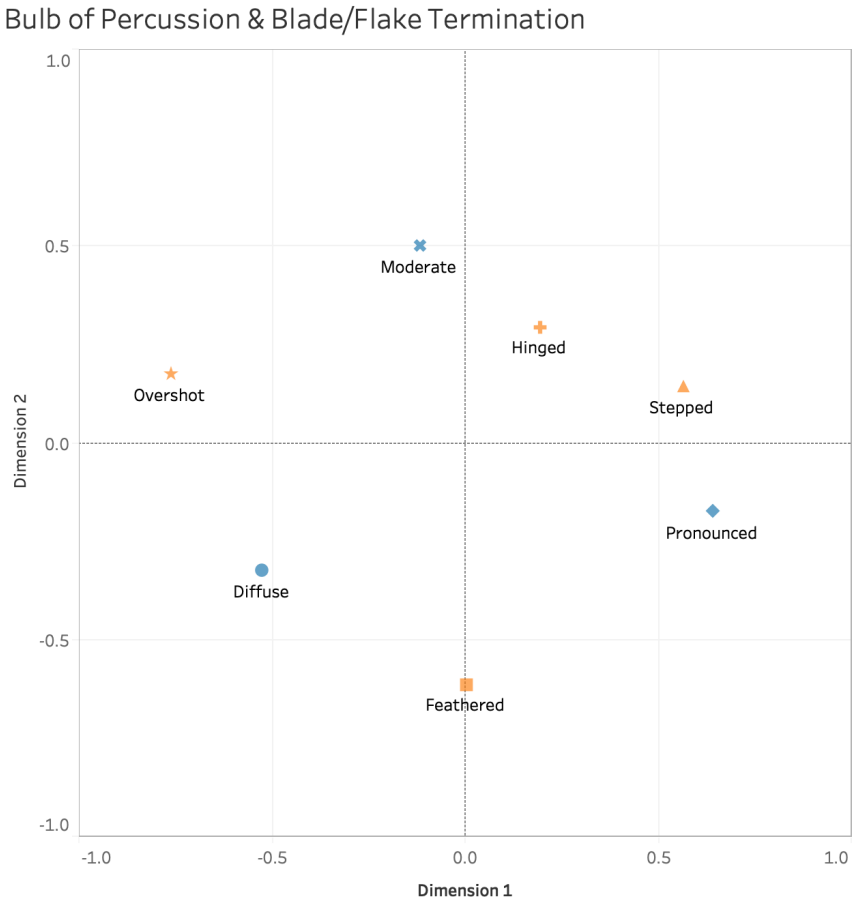


Figure 49. Correspondence analysis of the relative thickness of the bulb of percussion (m=3) and type of blade/flake termination (n=4) of the complete removals from the Neolithic burial mounds (n=140).

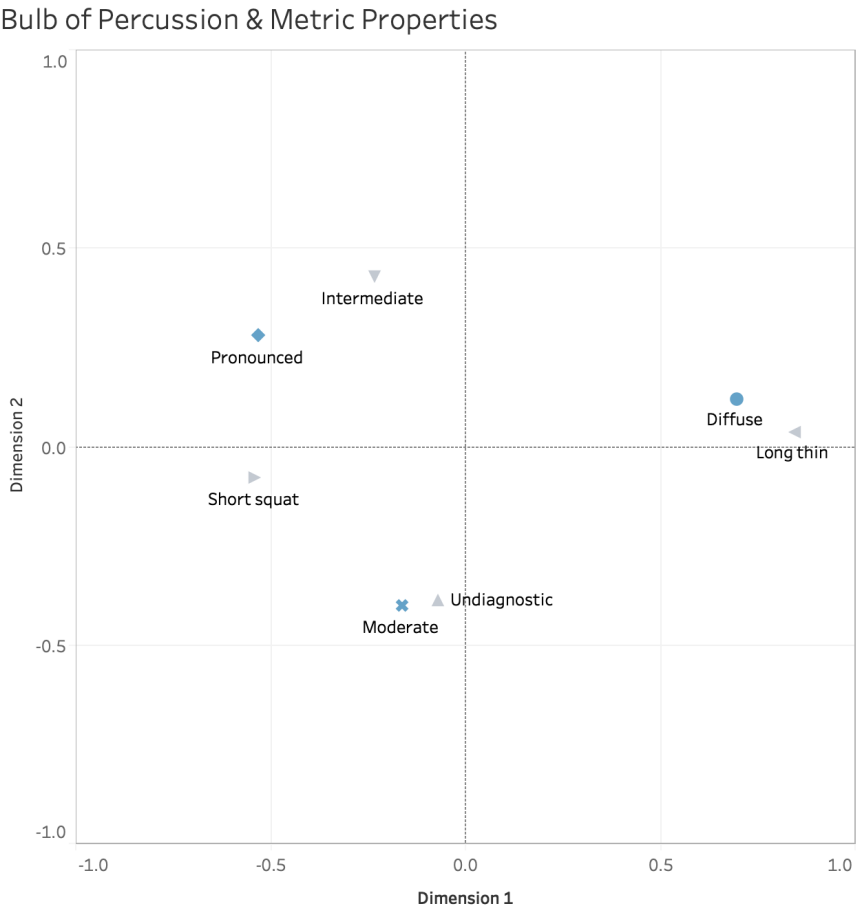


Figure 50. Correspondence analysis of the relative thickness of the bulb of percussion (m=3) and metric properties(n=4) of the complete removals from the Neolithic burial mounds (n=140).



Figure 51. Correspondence analysis of the type of blade/flake termination (m=4) and metric properties (n=4) of the complete removals from the Neolithic burial mounds (n=140).

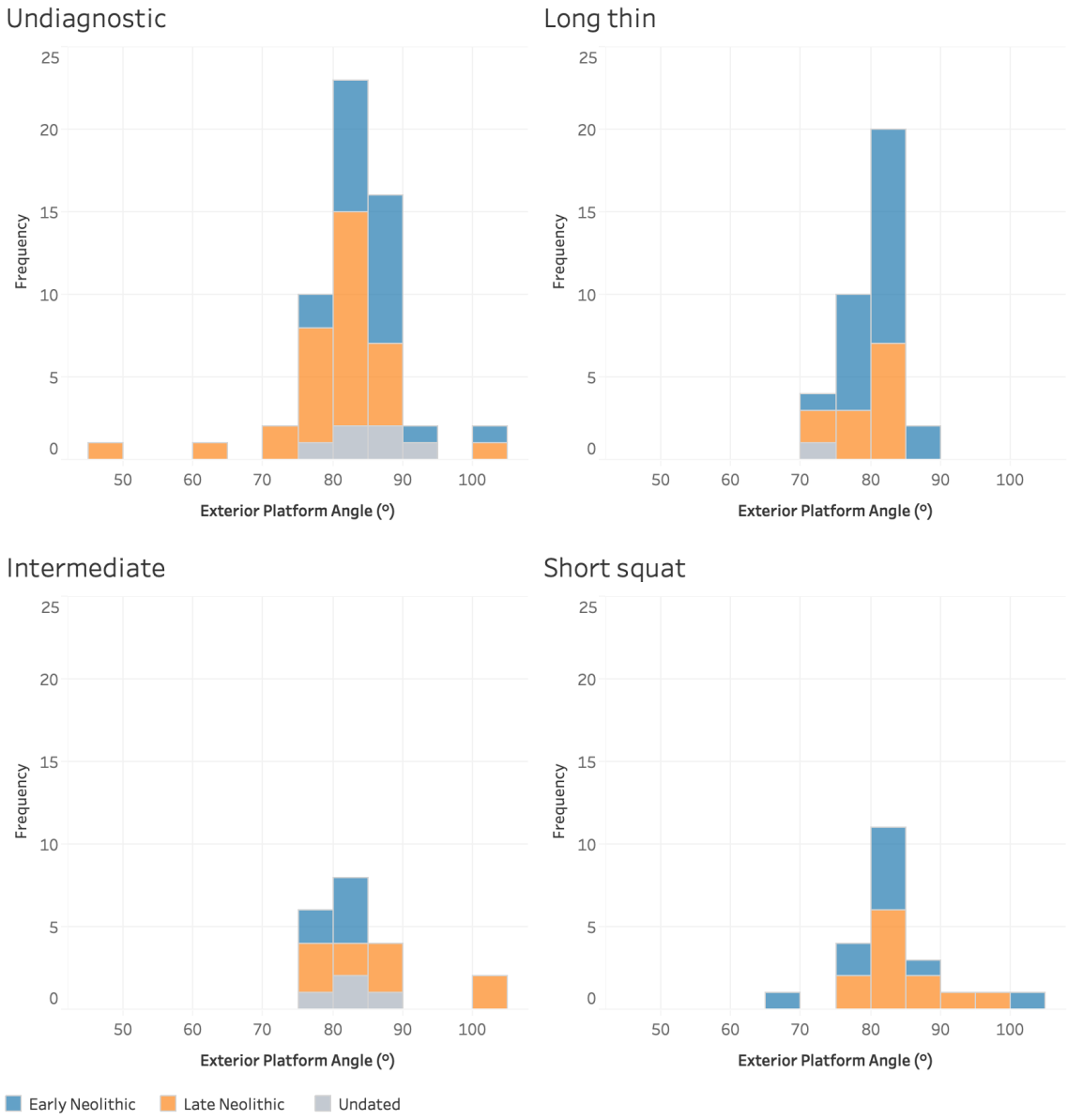


Figure 52. Exterior platform angle and metric properties of the complete removals from the Neolithic burial mounds (n=140).

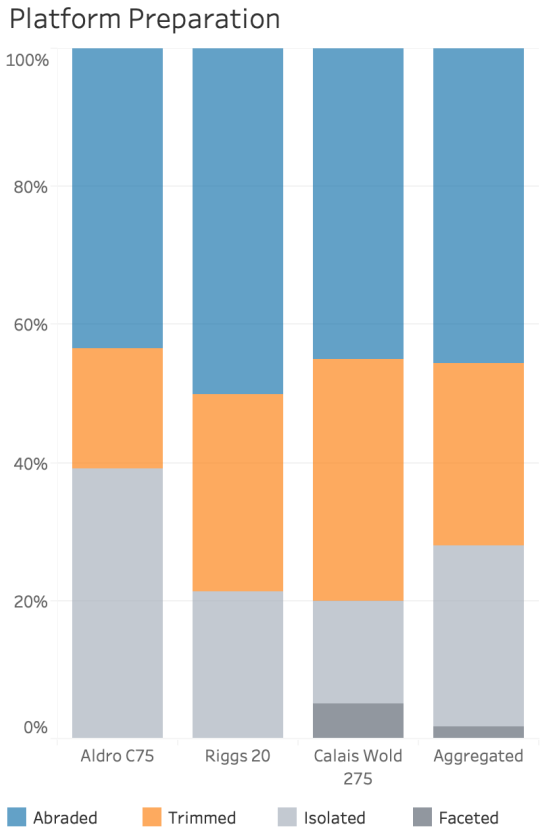


Figure 53. Stacked bar charts showing the methods of platform preparation for the complete removals from the individual assemblages of worked flint from the Neolithic burial mounds (n=90).

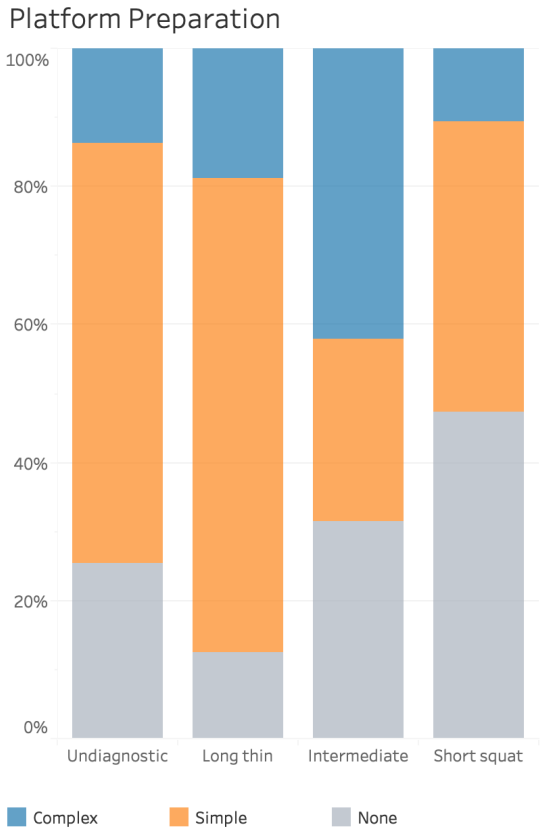


Figure 54. Stacked bar charts showing the methods of platform preparation represented amongst the groups of blades and flakes identified through cluster analysis of the maximum length and maximum breadth of the complete removals from the sample of Neolithic burial mounds (n=140).

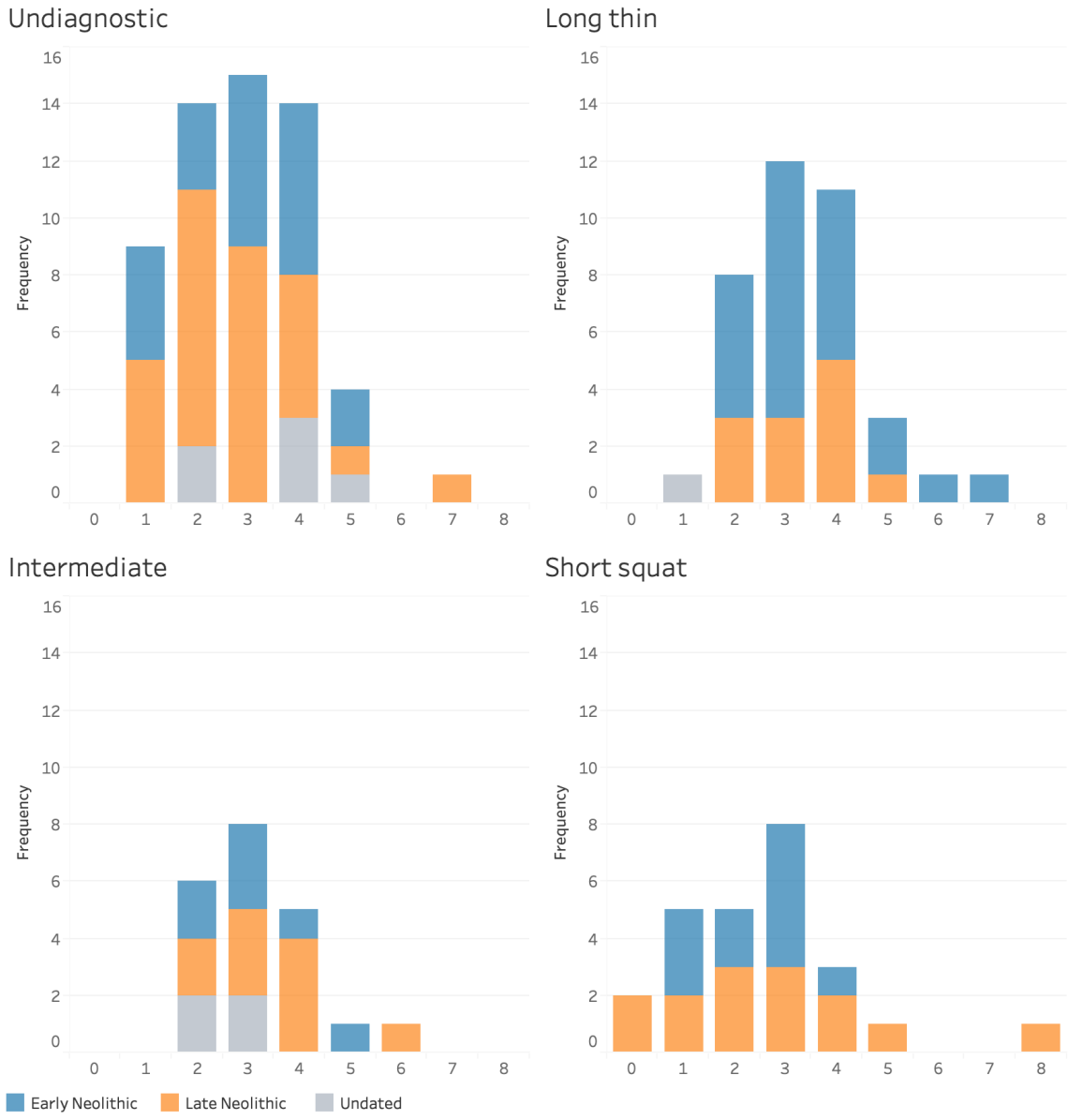


Figure 55. Bar charts showing the number of flake scars from previous removals and metric properties of the complete removals from the Neolithic burial mounds (n=140).

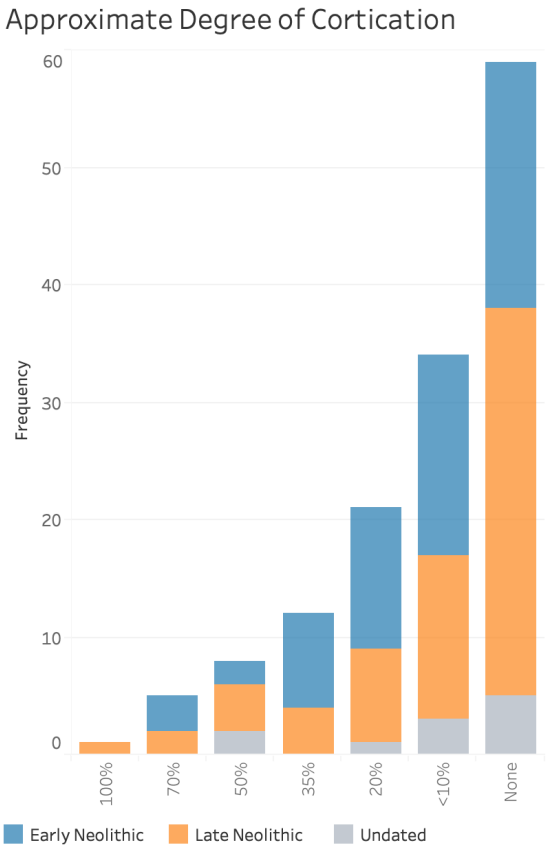


Figure 56. Bar chart showing the frequency of complete removals from the Neolithic burial mounds by approximate degree of cortication (n=140).

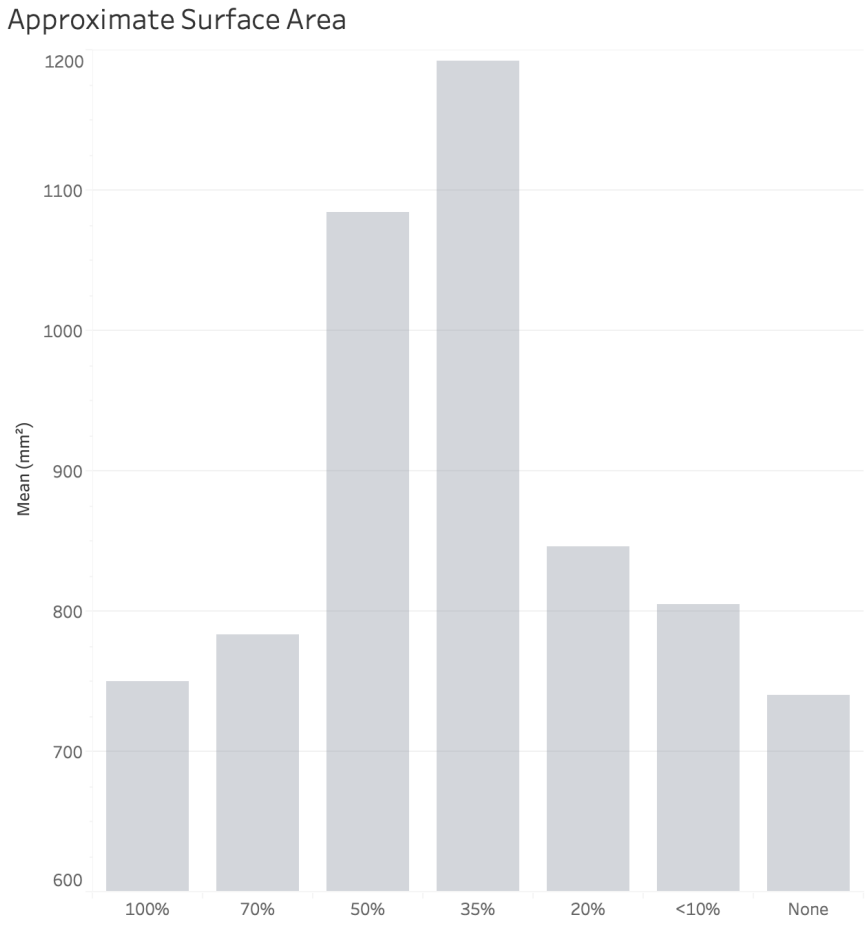


Figure 57. Bar chart showing the mean overall size/approximate surface area of the complete removals from the Neolithic burial mounds by approximate degree of cortication (n=140).

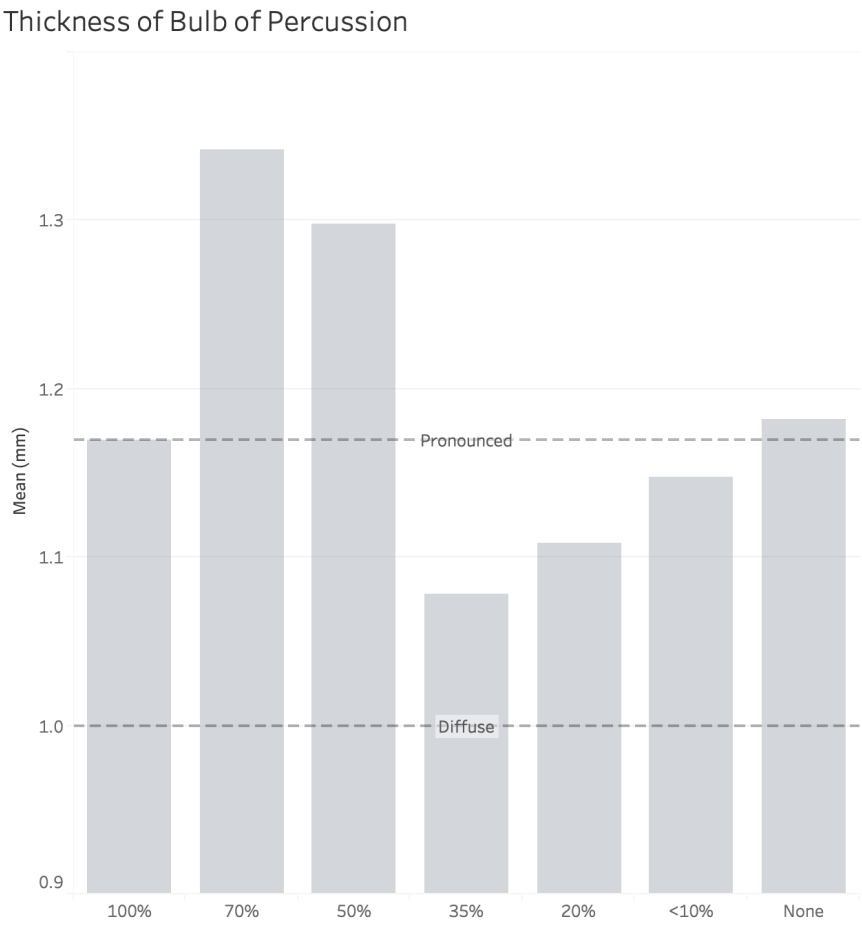


Figure 58. Bar chart showing the mean relative thickness of the bulb of percussion for the complete removals from the Neolithic burial mounds by approximate degree of cortication (n=140).

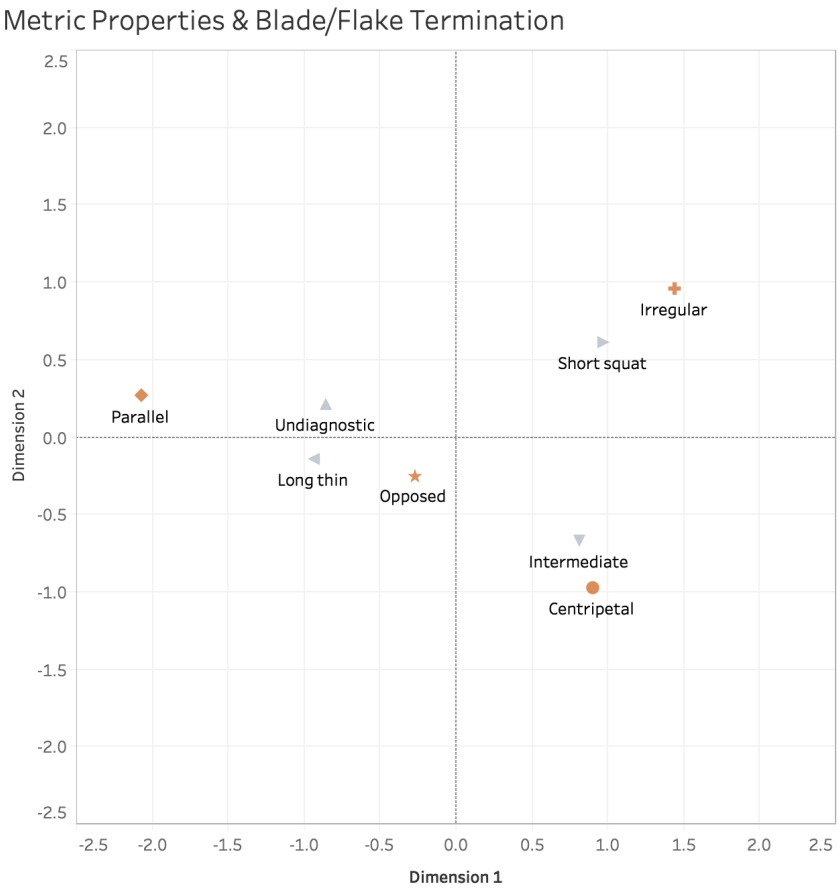


Figure 59. Correspondence analysis of the pattern of flake scars (m=4) and metric properties (n=4) of the complete removals from the Neolithic burial mounds (n=140).

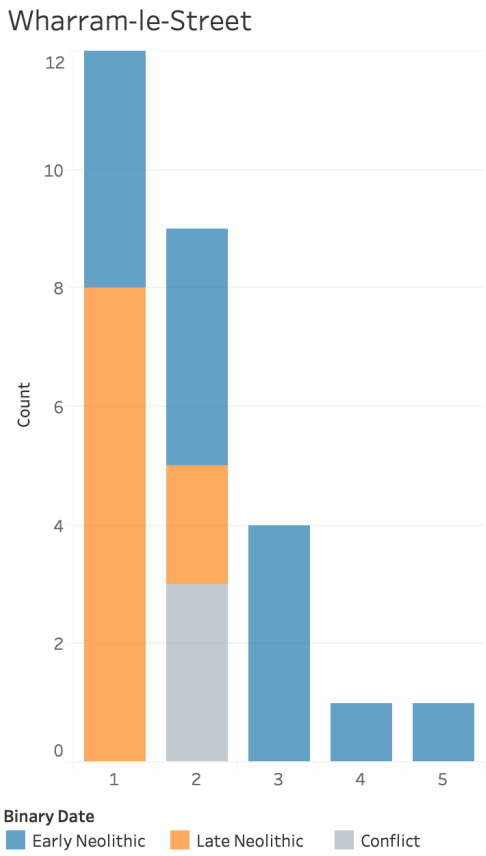


Figure 60. Histogram showing the dates of the lithic artefacts from the surface scatter at Wharram-le-Street based on the values of their binary scores (n=51).

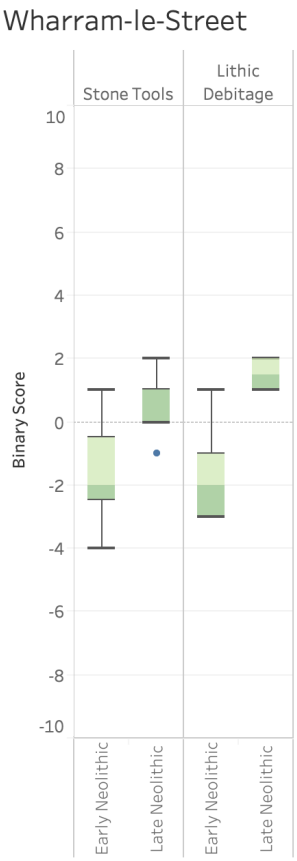


Figure 61. Boxplots of the aggregated binary scores for the Early Neolithic and Late Neolithic artefacts from the surface scatter at Wharram-le-Street (n=51).

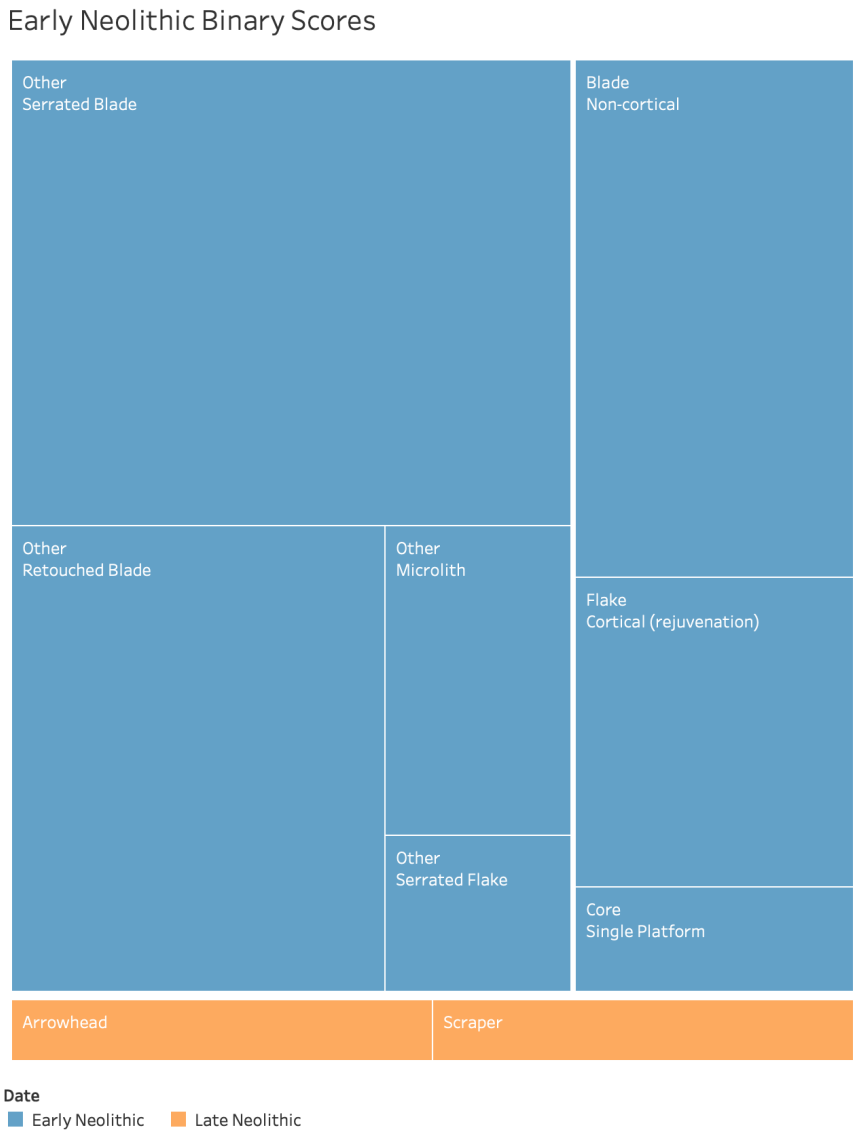


Figure 62. Lithic artefacts dated to the Early Neolithic on the basis of their binary scores (n=14). The size of the rectangles is proportionate to the aggregated score for each class of artefact.

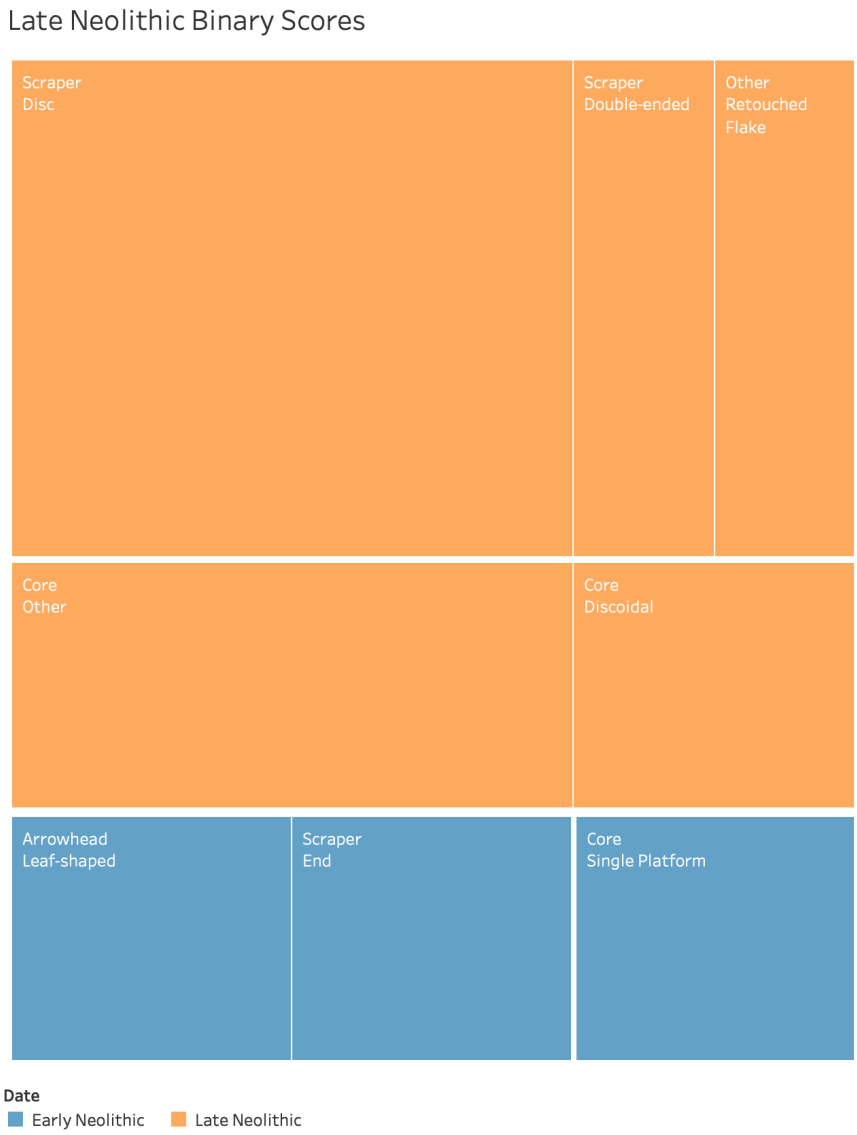


Figure 63. Lithic artefacts dated to the Late Neolithic on the basis of their binary scores (n=10). The size of the rectangles is proportionate to the aggregated score for each class of artefact.

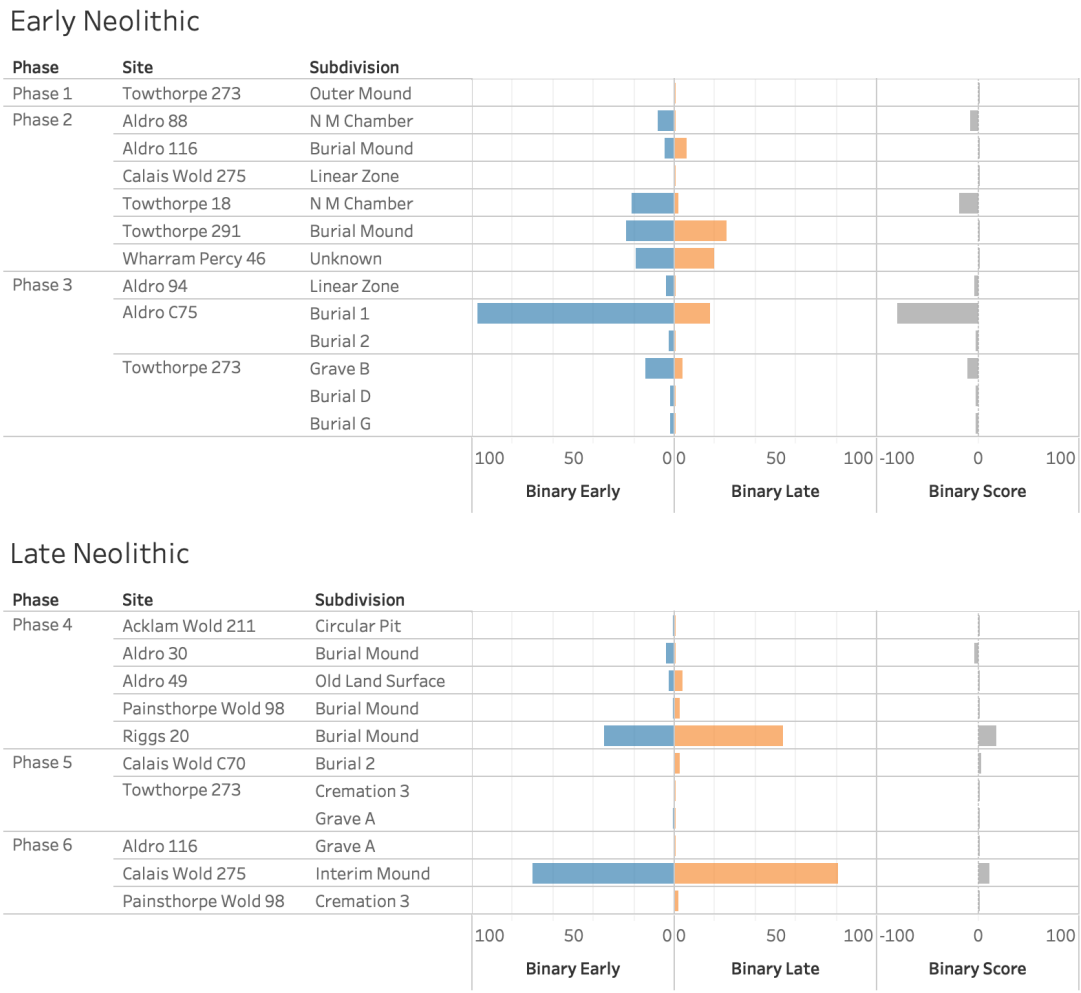


Figure 64. Aggregated binary scores for the Early Neolithic and Late Neolithic assemblages from the sample of Neolithic burial mounds (n=24).

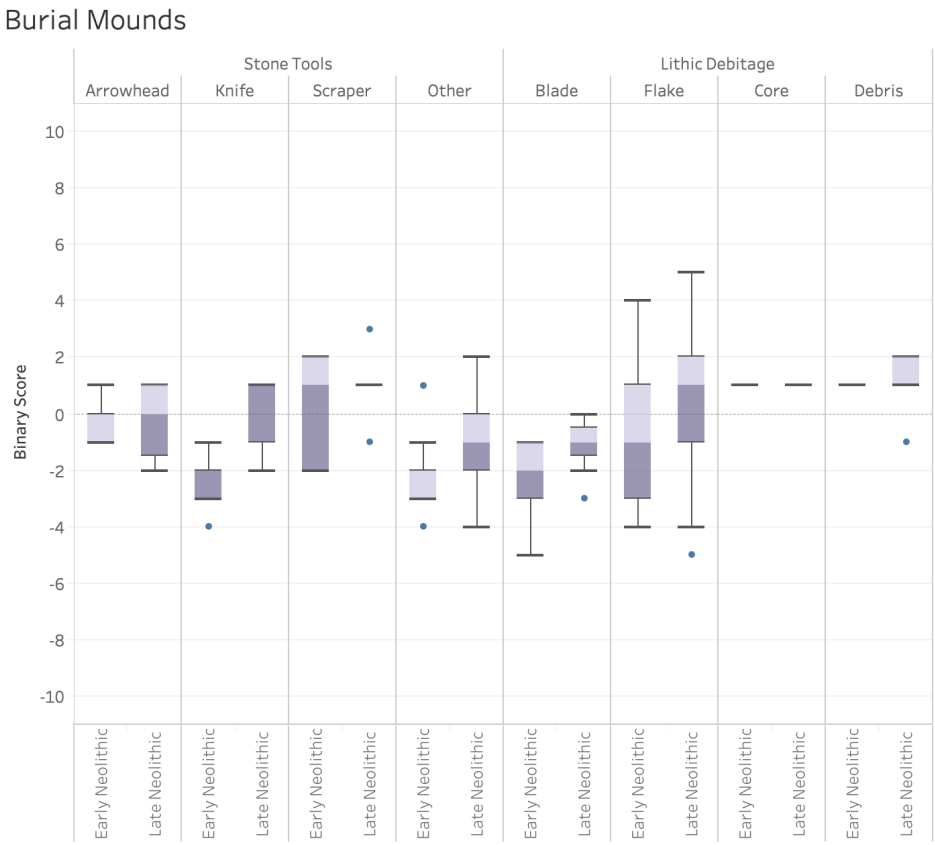


Figure 65. Boxplots of the aggregated binary scores for the lithic assemblages from the sample of Neolithic burial mounds (n=292).

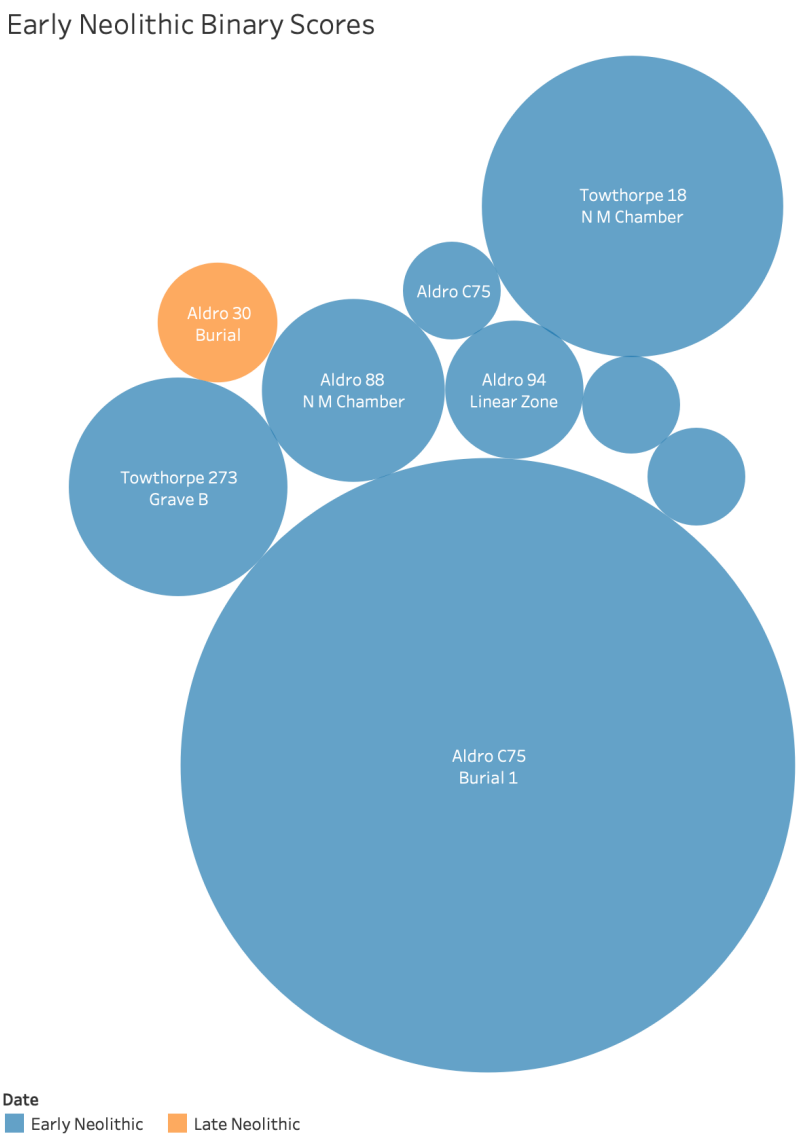


Figure 66. Lithic assemblages assigned an Early Neolithic date on the basis of their binary scores. The size of the bubbles is proportionate to the absolute value of the aggregated score for each assemblage (n=9).

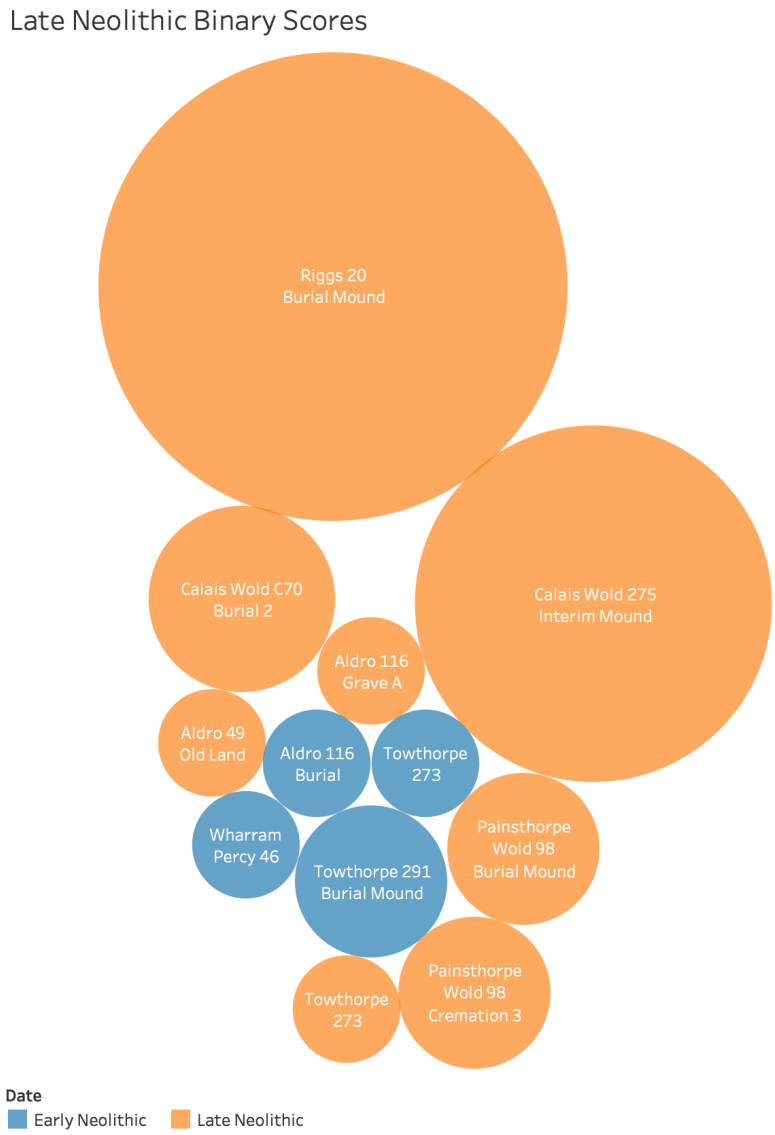


Figure 67. Lithic assemblages assigned a Late Neolithic date on the basis of their binary scores. The size of the bubbles is proportionate to the absolute value of the aggregated score for each assemblage (n=12).

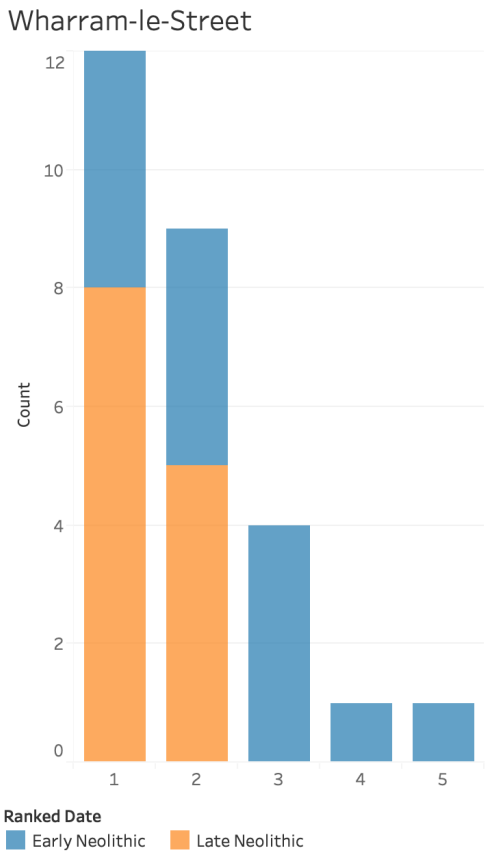


Figure 68. Histogram showing the dates of the lithic artefacts from the surface scatter at Wharram-le-Street based on the values of their ranked scores (n=27).

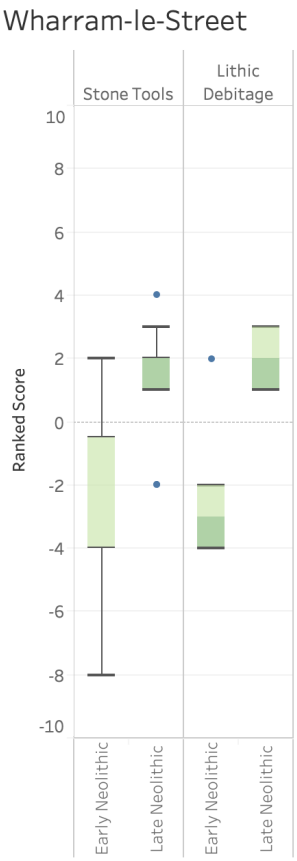


Figure 69. Boxplots of the aggregated ranked scores for the Early Neolithic and Late Neolithic artefacts from the surface scatter at Wharram-le-Street (n=51).

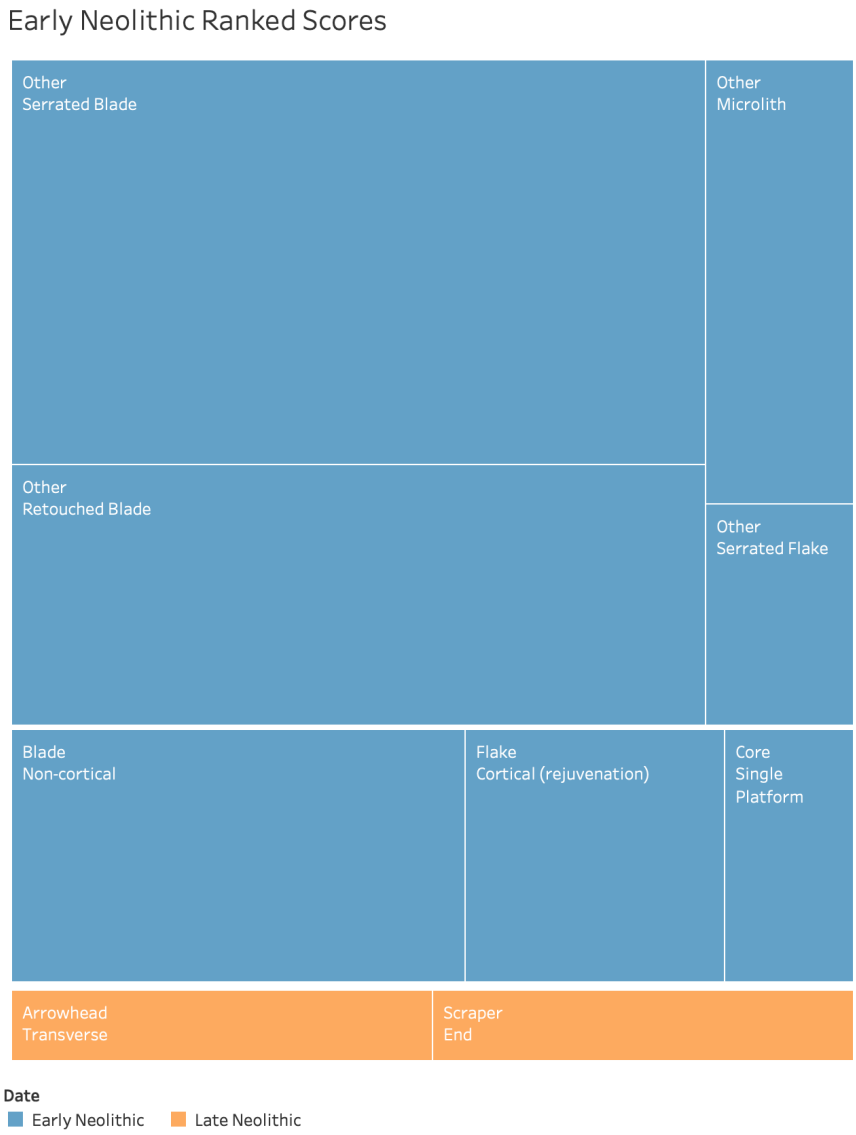


Figure 70. Lithic artefacts dated to the Early Neolithic on the basis of their ranked scores (n=14). The size of the rectangles is proportionate to the aggregated score for each class of artefact.

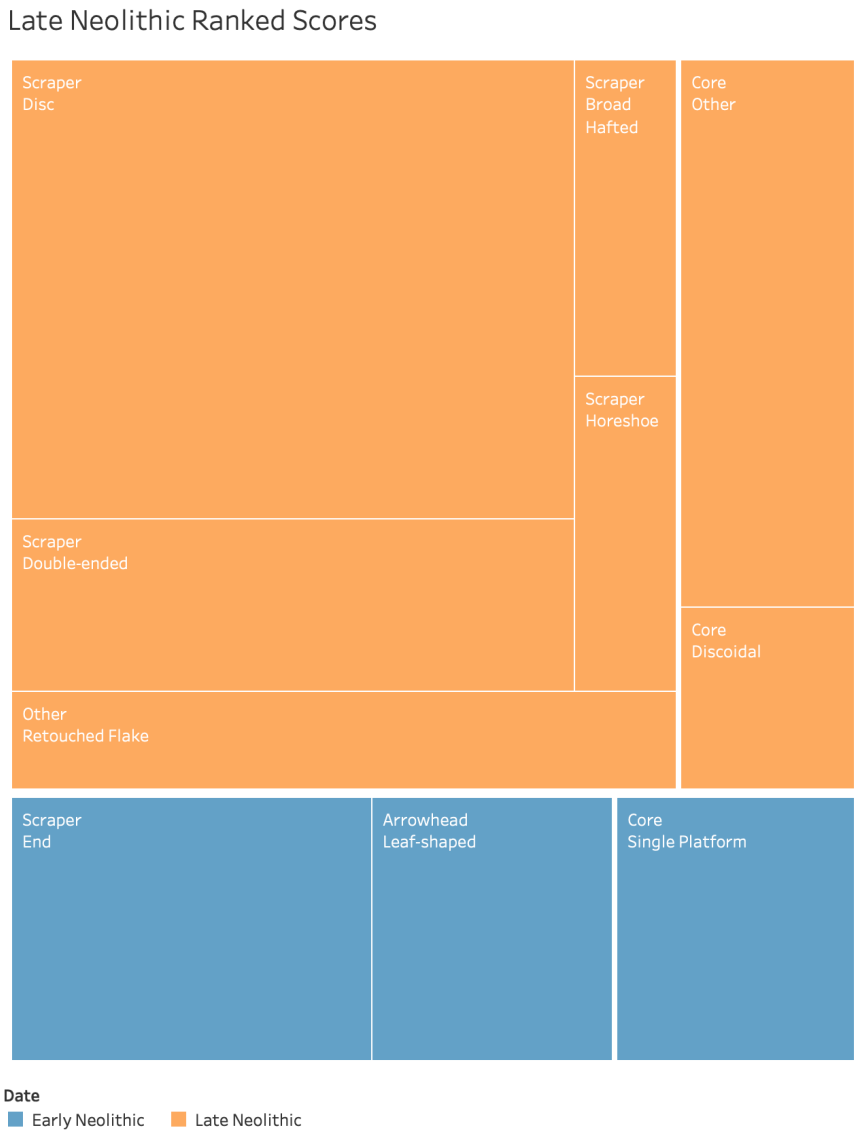


Figure 71. Lithic artefacts dated to the Late Neolithic on the basis of their ranked scores (n=13). The size of the rectangles is proportionate to the aggregated score for each class of artefact.

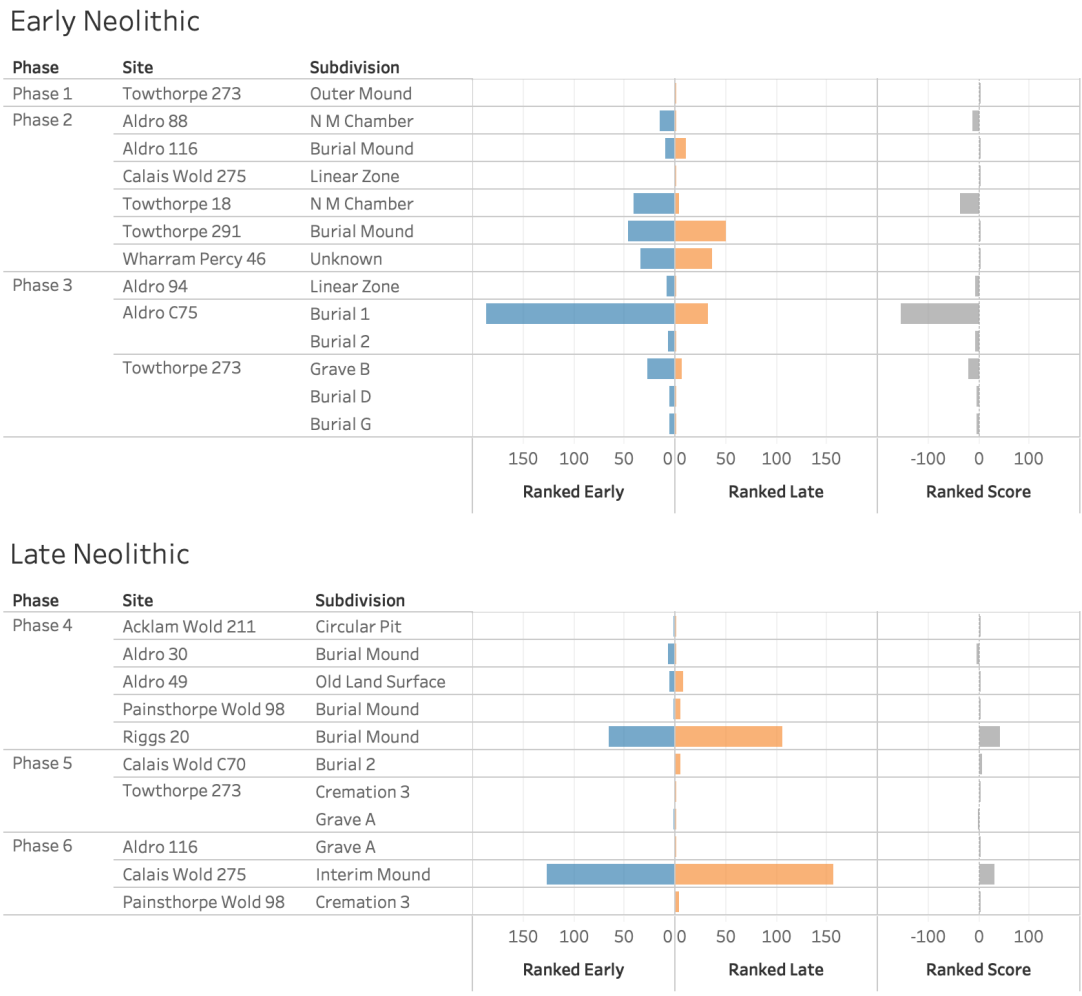


Figure 72. Aggregated ranked scores for the Early Neolithic and Late Neolithic assemblages from the sample of Neolithic burial mounds (n=24).

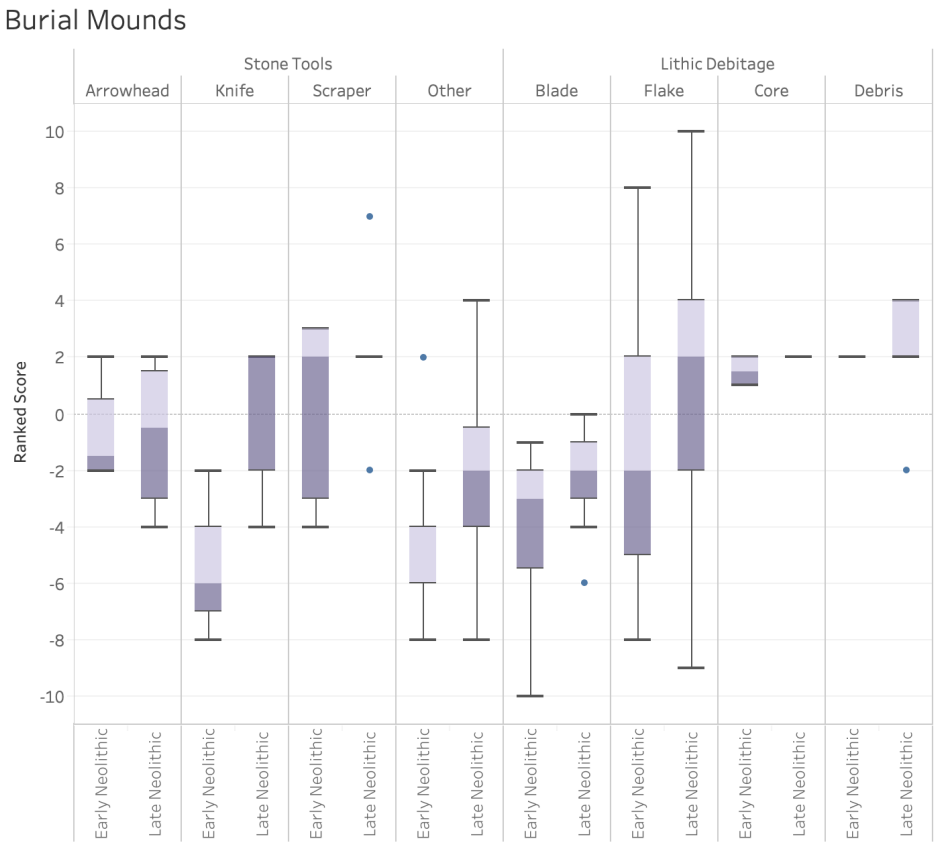


Figure 73. Boxplots of the aggregated ranked scores for the lithic assemblages from the sample of Neolithic burial mounds (n=292).

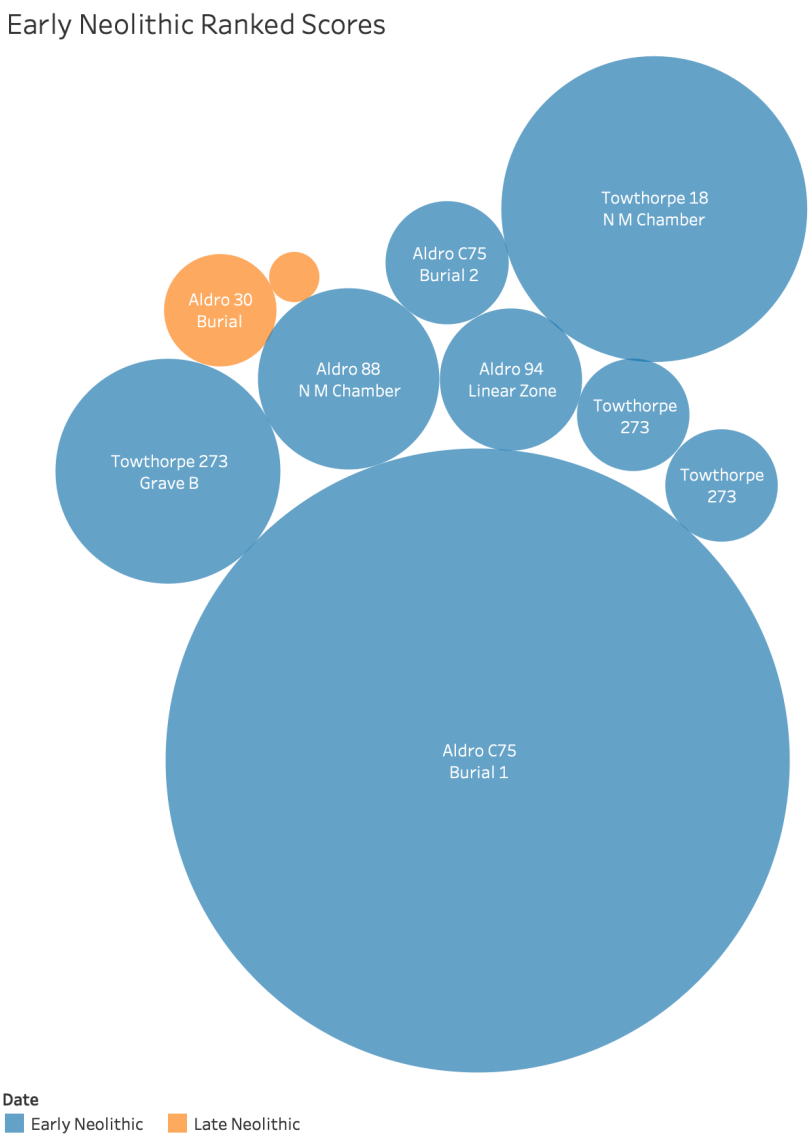


Figure 74. Lithic assemblages assigned an Early Neolithic date on the basis of their ranked scores. The size of the bubbles is proportionate to the absolute value of the aggregated score for each assemblage (n=10).

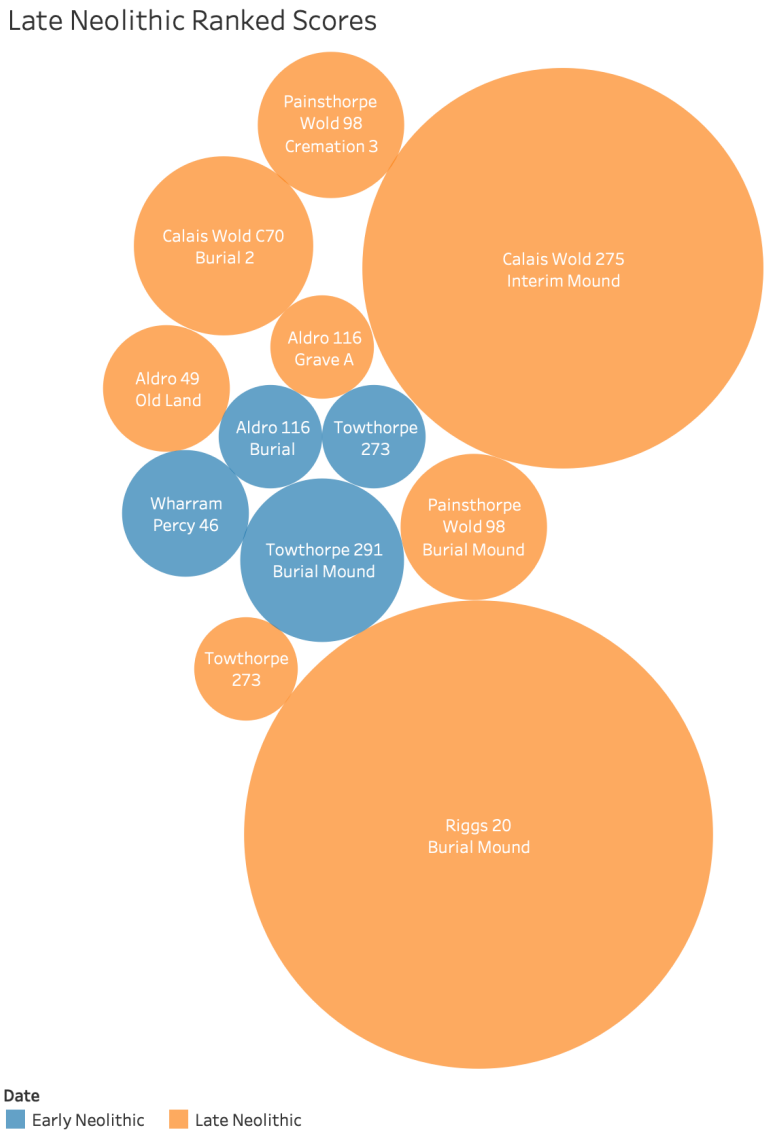


Figure 75. Lithic assemblages assigned a Late Neolithic date on the basis of their ranked scores (n=12). The size of the bubbles is proportionate to the absolute value of the aggregated score for each assemblage.

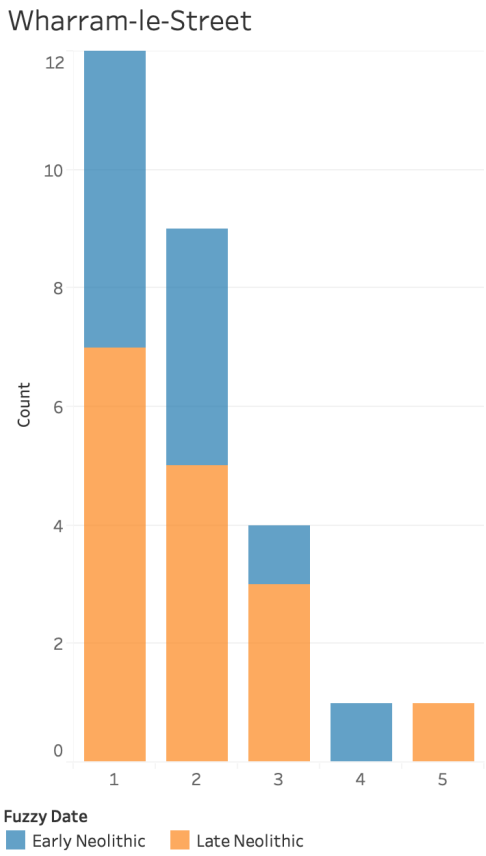


Figure 76. Histogram showing the dates of the lithic artefacts from the surface scatter at Wharram-le-Street based on the values of their fuzzy scores (n=27).

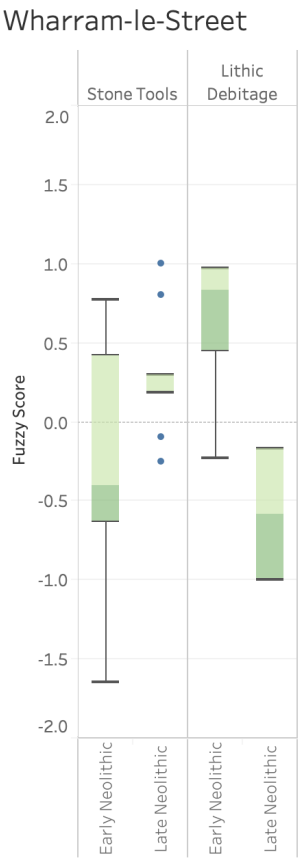


Figure 77. Boxplots of the aggregated fuzzy scores for the Early Neolithic and Late Neolithic artefacts from the surface scatter at Wharram-le-Street (n=51).

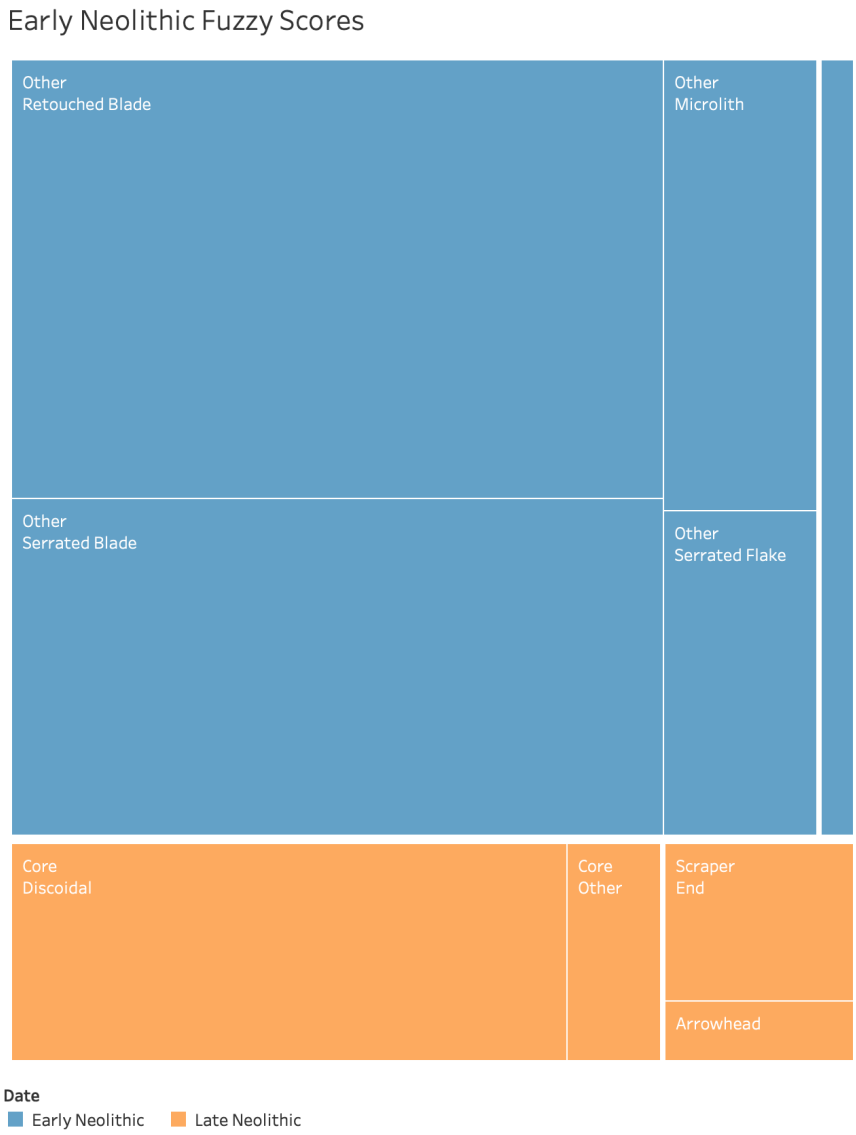


Figure 78. Lithic artefacts dated to the Early Neolithic on the basis of their fuzzy scores (n=11). The size of the rectangles is proportionate to the aggregated score for each class of artefact.

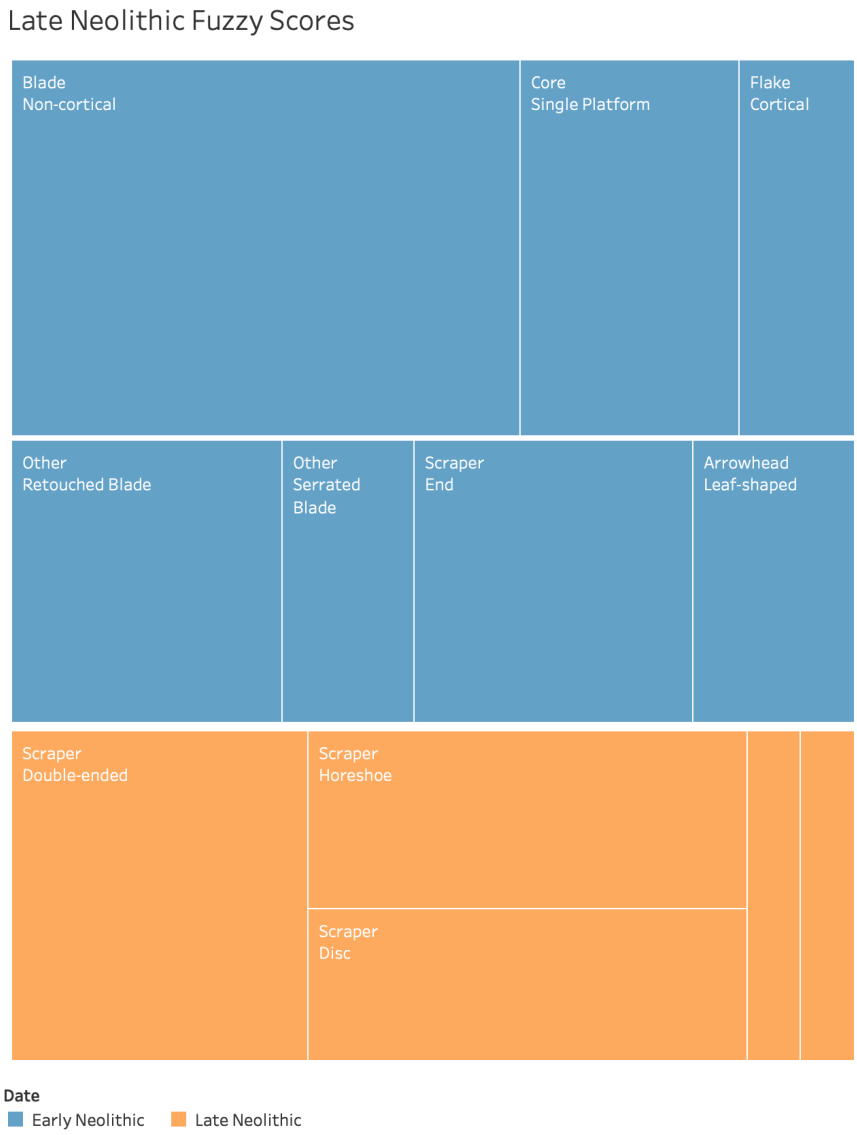


Figure 79. Lithic artefacts dated to the Late Neolithic on the basis of their fuzzy scores (n=16). The size of the rectangles is proportionate to the aggregated score for each class of artefact.

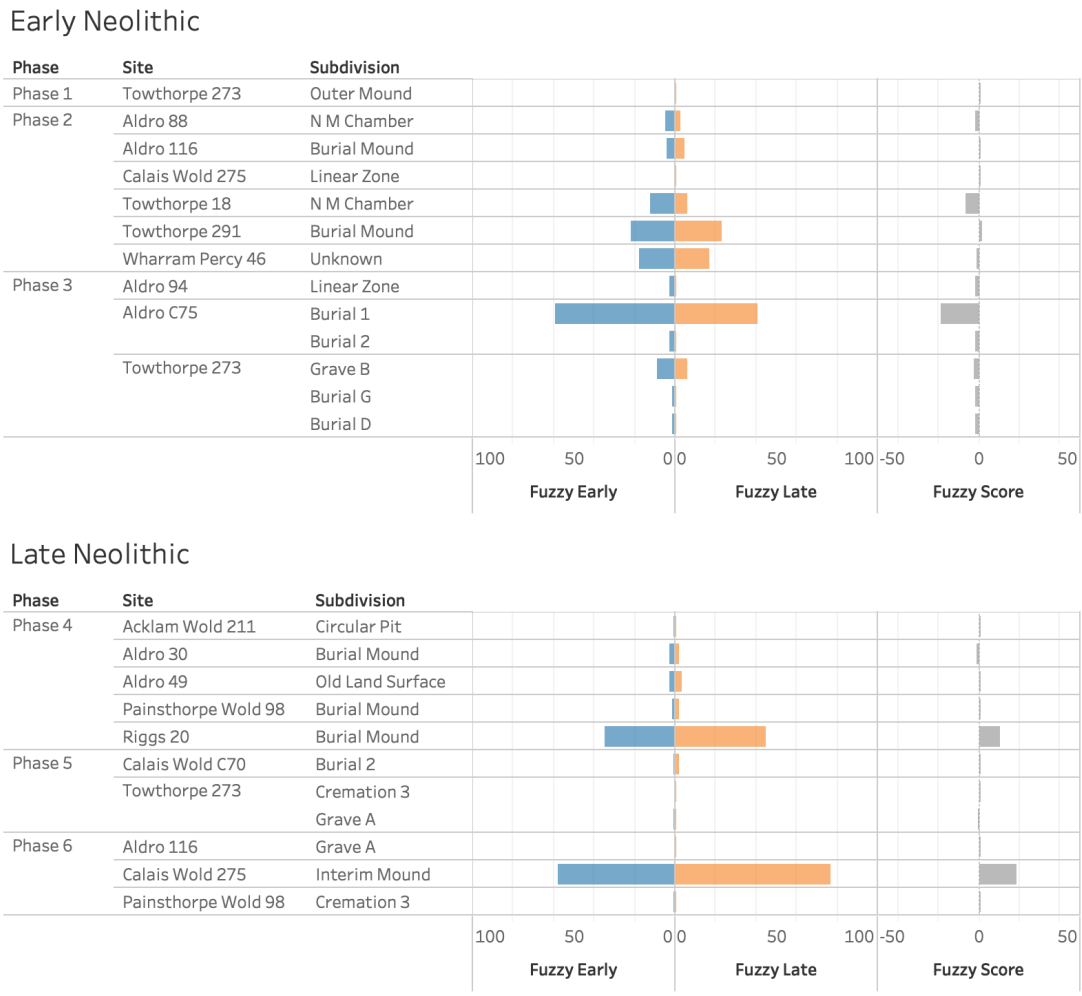


Figure 80. Aggregated fuzzy scores for the Early Neolithic and Late Neolithic assemblages from the sample of Neolithic burial mounds (n=24).

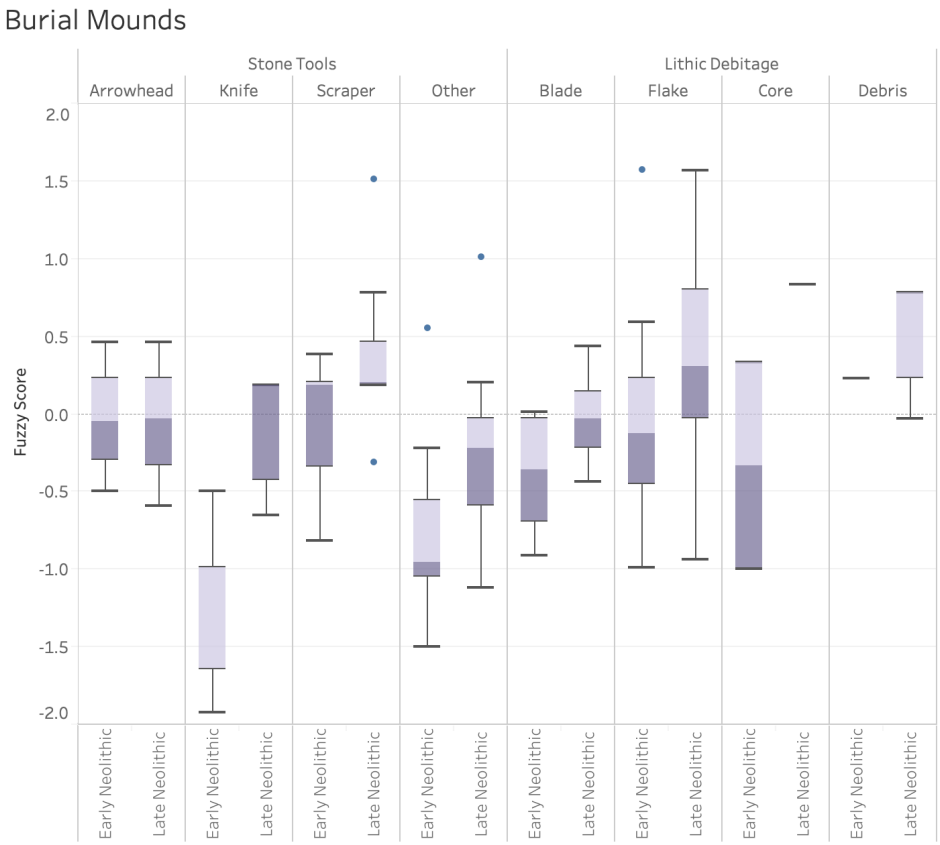


Figure 81. Boxplots of the aggregated fuzzy scores for the lithic assemblages from the sample of Neolithic burial mounds (n=292).

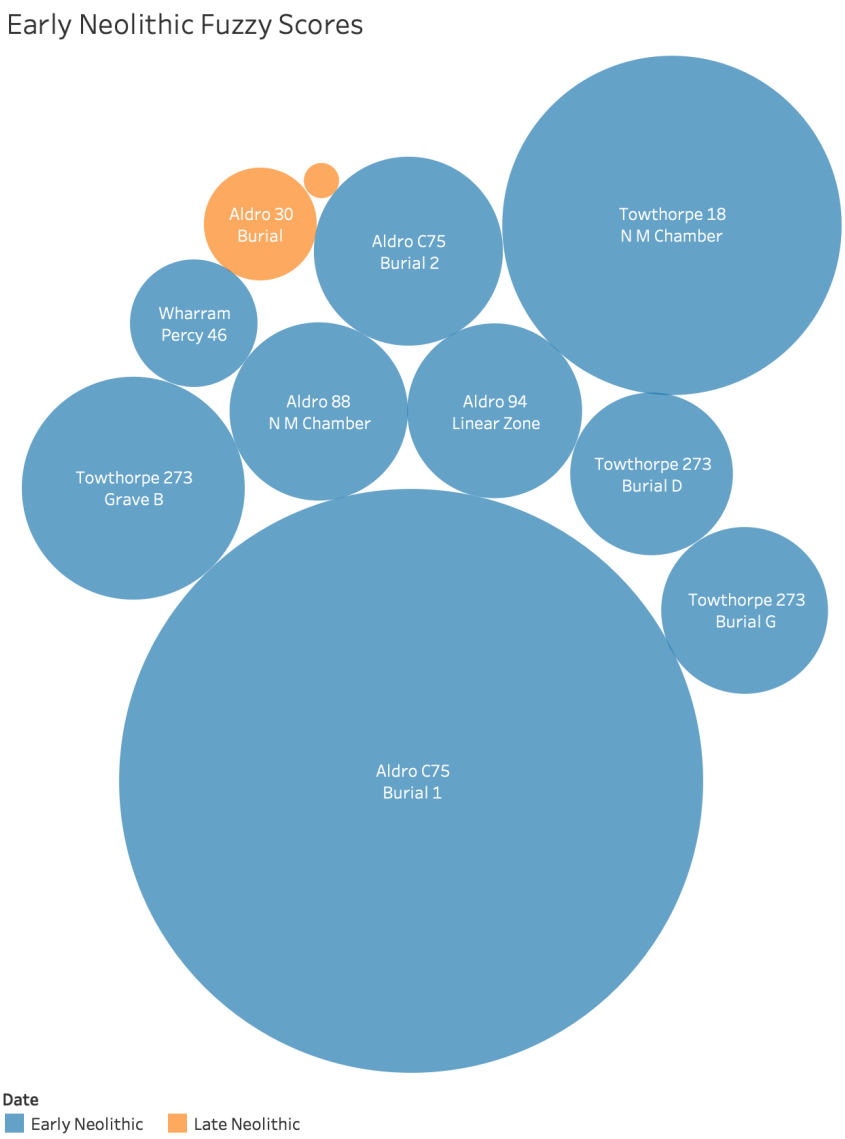


Figure 82. Lithic assemblages assigned an Early Neolithic date on the basis of their fuzzy scores (n=10). The size of the bubbles is proportionate to the absolute value of the aggregated score for each assemblage.

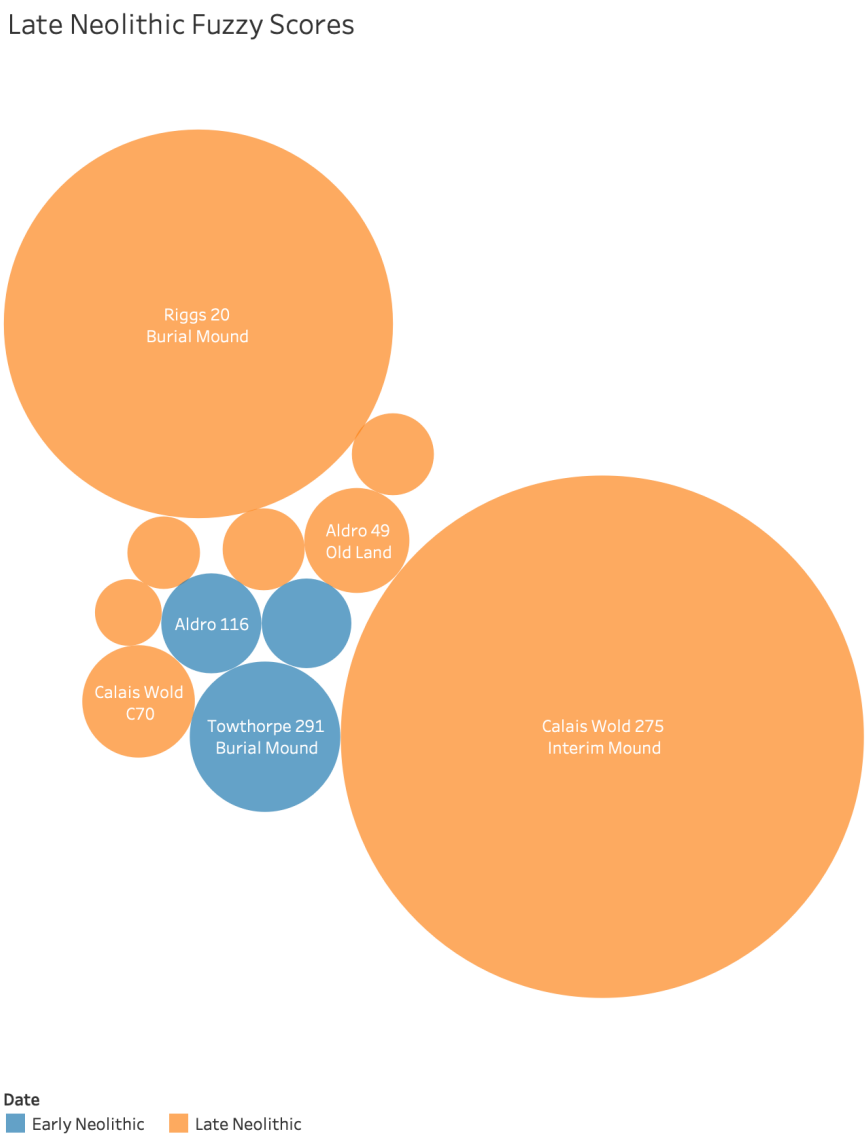


Figure 83. Lithic assemblages assigned a Late Neolithic date on the basis of their fuzzy scores (n=11). The size of the bubbles is proportionate to the absolute value of the aggregated score for each assemblage.

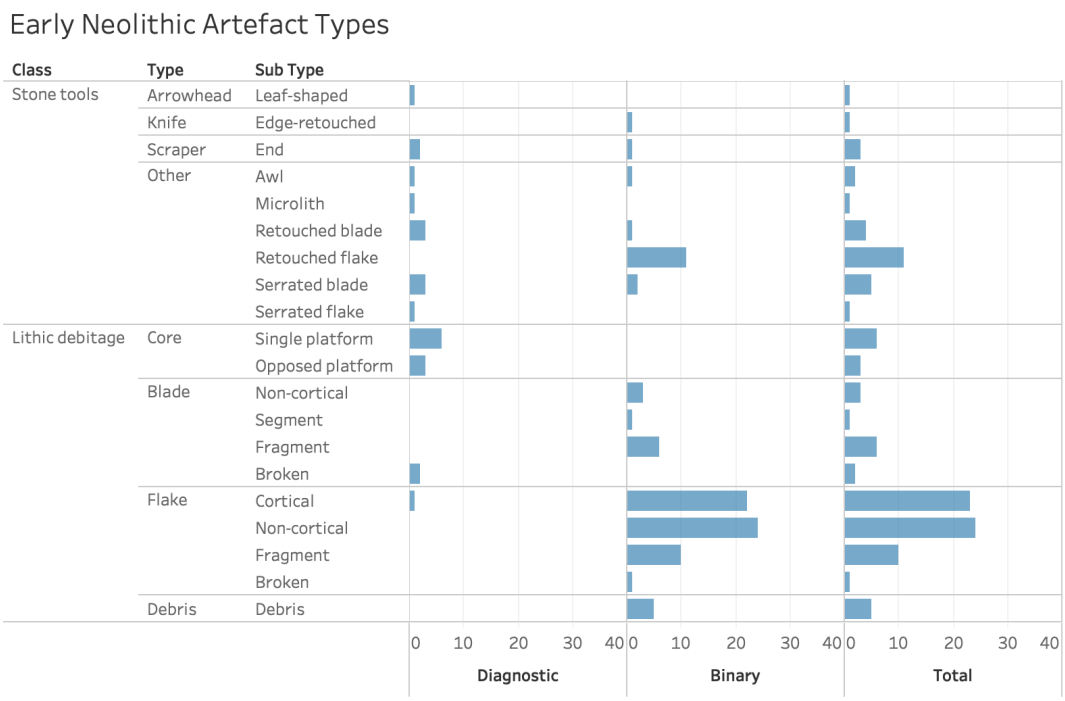


Figure 84. Histograms showing the frequencies of artefacts from the surface scatter at Wharram-le-Street that could be dated to the Early Neolithic (n=113) based on typologically diagnostic artefacts (left) and the binary scoring system (right).

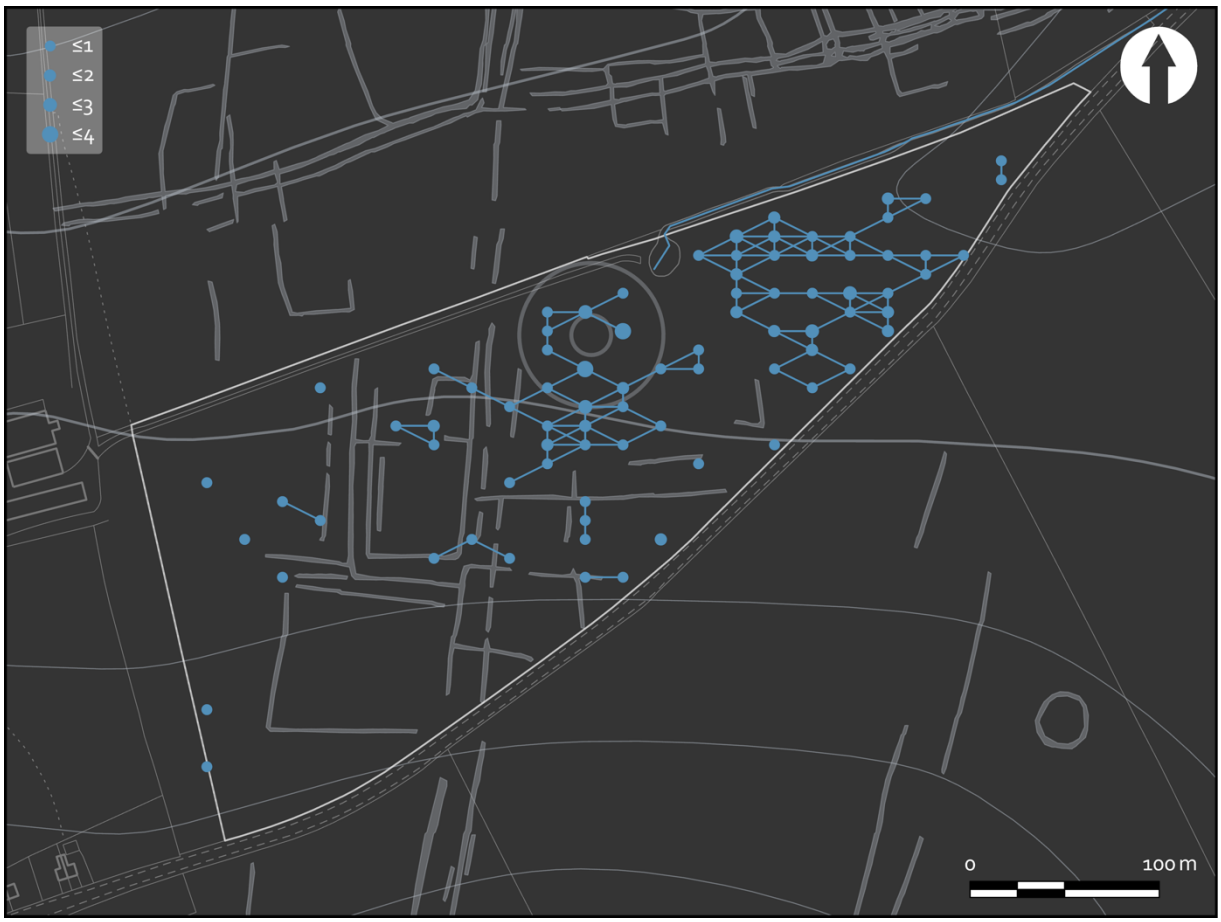


Figure 85. Thematic map with graduated symbols showing the frequency of artefacts from the surface scatter at Wharram-le-Street dated to the Early Neolithic using the binary scoring system.

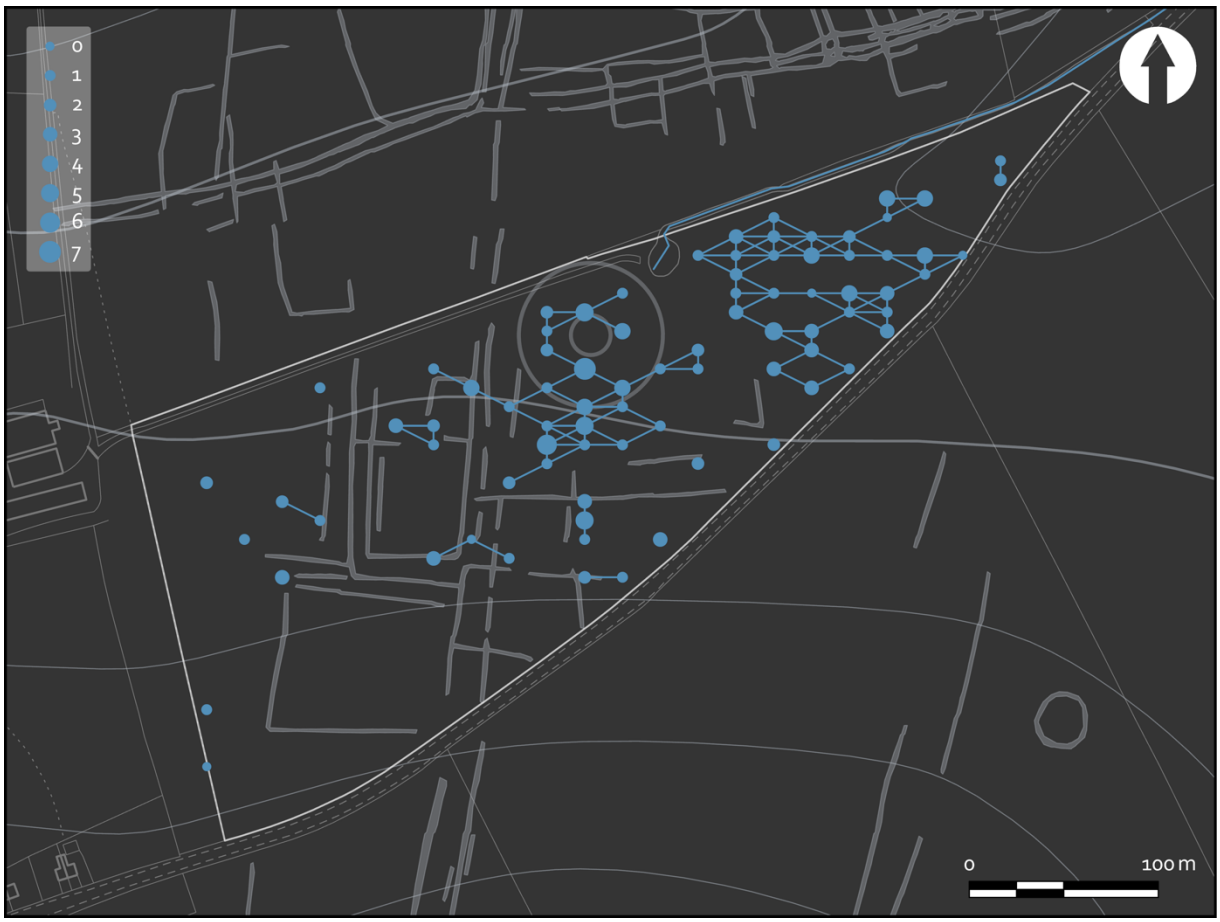


Figure 86. Thematic map with graduated symbols showing the aggregated binary scores for the Early Neolithic artefacts from the surface scatter at Wharram-le-Street.

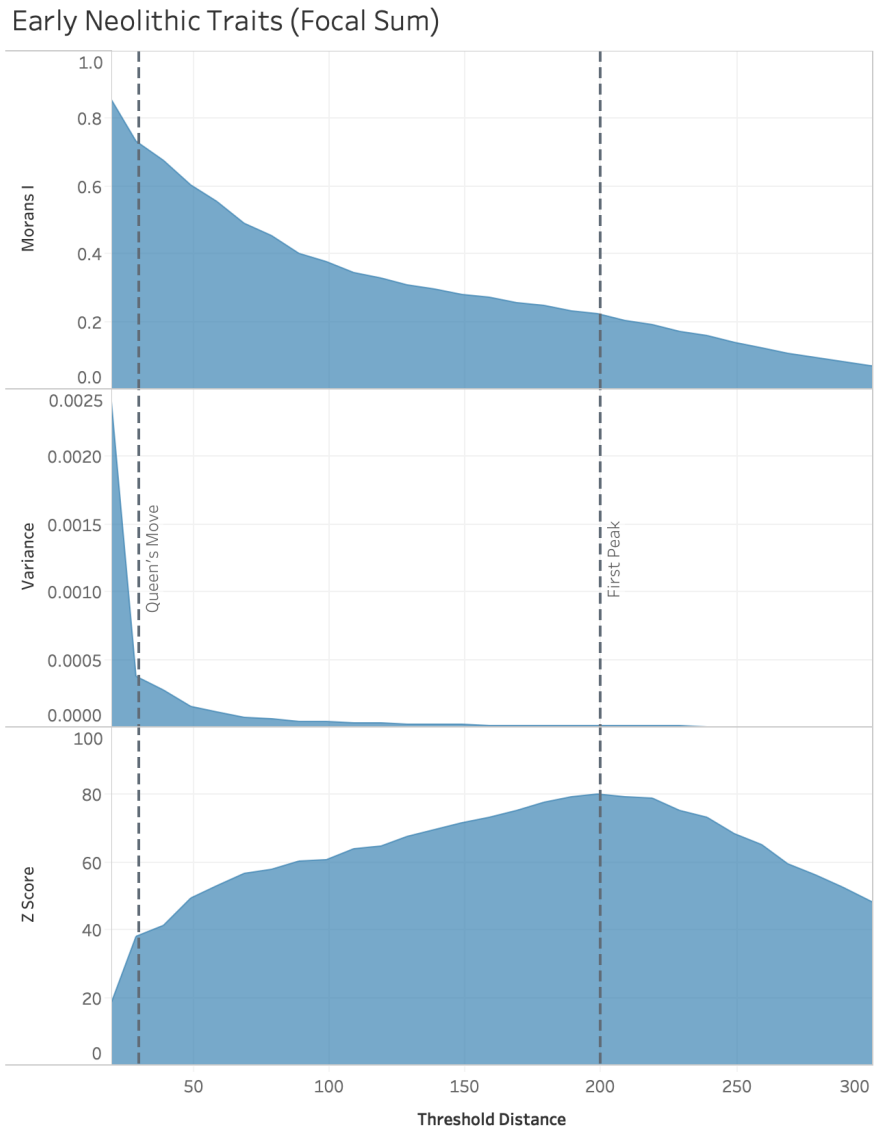


Figure 87. Incremental spatial autocorrelation for the aggregated binary scores for the Early Neolithic artefacts from the surface scatter at Wharram-le-Street.

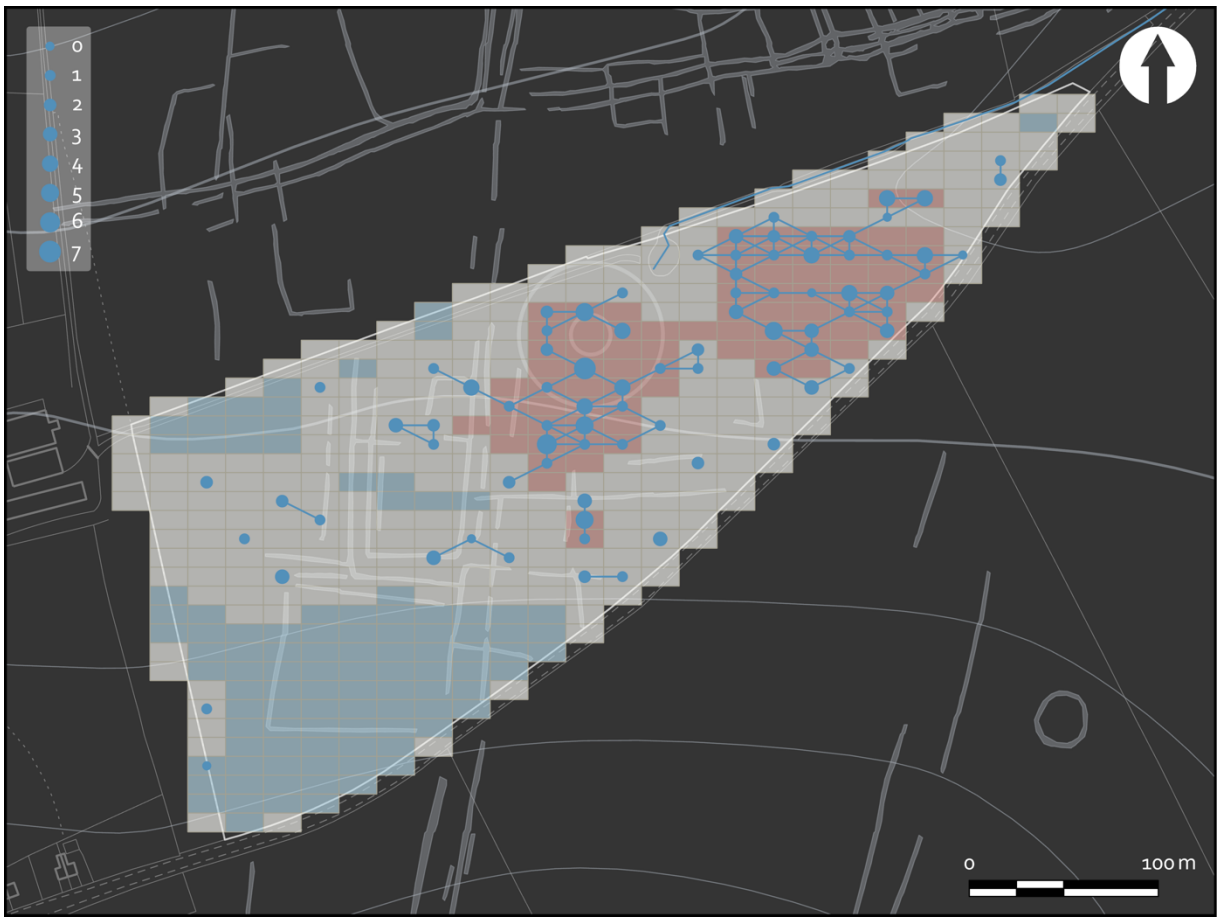


Figure 88. Thematic map showing the correlation between the aggregated binary scores for the Early Neolithic artefacts from the surface scatter at Wharram-le-Street and the clusters of values identified on the basis of the values of the Anselin's Local Moran's I statistic, with clusters of high values based on polygon contiguity (Queen's move) shown in red.

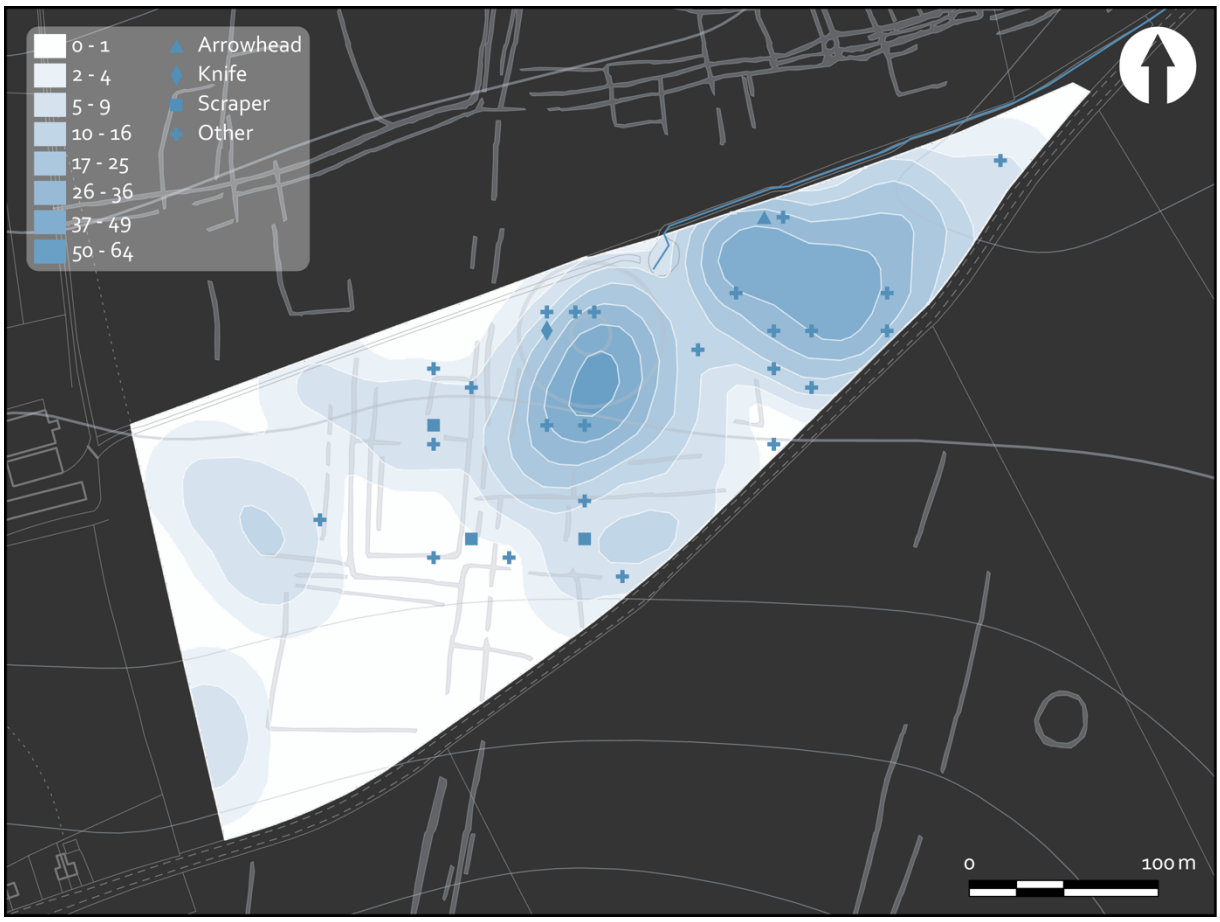


Figure 89. Kernel density plot showing the correlation between the stone tools and the lithic debitage dated to the Early Neolithic from the surface scatter at Wharram-le-Street.

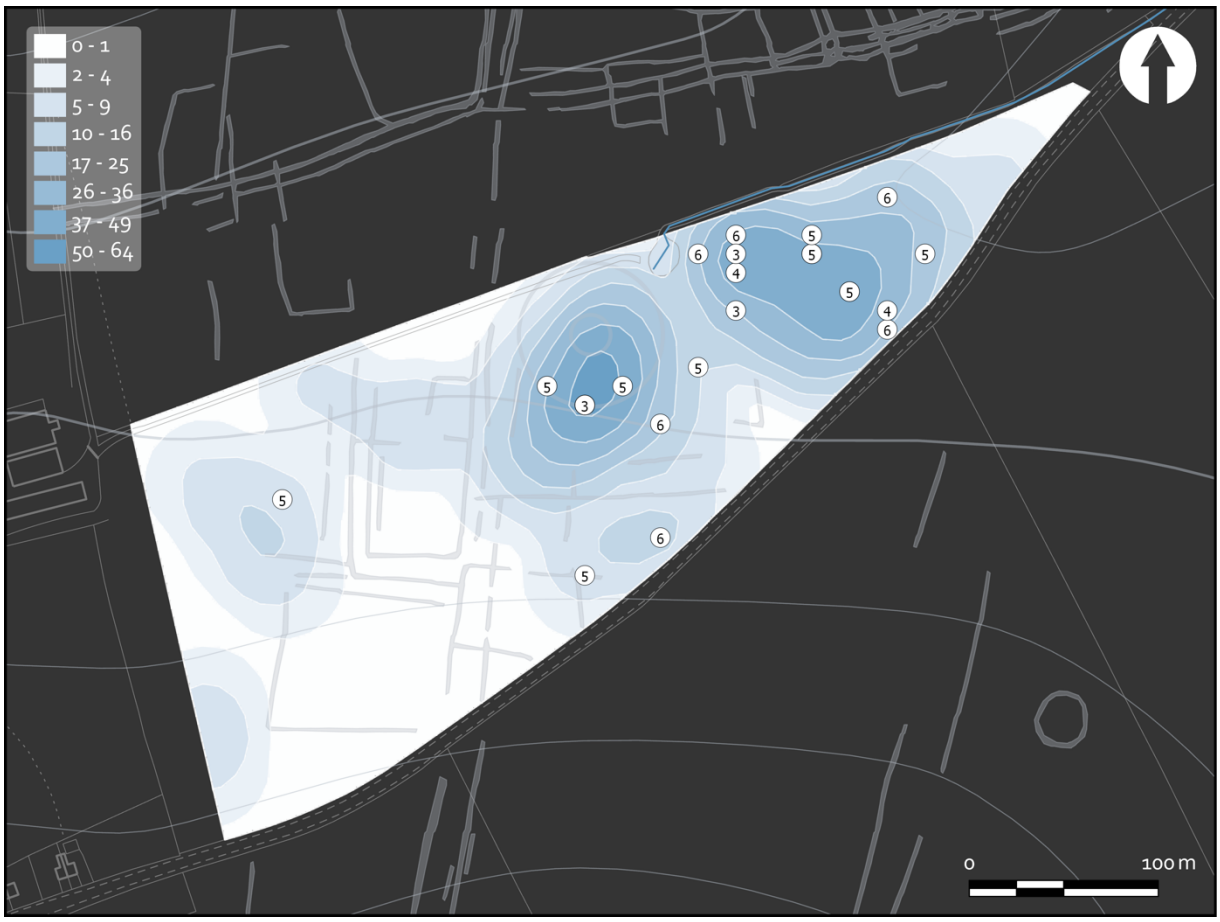


Figure 90. Distribution of Early Neolithic cortical blades and flakes from the surface scatter at Wharram-le-Street, sorted by lowest position.

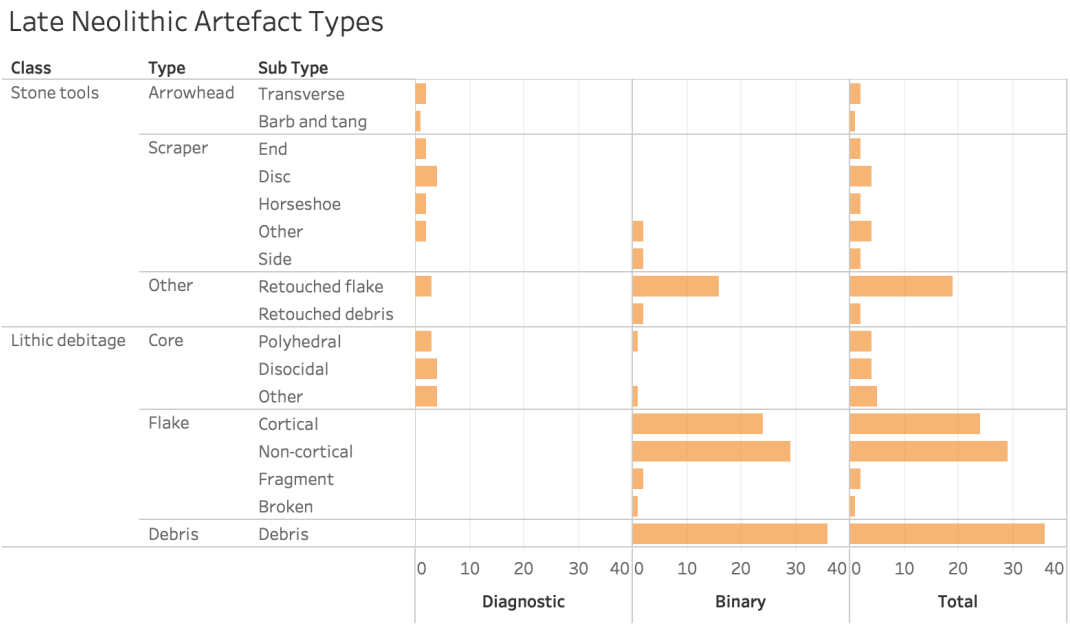


Figure 91. Histograms showing the frequencies of artefacts from the surface scatter at Wharram-le-Street that could be dated to the Late Neolithic (n=143) based on typologically diagnostic artefacts (left) and the binary scoring system (right).

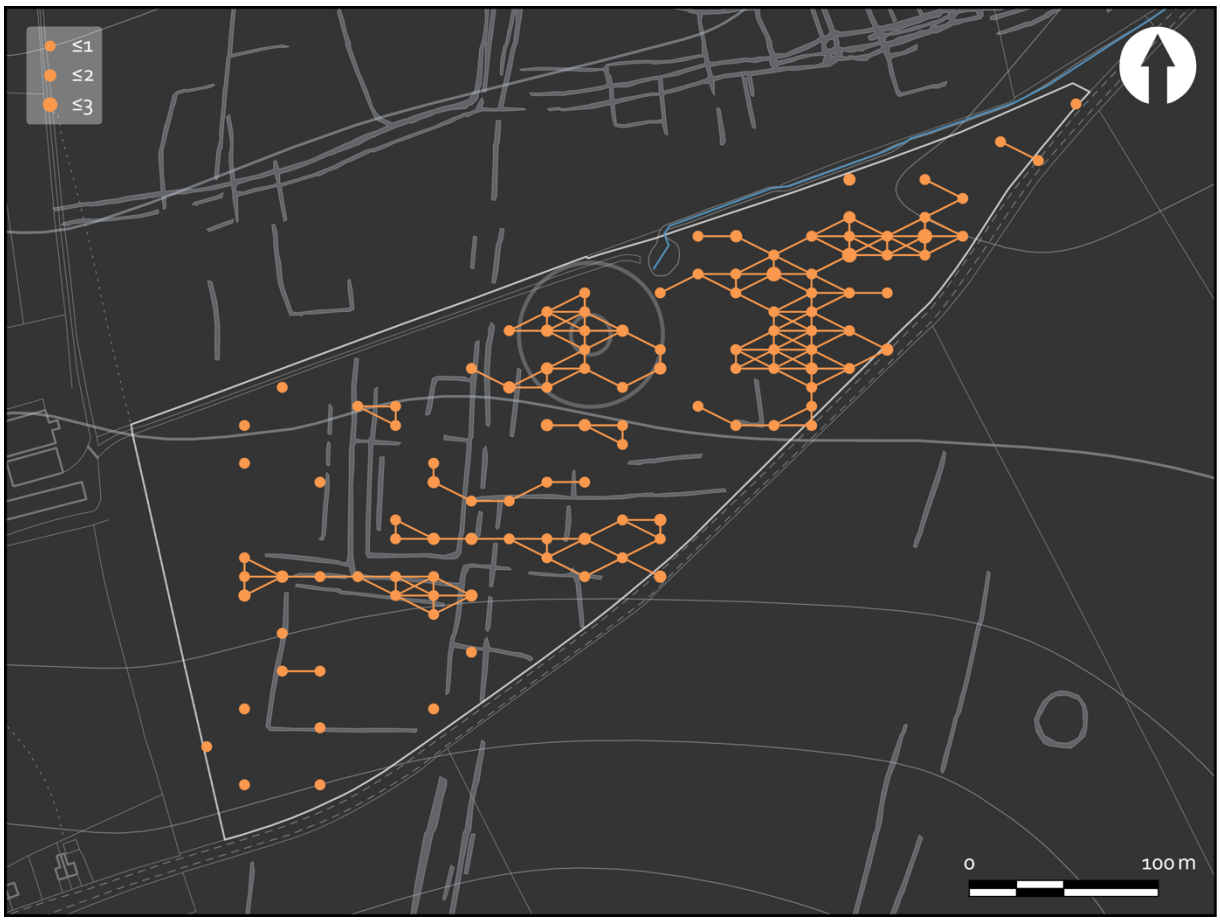


Figure 92. Thematic map with graduated symbols showing the frequency of artefacts from the surface scatter at Wharram-le-Street dated to the Late Neolithic using the binary scoring system.

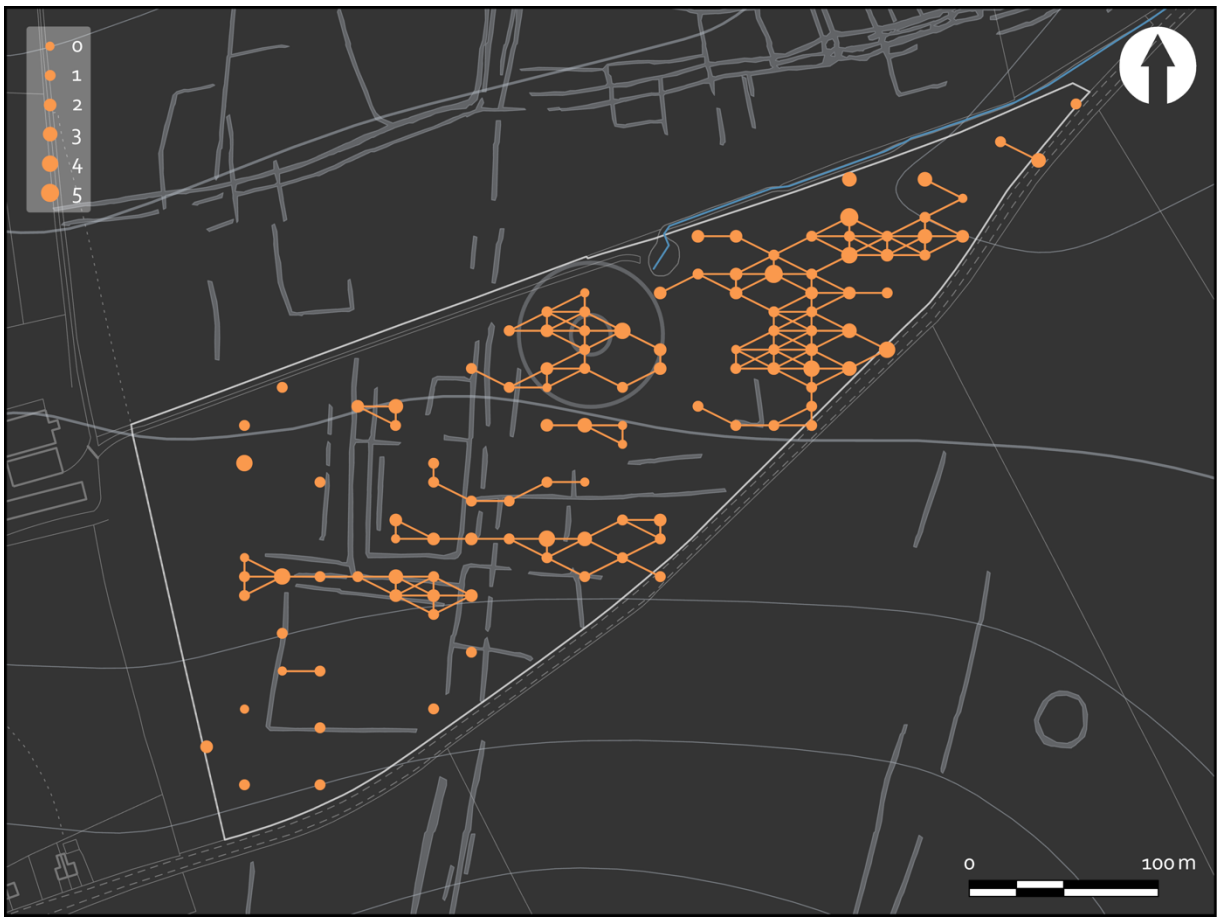


Figure 93. Thematic map with graduated symbols showing the aggregated binary scores for the Late Neolithic artefacts from the surface scatter at Wharram-le-Street.

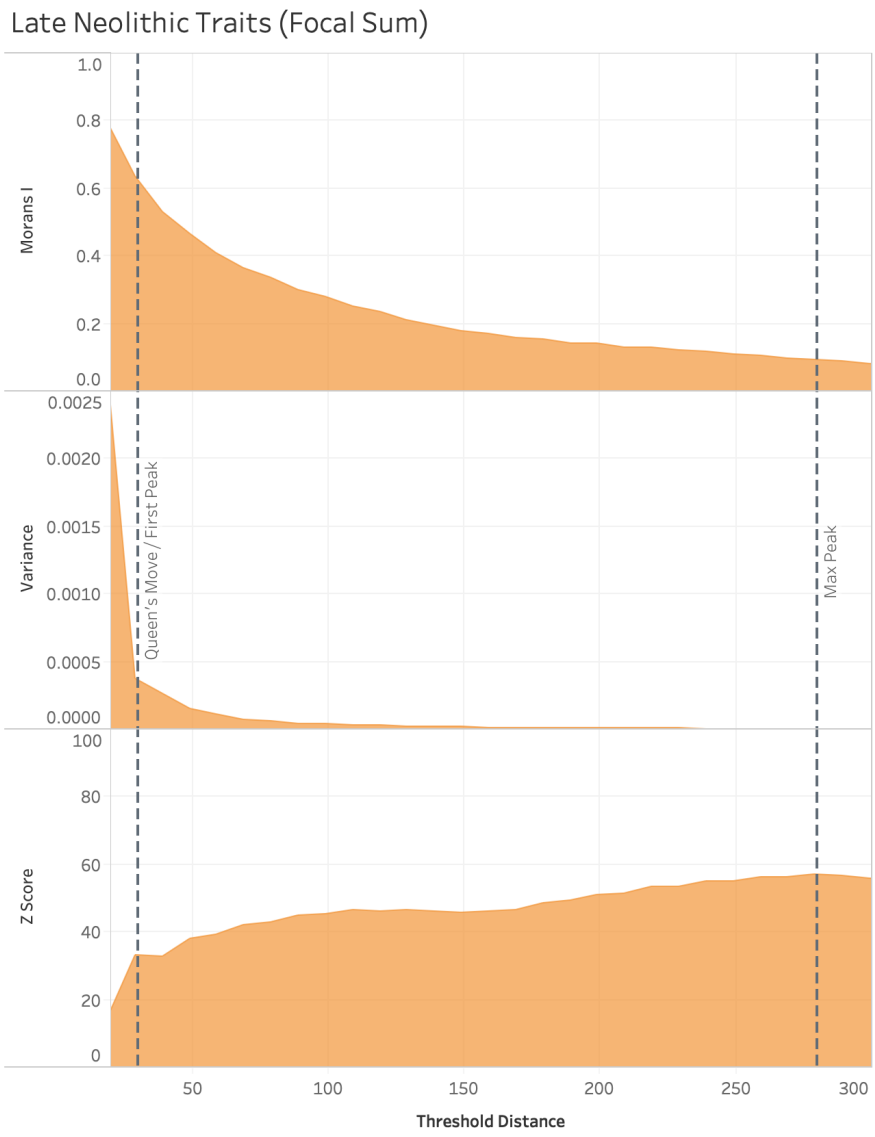


Figure 94. Incremental spatial autocorrelation for the aggregated binary scores for the Late Neolithic artefacts from the surface scatter at Wharram-le-Street.



Figure 95. Thematic map showing the correlation between the aggregated binary scores for the Late Neolithic artefacts from the surface scatter at Wharram-le-Street and the clusters of values identified on the basis of the values of the Anselin's Local Moran's I statistic, with clusters of high values based on polygon contiguity (Queen's move) shown in red and clusters of low values shown in blue.

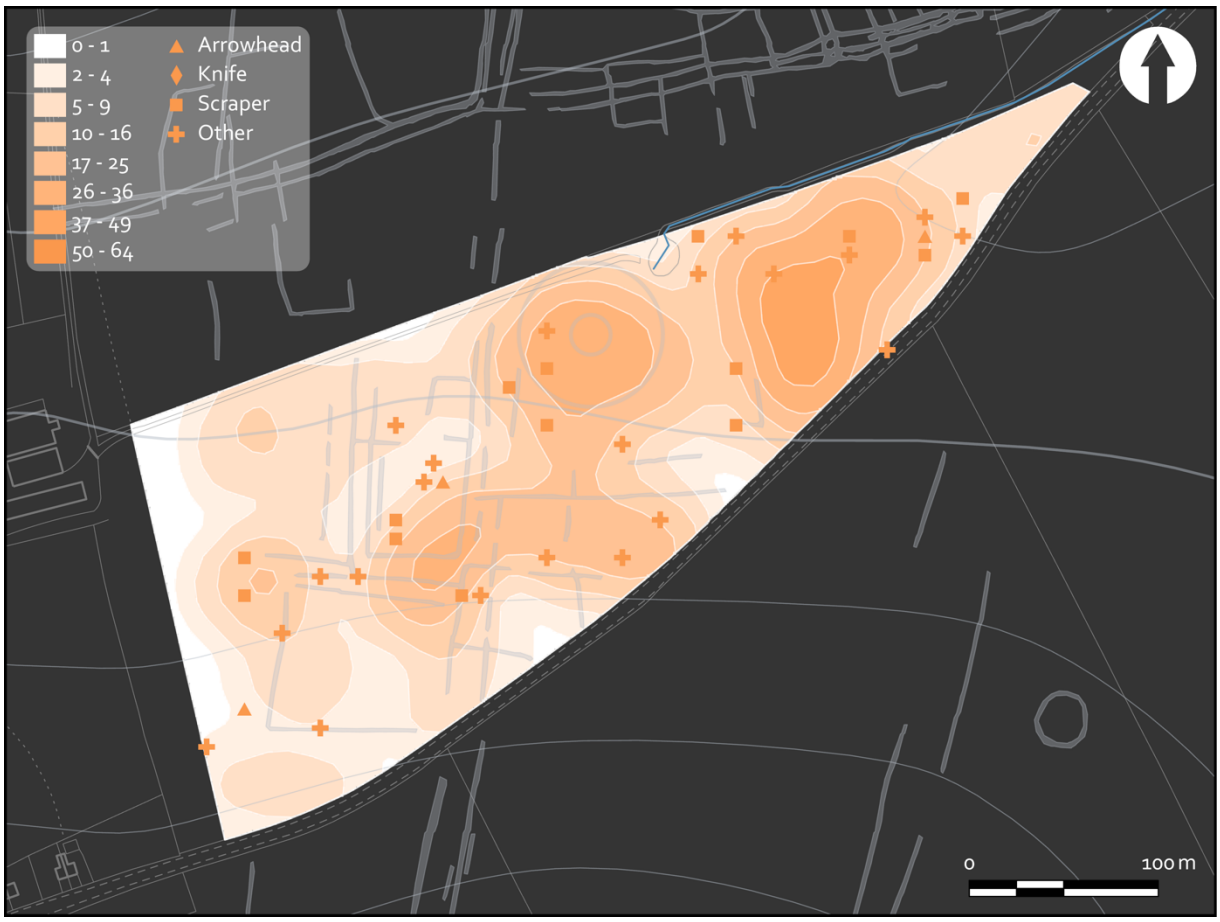


Figure 96. Kernel density plot showing the correlation between the stone tools and the lithic debitage dated to the Late Neolithic from the surface scatter at Wharram-le-Street.

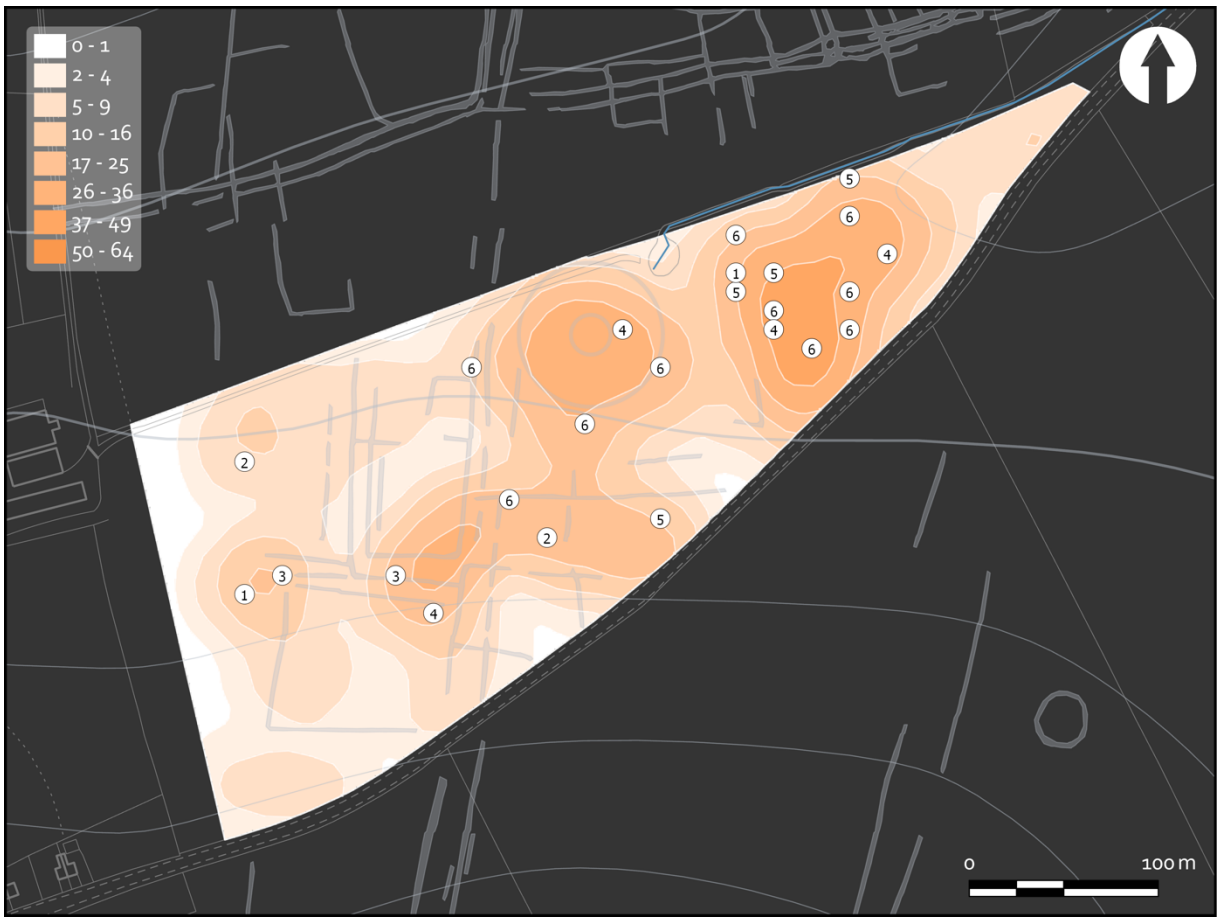


Figure 97. Distribution of Late Neolithic cortical blades and flakes from the surface scatter at Wharram-le-Street, sorted by lowest position.

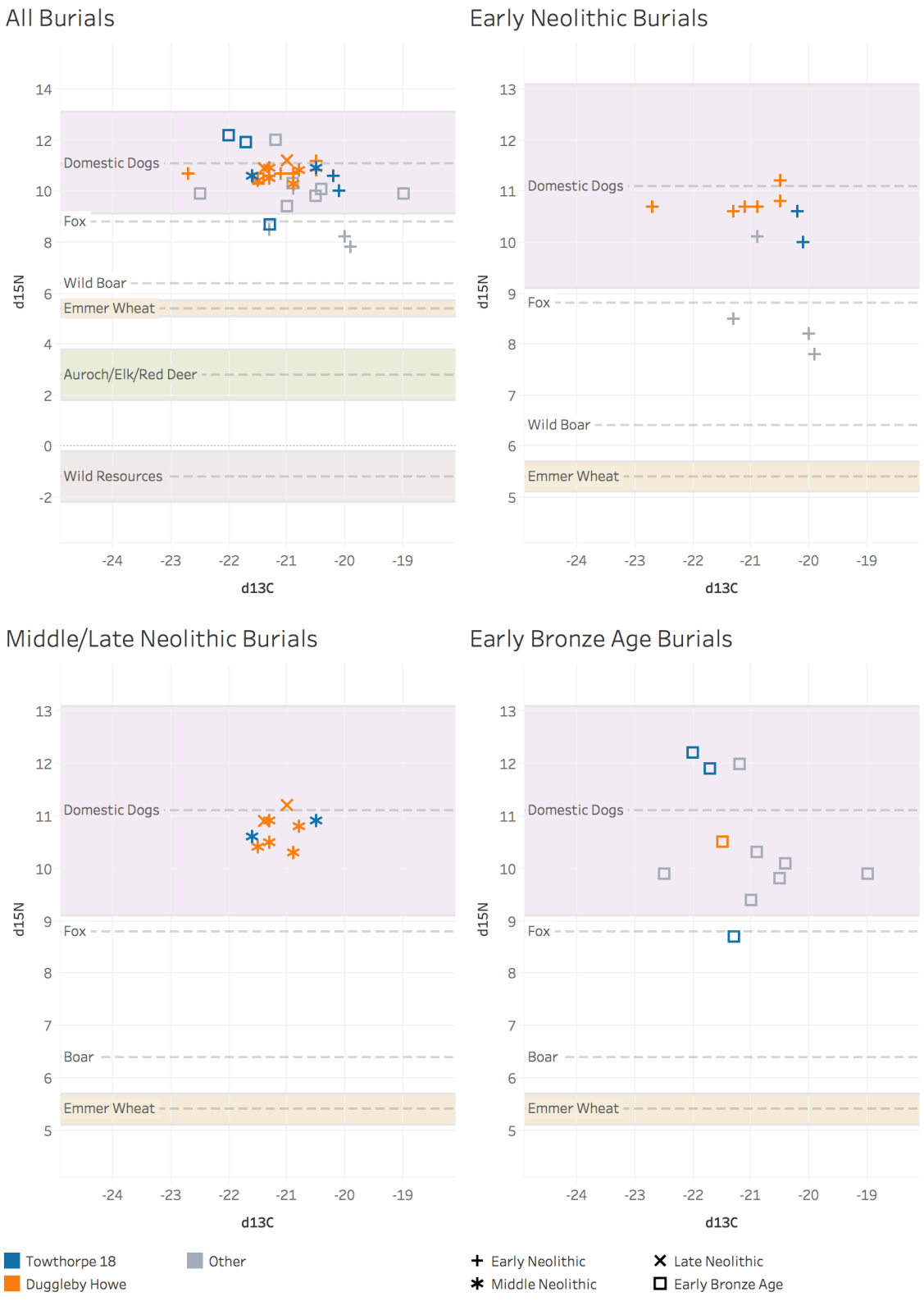


Figure 98. Stable isotope values for bone collagen from Neolithic and Bronze Age individuals from burial mounds on the Yorkshire Wolds (n=25).

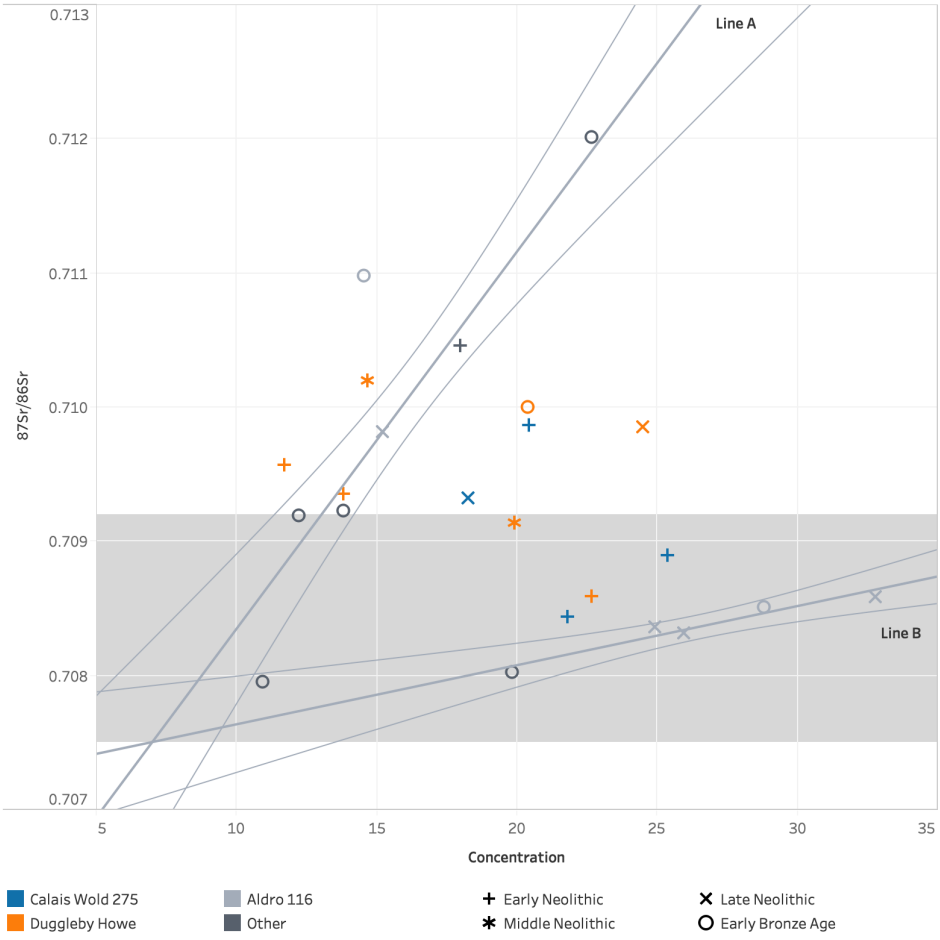


Figure 99. Strontium isotope ratios and strontium concentrations for tooth enamel from Neolithic and Bronze Age individuals from burial mounds on the Yorkshire Wolds (n=22). The expected range of values for the Yorkshire Wolds based on chalk and rainwater end members is shown in light grey.

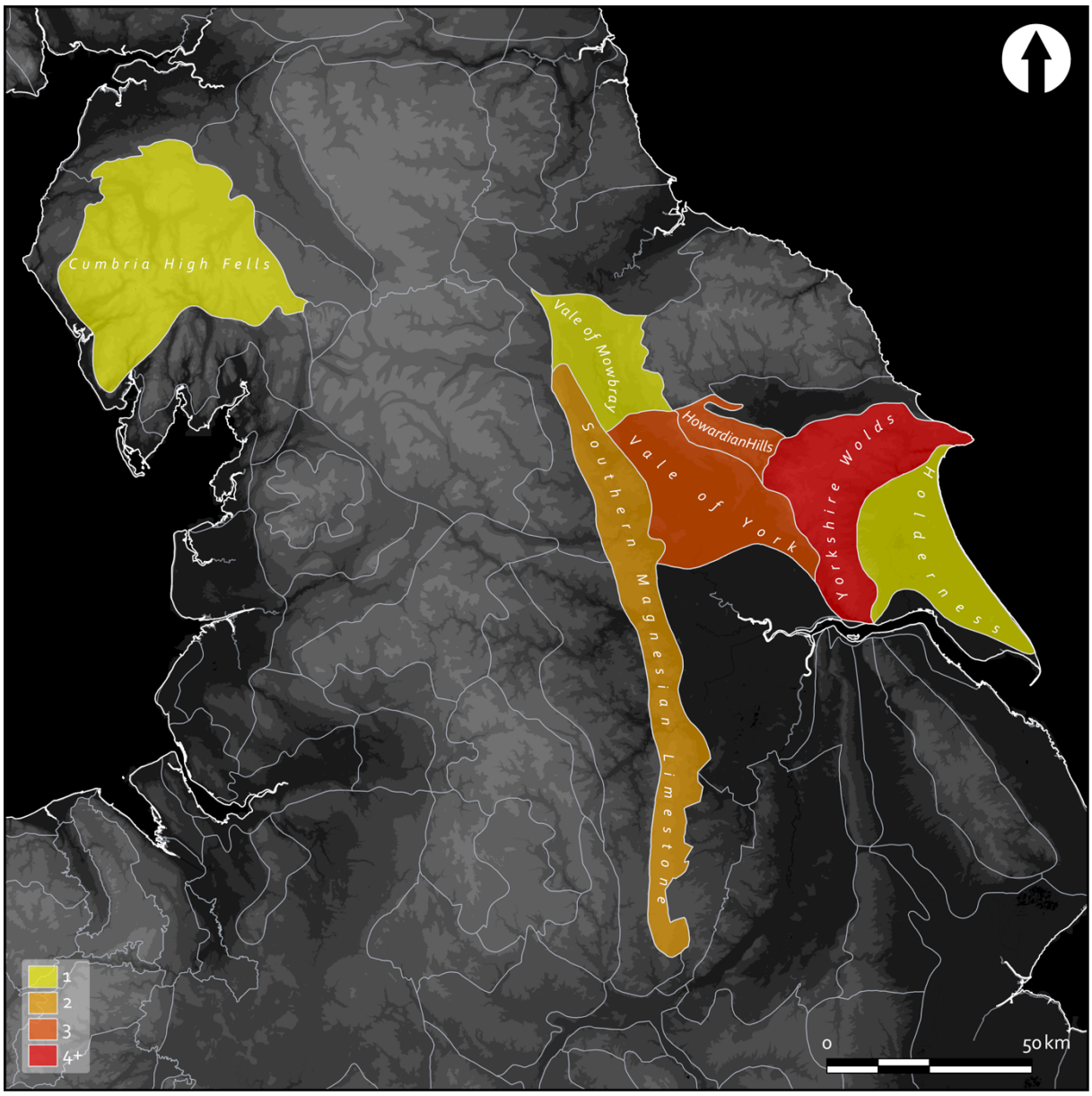


Figure 100. Geographic origins of the Neolithic and Early Bronze Age burials from the Yorkshire Wolds based on probability densities calculated using a 5km search radius (n=22).

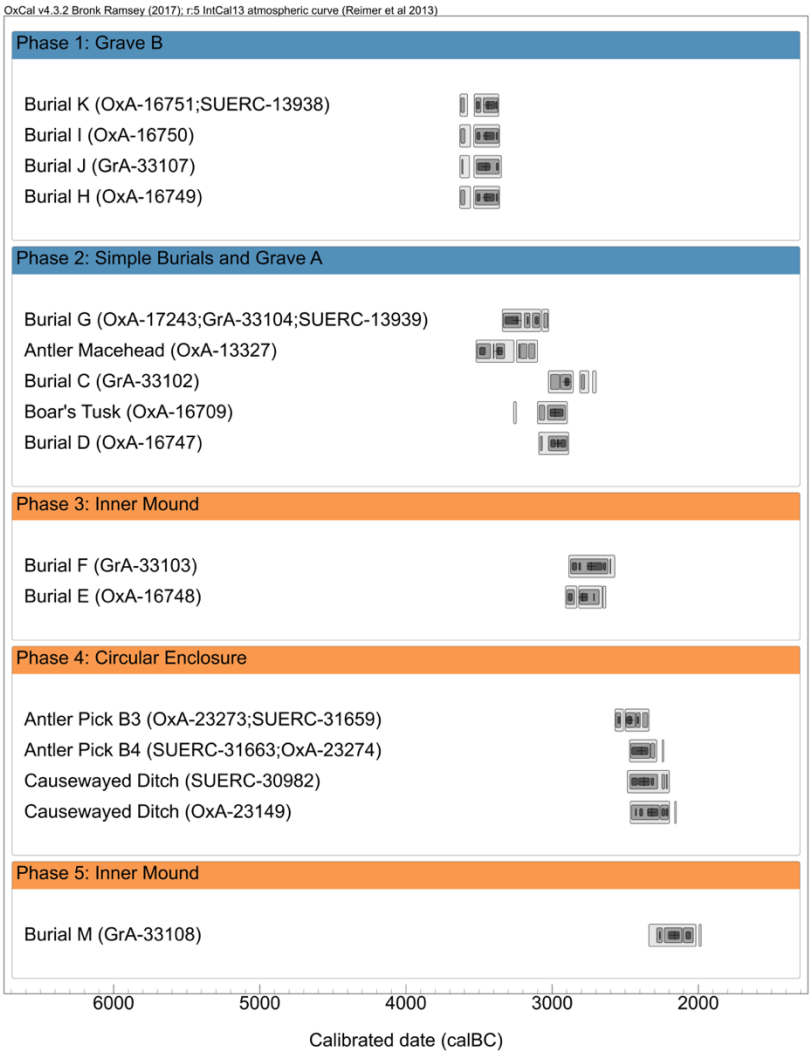


Figure 101. Structural sequence for the burial mound and circular enclosure at Duggleby Howe.

Neolithic occupation and stone working on the Yorkshire Wolds

Table 1. Historic England Periods List showing the terminology and date ranges for British prehistory

Level 1	Level 2	Level 3	Level 4	Date From	Date To
Prehistoric	Early Prehistoric	Palaeolithic	Early Palaeolithic	500000 BC	150000 BC
			Middle Palaeolithic	150000 BC	40000 BC
			Upper Palaeolithic	40000 BC	10000 BC
		Mesolithic	Early Mesolithic	10000 BC	7000 BC
			Late Mesolithic	7000 BC	4000 BC
	Later Prehistoric	Neolithic	Early Neolithic	4000 BC	3300 BC
			Middle Neolithic	3300 BC	2900 BC
			Late Neolithic	2900 BC	2000 BC
		Bronze Age	Early Bronze Age	2600 BC	1600 BC
			Middle Bronze Age	1600 BC	1200 BC
			Late Bronze Age	1200 BC	700 BC
		Iron Age	Early Iron Age	800 BC	300 BC
			Middle Iron Age	300 BC	100 BC
			Late Iron Age	100 BC	AD 43

From http://heritage-standards.org.uk/wp-content/uploads/2015/08/Periods-List-HE-FISH-WP.pdf (visited 12/09/2018). Overlaps between chronological periods are highlighted in light grey.

Table 2. The relative chronology used for the analysis of the lithic assemblages from the Neolithic burial mounds.

Period	Phase	Structural Associations		Ceramic Phasing	
		Stage	Description	Tradition	Variants
Early Neolithic	1	-	-	Grimston-Lyles Hill	Grimston Ware
	2	B/C	Linear zones Non-Megalithic Chambers	Grimston-Lyles Hill	Towthorpe Ware
	3	C/D	Graves Simple Burials	Grimston-Lyles Hill	Towthorpe Ware
Late Neolithic	4	D	Graves	Late Neolithic Impressed Ware	Peterborough Ware: Ebbsfleet Style Fengate Style Rudston Style
	5	E	Cemeteries	Grooved Ware	Clacton Style
	6	-	-	Beaker	AOC and AOTC (Steps 1 and 2)

Table 3. Summary of the lithic assemblages dated to the Early Neolithic (Phases 1 to 3)

Phase	Barrow	Context	Stone Tools				Lithic Debitage			
			Ahead	Knife	Scraper	Other	Core	Blade	Flake	Debris
1	Towthorpe 273	Outer Mound	1	-	-	1	1	-	-	-
2	Towthorpe 18	NM Chamber	6	-	-	6 (3)	-	-	1	-
	Aldro 88	N M Chamber	1	-	-	-	-	3	-	-
	Calais Wold 275	Linear Zone	3	-	-	-	-	-	-	-
	Towthorpe 291	Burial Mound	-	-	2	3 (1)	2	-	20	-
	Aldro 116	Burial Mound	-	2	1	-	-	-	2	-
	Wharram Percy	Unknown	-	1	2	2	4	2	7	3
3	Aldro 94	Linear Zone	-	1*	-	-	-	-	-	-
	Towthorpe 273	Grave B	-	-	2	2	-	2	1	-
		Burial D	-	1*	-	-	-	-	-	-
		Burial G	1	-	-	1*	-	-	-	-
	Aldro C75	Burial 1	-	3**	-	3	1	6	31	-
		Burial 2	-	1*	-	-	-	-	-	-

* Asterisks denote polished implements.
Figures in parentheses denote coarse stone.

Table 4. Summary of the lithic assemblages dated to the Late Neolithic (Phases 4 to 6)

Phase	Barrow	Context	Stone Tools				Lithic Debitage			
			Ahead	Knife	Scraper	Other	Core	Blade	Flake	Debris
4	Aldro 30	Burial Mound	-	-	1	-	-	-	1	-
	Aldro 49	Old Land Surface	-	2	-	-	-	-	1	-
	Acklam Wold 211	Circular Pit	-	-	-	1	-	-	2	-
	Painsthorpe Wold 98	Burial Mound	-	1	4	-	1	-	1	1
	Riggs 20	Burial Mound	-	-	8	3	1	3	31	6
5	Towthorpe 273	Grave A	5	-	1	-	-	-	-	-
		Cremation 3	1	-	-	-	-	-	-	-
	Calais Wold C70	Burial 2	-	-	-	-	-	-	1	-
6	Aldro 116	Grave A	-	-	-	-	-	-	1	-
	Painsthorpe Wold 98	Cremation 3	-	2	-	-	-	-	-	-
	Calais Wold 275	Interim Mound	2	-	7	9	7	6	41	5

Table 5. Binary spatial weights matric for the cells in a 3 x 3 window based on spatially contiguous neighbours (Queen's Case).

Cell	Z_1	Z_2	Z_3	Z_4	Z_5	Z_6	Z_7	Z_8	Z_9
Z_1	0	1	0	1	1	0	0	0	0
Z_2	1	0	1	1	1	1	0	0	0
Z_3	0	1	0	0	1	1	0	0	0
Z_4	1	1	0	0	1	0	1	1	0
Z_5	1	1	1	1	0	1	1	1	1
Z_6	0	1	1	0	1	0	0	1	1
Z_7	0	0	0	1	1	0	0	1	0
Z_8	0	0	0	1	1	1	1	0	1
Z_9	0	0	0	0	1	1	0	1	0

Table 6. Changes in the number and average area of the parishes in the Wolds study area.

Date	Source	Parishes		Area (ha.)	
		Divided	n	Sum	Mean
1851	Kain and Oliver (2001)	7	141	96.435	68.393
1871	Great Britain Historical GIS	4	100	96,787	96.787
1921	Great Britain Historical GIS	2	97	96,787	99.780
1971	Great Britain Historical GIS	-	60	97,927	163.212
1991	UK Borders	-	58	96,085	165.664

Table 7. Survey data from the Wharram-le-Street case study classified octiles (after Millett 1991).

Class	Quantile	Value	n	CDF
1	Lower Octile	0	242	242
2	2nd Octile	1	111	353
3	3rd Octile	2	33	386
4	4th Octile	3	28	414
5	5th Octile	4	10	424
6	6th Octile	5	4	428
7	7th Octile	6	2	430
8	Upper Octile	7	1	431

Table 8. Survey dated from the Wharram-le-Street case study classified using standard deviations (after Lock, Bell and Lloyd 1999).

Zero Values	μ	σ	Value	Limit	Frequency	Cumulative
Excluded	1.799	1.183	3	Upper	17	79
Excluded	1.799	1.183	3	Lower	45	163
Included	0.789	1.188	2	Upper	45	163
Included	0.789	1.188	2	Lower	156	229

Table 9. Nearest neighbour test statistics for the survey data from the Wharram-le-Street case study.

Frequency	n	Ratio	z score	p value	Pattern
≥ 0	431	1.48	19.22	-	Dispersed 1%
≥ 1	189	1.21	5.41	-	Dispersed 1%
≥ 2	78	1.01	0.21	0.83	Random
≥ 3	45	0.83	-2.24	0.03	Clustered 5%
≥ 4	17	0.64	-2.81	-	Clustered 1%
≥ 5	7	0.57	-2.20	0.03	Clustered 5%
≥ 6	3	0.60	-1.32	0.19	Random
7	1	-	-	-	n/a

Table 10. Distribution of the stone tools from the Neolithic burial mounds.

Group	Sub Group	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6
Arrowhead	Leaf-shaped	-	10	1	-	-	1
	Transverse	1	-	-	-	6	1
	Barbed and tanged	-	-	-	-	-	-
Knife	Edge-retouched	-	2	1	2	-	-
	Plano-convex	-	1	-	1	-	2
	Polished-edge	-	-	5	-	-	-
Scraper	End	-	2	-	6	-	2
	Side	-	-	-	3	-	1
	Disc	-	1	1	2	-	2
	Broken	-	2	1	2	1	2
Other	Awl	-	1	-	-	-	1
	Burin	-	2	-	1	-	5
	Fabricator	1	-	-	-	-	-
	Leaf point	-	-	-	-	-	-
	Polished adze	-	-	1	-	-	-
	Retouched	-	2	-	2	-	2
	Serrated	-	6	5	1	-	1
		Early Neolithic			**Late Neolithic**		

Table 11. Relative frequencies of the colour of flint for the stone tools from the Neolithic burial mounds.

Quality	Colour	Phases 1 and 2	Phase 3	Phases 4 to 6
High	Black	2	-	1
	Dark Grey/Brown	5	-	6
↓	Mid Grey/Brown	10	6	23
	Light Grey/Brown	5	3	10
Low	White	-	-	1
		Early Neolithic		**Late Neolithic**

Table 12. Descriptive statistics for the metric properties of the end scrapers from the Neolithic burial mounds.

Variable	Date	min	max	$\bar{x}$	σ	n
Surface	Phase 2	798mm²	1,111mm²	954mm²	221mm²	2
	Phases 4 and 6	369mm²	1,929mm²	902mm²	496mm²	8
Ratio	Phase 2	1.15	1.55	1.35	0.28	2
	Phases 4 and 6	0.69	1.61	1.13	0.37	8

Table 13. Descriptive statistics for the metric properties of the stone tools from the Neolithic burial mounds.

Variable	Date	min	max	$\bar{x}$	σ	n
Surface	Phase 1	1,016mm²	1,688mm²	1,352mm²	475mm²	2
	Phase 2	334mm²	3,792mm²	1,222mm²	914mm²	24
	Phase 3	240mm²	3,605mm²	1,535mm²	918mm²	12
	Phase 4	369mm²	2,346mm²	1,145mm²	656mm²	17
	Phase 5	928mm²	1,435mm²	1,092mm²	196mm²	6
	Phase 6	238mm²	2,714mm²	968mm²	583mm²	17
Ratio	Phase 1	1.57	3.52	2.54	1.38	2
	Phase 2	0.88	3.88	2.08	0.76	24
	Phase 3	1.04	4.31	2.88	0.98	12
	Phase 4	0.76	3.61	1.53	0.85	17
	Phase 5	0.91	1.87	1.34	0.42	6
	Phase 6	0.64	2.96	1.49	0.76	17

Table 14. Pre-determined debitage methods used in the production of blanks for the stone tools from the Neolithic burial mounds.

Date	Regular	Irregular	Levallois Method
Phase 1	-	-	-
Phase 2	5	1	-
Phase 3	8	-	-
Phase 4	2	2	-
Phase 5	-	-	1
Phase 6	3	2	1
	Blade		**Other**

Table 15. Distribution of the cores from the Neolithic burial mounds.

Group	Sub Group	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6
Platform	Single	-	-	1	-	-	-
	Opposed	-	-	-	-	-	1
Polyhedral	n/a	-	4	-	2	-	2
	Re-used	-	1	-	-	-	4
Other	n/a	1	1	-	-	-	-
		Early Neolithic			**Late Neolithic**		

Table 16. Categorical variables recorded for the cores from the Neolithic burial mounds.

Variable	Description	Value(s)
Colour	Colour of piece of flint (Ordinal)	Black Dark Grey Dark Brown Mid Grey Mid Brown Light Grey Light Brown White
Cortication	Approximate degree of cortication (Ordinal)	100% 70% 50% 35% 20% <10% None
Platform	Type of striking platform (Nominal)	Trimmed None
Removals	Number of flake scars from previous removals (Ordinal)	0 to 8
Directions	Number of directions from which blades/flakes had previously been removed (Ordinal)	0 to 5
Pattern	Pattern of flake scars (Nominal)	Parallel Opposed Centripetal Irregular Unclassified None

Table 17. Descriptive statistics for the metric properties of the polyhedral cores from the Neolithic burial mounds.

Variable	min	max	$\bar{x}$	σ	n
Length	23.13mm	62.28mm	37.60mm	10.62mm	13
Breadth	21.24mm	57.05mm	34.21mm	9.91mm	13
Thickness	15.72mm	44.17mm	26.04mm	8.21mm	13
|L – B|	2.18mm	13.07mm	6.24mm	3.19mm	13
|L – T|	3.24mm	20.12mm	12.23mm	5.94mm	13
|B – T|	0.90mm	22.89mm	9.06mm	6.97mm	13

Table 18. Distribution of the lithic debitage from the Neolithic burial mounds.

Group	Sub Group	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6
Blade	Cortical	-	3	2	-	-	-
	Non-cortical	-	1	3	-	-	5
	Broken	-	-	-	-	-	-
	Fragment	-	1	3	3	-	1
Flake	Cortical	-	18	19	22 (17)	-	18 (17)
	Non-cortical	-	9	8	9	1	19 (17)
	Broken	-	1	2	1	-	-
	Fragment	-	2	3	4	-	5
Shatter	Debris	-	3	-	7	-	5
		Early Neolithic			**Late Neolithic**		

* Figures in brackets denote totals excluding removals with missing values

Table 19. Lamellar indices for the aggregated assemblages of worked flint from the Neolithic burial mounds.

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6
Blades	-	5	8	3	-	6
Flakes	-	30	32	36	1	42
Total	-	35	40	39	1	48
Index	-	14.29%	20.00%	7.69%	0.00%	12.50%
	Early Neolithic			**Late Neolithic**		

Table 20. Categorical variables recorded for the complete removals from the Neolithic burial mounds.

Variable	Description	Value(s)
Colour	Colour of piece of flint (Ordinal)	Black Dark Grey Dark Brown Mid Grey Mid Brown Light Grey Light Brown White
Cortication	Approximate degree of cortication (Ordinal)	100% 70% 50% 35% 20% <10% None
Platform	Type of striking platform (Nominal)	Abraded Trimmed Isolated Faceted Crushed Corticated None
EPA	Exterior platform angle to nearest 5º (Ordinal)	45º to 100º
Terminal	Type of blade/flake termination (Nominal)	Feathered Overshot Hinged Stepped
Removals	Number of flake scars from previous removals (Ordinal)	0 to 8
Directions	Number of directions from which blades/flakes had previously been removed (Ordinal)	0 to 5
Pattern	Pattern of flake scars (Nominal)	Parallel Opposed Centripetal Irregular n/a None

Table 21. Continuous variables derived from the basic measurements recorded for the complete removals from the Neolithic burial mounds.

Variable	Description	Value
Lmax	Maximum length (mm)	L
Bmax	Maximum breadth (mm)	$\max(B_p, B_m, B_d)$
Tmax	Maximum thickness (mm)	$\max(T_p, T_m, T_d)$
Surface	Overall size/Approximate surface area (mm²)	$\mathrm{L.max}(B_p, B_m, B_d)$
Ratio	Relative proportions	$\frac{L}{\max(B_p, B_m, B_d)}$
Depth	Depth of striking platform (mm)	T_p
Area	Area of striking platform (mm²)	$T_p . B_p$
Bulb	Relative thickness of the bulb of percussion	$\frac{2T_b}{T_p + T_m}$
Variation	Maximum variation in breadth (mm)	$\max(\lvert B_p - B_m\rvert, \lvert B_m - B_d\rvert, \lvert B_p - B_d\rvert)$

Table 22. Relative frequencies of the colour of flint for the complete removals from the aggregated assemblages of worked flint from the Neolithic burial mounds.

Quality	Colour	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6
High	Black	-	3	-	-	-	-
	Dark Grey/Brown	-	4	10	5	-	13
↓	Mid Grey/Brown	-	14	20	13	1	15
	Light Grey/Brown	-	9	2	8	-	9
Low	White	-	1	-	-	-	2
		Early Neolithic			**Late Neolithic**		

Table 23. Descriptive statistics for the overall size/approximate surface area of the complete removals from the Neolithic burial mounds by phase of activity.

Surface	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6
min	-	243.26mm²	293.01mm²	283.43mm²	803.38mm²	247.73mm²
max	-	2,480.39mm²	1,971.27mm²	2,228.23mm²	803.38mm²	2,682.86mm²
$\bar{x}$	-	724.31mm²	797.24mm²	948.09mm²	803.38mm²	829.90mm²
σ	-	435.66mm²	378.55mm²	547.08mm²	-	547.16mm²
n	-	31	32	26	1	39
	Early Neolithic			**Late Neolithic**		

Table 24. Descriptive statistics for the relative proportions of the complete removals from the Neolithic burial mounds by phase of activity.

Ratio	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6
min	-	0.52	1.10	0.74	1.18	0.53
max	-	3.58	7.39	2.99	1.18	4.19
$\bar{x}$	-	1.55	3.29	1.54	1.18	2.05
σ	-	0.83	1.46	0.67	-	1.08
n	-	31	32	26	1	39
		Early Neolithic		**Late Neolithic**		

Table 25. Mean values of the metric properties of the complete removals for the individual assemblages of worked flint from the Neolithic burial mounds.

Variable	Aldro C75	Riggs 20	Calais Wold 275	Aggregated
Maximum length	48.30mm	34.72mm	36.53mm	37.99mm
Maximum breadth	16.63mm	24.87mm	22.41mm	21.89mm
Maximum thickness	4.55mm	5.16mm	5.81mm	5.36mm
Overall size/Approximate surface area	805.52mm²	907.25mm²	829.90mm²	831.94mm²
Relative proportions	3.23	1.55	2.05	2.12
Maximum variation in breadth	11.25mm	18.00mm	15.03mm	14.88mm
	Phase 3	**Phase 4**	**Phase 6**	**All**

Table 26. 'Size sorting' of the complete removals from the individual assemblages of worked flint from the Neolithic burial mounds.

Cluster	Aldro C75	Riggs 20	Calais Wold 275	Aggregated
1. Undiagnostic removals	8	8	20	57
2. Long thin removals	18	3	8	37
3. Intermediate removals	3	3	6	21
4. Short squat removals	-	8	5	25
	Phase 3	**Phase 4**	**Phase 6**	**All**

Table 27. Descriptive statistics for the maximum variation in breadth of the regular and irregular blades from the Neolithic burial mounds.

Variation	Regular Blades	Irregular Blades
min	2.20mm	3.69mm
max	6.27mm	21.17mm
$\bar{x}$	4.16mm	12.36mm
σ	1.72mm	4.44mm
n	5	32

Table 28. Relative thickness of the bulb of percussion of the complete removals from the individual assemblages of worked flint from the Neolithic burial mounds.

Mode of Percussion	Bulb	Aldro C75	Riggs 20	Calais Wold 275	Aggregated
Soft hammer	Diffuse	15	3	11	43
↓	Moderate	7	6	12	36
Hard hammer	Pronounced	7	13	16	61
		Phase 3	**Phase 4**	**Phase 6**	**All**

Table 29. Type of blade/flake termination for the complete removals from the individual assemblages of worked flint from the Neolithic burial mounds.

Termination	Aldro C75	Riggs 20	Calais Wold 275	Aggregated
Feathered	12	7	18	59
Overshot	8	3	7	30
Hinged	1	5	10	21
Stepped	8	7	4	30
	Phase 3	**Phase 4**	**Phase 6**	**All**

Table 30. Relative frequencies of the method of platform preparation/type of striking platform for the complete removals from the aggregated assemblages of worked flint from the Neolithic burial mounds.

Method	Type	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6
Simple	Abraded	-	6	11	9	-	9
↓	Trimmed	-	10	5	4	1	7
Complex	Isolated	-	2	9	3	-	3
	Faceted	-	-	-	-	-	1
Unprepared	Crushed	-	9	2	6	-	9
	Corticated	-	1	2	1	-	1
	None	-	3	3	3	-	9
		Early Neolithic			**Late Neolithic**		

Table 31. Descriptive statistics for the depth of the striking platform of the complete removals from the Neolithic burial mounds.

Depth	Cluster 1	Cluster 2	Cluster 3	Cluster 4
min	0.95mm	0.95mm	1.75mm	1.12mm
max	7.60mm	9.13mm	10.37mm	10.08mm
$\bar{x}$	2.74mm	3.22mm	5.73mm	4.50mm
σ	1.55mm	1.72mm	2.84mm	2.62mm
n	57	37	21	25
	Undiagnostic	**Long thin**	**Intermediate**	**Short squat**

Table 32. Descriptive statistics for the area of the striking platform of the complete removals from the Neolithic burial mounds.

Depth	Cluster 1	Cluster 2	Cluster 3	Cluster 4
min	2.66mm²	4.00mm²	7.50mm²	2.79mm²
max	228.23mm²	190.82mm²	266.81mm²	310.08mm²
$\bar{x}$	26.87mm²	28.28mm²	93.42mm²	65.27mm²
σ	35.03mm²	36.07mm²	90.67mm²	71.58mm²
n	57	37	21	25
	Undiagnostic	**Long thin**	**Intermediate**	**Short squat**

Table 33. Descriptive statistics for the number of flake scars from previous removals for the complete removals from the Neolithic burial mounds by approximate degree of cortication.

Removals	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	Stage 6	Stage 7
min	-	1	1	1	1	1	1
max	-	2	4	4	5	7	8
mode	0	2	1	2	3	2=3	3
range	-	1	3	3	4	6	7
n	1	5	8	12	21	34	59
	100%	**70%**	**50%**	**35%**	**20%**	**<10%**	**None**

Table 34. Descriptive statistics for the number of directions from which blades/flakes had previously been removed for the complete removals from the aggregated assemblages of worked flint from the Neolithic burial mounds.

Directions	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6
min	-	1	1	0	3	0
Max	-	2	2	4	3	5
mode	-	1	1	1	3	1
range	-	1	1	4	0	5
n	-	31	32	26	1	39
		Early Neolithic		**Late Neolithic**		

Table 35. Patterns of flake scars for the complete removals from the aggregated assemblages of worked flint from the Neolithic burial mounds.

Pattern	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6
Parallel	-	10	16	5		13
Opposed	-	1	2	-		2
Irregular	-	5	8	7	1	6
Centripetal	-	1	1	2	-	4
n/a	-	9	3	9	-	8
None	-	5	2	3	-	6
		Early Neolithic		**Late Neolithic**		

Table 36. Diagnostic traits distilled from the life histories and debitage signatures reconstructed for the Neolithic burial mounds. Black circles indicate that the trait applies to all artefacts. White circles indicate that the trait applies to specific sub types only.

Group	Trait		Arrowheads	Knives	Scrapers	Other	Cores	Blades	Flakes	Debris
1	1	Source	●	●	●	●	●	●	●	●
	2	Colour/quality	●	●	●	●	●	●	●	●
	3	Re-use	●	●	●	●	●	●	●	●
2	4	Exterior platform angle	-	-	-	-	-	○	○	-
	5	Platform preparation	●	●	●	●	●	●	●	●
	6	Rejuvenation	●	●	●	●	-	●	●	-
3	7	Initiation	●	●	●	●	-	●	●	-
	8	Pattern of flake scars	●	●	●	●	-	○	○	-
	9	Approximate degree of cortication	-	-	-	-	-	○	○	-
4	10	Relative thickness of a bulb of percussion	-	-	-	-	-	○	○	-
	11	Reduction of the bulb percussion	●	●	●	●	-	-	-	-
	12	Type of blade or flake termination	●	●	●	●	-	○	○	-
5	13	Outliers or extreme values	-	-	-	○	-	○	○	-
	14	Size sorting	-	●	●	○	-	○	○	-
	15	Type of blank	●	●	●	●	-	-	-	-
6	16	Preparation of blanks	●	●	●	●	-	-	-	-
	17	Edge modification	●	●	●	●	-	-	-	-
	18	Surface treatment	●	●	●	●	-	-	-	-
			Stone Tools				**Lithic Debitage**			

Table 37. Increments and weights assigned to the values of the diagnostic traits for the stone tools and lithic debitage from the Neolithic burial mounds and the Wharram-le-Street case study.

Trait	Value		Early	Late	Early	Late	Early	Late
1	1	Chalk	0	1	0	3	0.000	1.000
	2	Gravel	0	1	0	2	0.222	0.778
	3	Tabular	0	1	0	2	0.000	0.833
2	1	Black	1	0	2	0	0.625	0.125
	2	White	0	1	0	2	0.333	0.667
3	1	Re-used	0	1	0	1	1.000	0.000
4	1	Low: ≤ 70°	0	1	0	2	0.182	0.727
	2	High: ≥ 95°	0	1	0	2	0.333	0.667
5	1	Isolated	1	0	2	0	0.500	0.273
	2	Façeted	0	1	0	3	0.000	1.000
	3	Crushed	0	1	0	2	0.414	0.552
6	1	Rejuvenation	1	0	1	0	0.200	0.800
			Binary		**Ranked**		**Fuzzy**	

Table 37 (cont.).

Trait	Value		Early	Late	Early	Late	Early	Late
7	1	Crested	1	0	2	0	0.500	0.000
8	1	Parallel	1	0	2	0	0.471	0.441
	2	Opposed	1	0	2	0	0.467	0.400
	3	Irregular	0	1	0	2	0.345	0.575
	4	Centripetal	0	1	0	1	0.286	0.286
9	1	Stage 5: 20%	1	0	2	0	0.545	0.409
	2	Stage 2: 70%	0	1	0	2	0.429	0.571
	3	Stage 3: 50%	0	1	0	2	0.250	0.500
10	1	Diffuse: < 0.9	1	0	2	0	0.615	0.308
	2	Pronounced: > 1.5	0	1	0	2	0.400	0.500
11	1	Reduced	1	0	2	0	0.500	0.250
12	1	Overshot	1	0	1	0	0.432	0.432
	2	Stepped	1	0	2	0	0.524	0.429
	3	Hinged	0	1	0	2	0.214	0.679
13	1	Extreme value (tool)	1	0	1	0	0.250	0.250
	2	Outlier (tool)	1	0	1	0	-	-
	3	Multiple (tool)	1	0	2	0	0.500	0.000
	4	Extreme value (debitage)	0	1	0	1	0.500	0.375
	5	Outlier (debitage)	0	1	0	2	0.250	0.500
	6	Multiple (debitage)	0	1	0	2	0.167	0.833
14	1	Long thin (small)	1	0	1	0	0.000	1.000
	2	Long thin (large)	1	0	2	0	0.630	0.204
	3	Short squat (small)	0	1	0	2	0.360	0.560
	4	Short squat (large)	0	1	0	2	0.273	0.455
15	1	Blade	1	0	2	0	0.519	0.296
	2	Debris	0	1	0	1	-	-
16	1	Microburin	1	0	2	0	0.667	0.333
17	1	Serrated	1	0	2	0	0.550	0.150
	2	Polished	1	0	3	0	1.000	0.000
18	1	Polished	1	0	3	0	1.000	0.000
			Binary		**Ranked**		**Fuzzy**	

Table 38. Summary of the validation of the binary, ranked and fuzzy scoring systems. The best performing scoring system for each of the assessment criteria are highlighted in bold and denoted by an asterisk for both the individual lithic artefacts and the aggregated assemblages of worked flint.

	Binary	Ranked	Fuzzy	Binary	Ranked	Fuzzy
1. Number Dated	24 47.06%	**27*** **52.94%**	**27*** **52.94%**	21 87.50%	**22*** **91.67%**	**22*** **91.67%**
2. Correct Scores	19 37.25%	**21*** **41.18%**	14 27.45%	16 66.67%	16 66.67%	**17*** **87.50%**
3. False Positives	**5*** **9.80%**	6 11.76%	13 25.49%	**5*** **20.83%**	6 25.00%	**5*** **20.83%**
4. False Negatives	27 52.94%	**24*** **47.06%**	**24*** **47.06%**	3 12.50%	**2*** **8.33%**	**2*** **4.17%**
	Artefacts			**Assemblages**		

Table 39. Estimates of the frequencies and densities of Early Neolithic artefacts for the areal units corresponding to the clusters of high values and the areal units from the other parts of the survey area, based on the assumptions that the artefacts recovered during the course of the survey represent a 20% sample of the sample frame (i.e. the artefacts visible on the surface of the ploughed field) and that the sample frame represents a 5% sample of the sample population (i.e. the total number of artefacts circulating within the plough zone).

	Areal Units	Artefacts	Area	$\overline{x}$	Frame	Population
Western cluster	38	31	0.76 ha.	0.816 / unit	204 / ha.	4,079 / ha.
Eastern cluster	40	39	0.80 ha.	0.975 / unit	244 / ha.	4,875 / ha.
Rest of survey area	353	43	7.06 ha.	0.122 / unit	30 / ha.	609 / ha.

Table 40. Estimates of the frequencies and densities of Late Neolithic artefacts for the areal units corresponding to the clusters of high values and the areal units from the other parts of the survey area, based on the assumptions that the artefacts recovered during the course of the survey represent a 20% sample of the sample frame (i.e. the artefacts visible on the surface of the ploughed field) and that the sample frame represents a 5% sample of the sample population (i.e. the total number of artefacts circulating within the plough zone).

	Areal Units	Artefacts	Area	$\overline{x}$	Frame	Population
Western cluster	6	7	0.18 ha.	1.167 / unit	292 / ha.	5,833 / ha.
Eastern cluster	46	43	0.84 ha.	0.935 / unit	234 / ha.	4,674 / ha.
Cluster 3	7	7	0.10 ha.	1.000 / unit	250 / ha.	5,000 / ha.
Cluster 4	7	5	0.20 ha.	0.714 / unit	179 / ha.	3,571 / ha.
Rest of survey area	365	81	7.42 ha.	0.222 / unit	55 / ha.	1,110 / ha.

Table 41. Stable isotopes and radiocarbon dates from Neolithic and Bronze Age burials on the Yorkshire Wolds.

Date	Site	Subdivision	Burial	^{13}C ‰	^{15}N ‰	Sample ID	Age BP
Early Neolithic	Towthorpe 18	NM Chamber	Burial 4	-20.1	10.0	OxA-17239	4687±34
			Burial 6	-20.2	10.6	OxA-17238	4746±32
	Towthorpe 273	Grave B	Burial H	-20.9	10.7	OxA-16749	4679±34
			Burial I	-20.5	10.8	OxA-16750	4679±34
			Burial J	-21.1	10.7	GrA-33107	4660±35
			Burial K	-21.3	10.6	GrA-33105	4400±35
				-20.5	11.2	OxA-16751	4701±32
				-22.7	10.7	SUERC-13938	4675±35
	Wold Newton	N/A	Burial 2	-21.3	8.5	SUERC-13937	5000±35
			Burial 7	-20.9	10.1	GrA-33109	4780±35
			Child	-20.0	8.2	OxA-16752	5038±33
				-19.9	7.8	OxA-17246	4968±33
Middle Neolithic	Towthorpe 18	NM Chamber	Burial 3	-20.5	10.9	OxA-17240	4541±31
				-21.6	10.6	SUERC-13930	4535±35
	Towthorpe 273	Simple Burials	Burial D	-20.8	10.8	OxA-16747	4344±33
			Burial G	-21.3	10.5	GrA-33104	4470±35
				-20.9	10.3	OxA-17243	4485±31
				-21.5	10.4	SUERC-13939	4460±35
		Grave A	Boar Tusk	-21.3	6.4	OxA-16709	4374±30
			Burial C	-21.3	10.9	GrA-33102	4280±35
Late Neolithic	Towthorpe 273	Inner Mound	Burial E	-21.0	11.2	OxA-16748	4211±31
			Burial F	-21.4	10.9	GrA-33103	4140±35
Early Bronze Age	Towthorpe 18	NM Chamber	Burial 3A	-21.3	8.7	SUERC-13927	3800±35
			Burial 5	-21.7	11.9	SUERC-13929	3775±35
			Burial 6A	-20.3	8.8	SUERC-13928	3655±35
		Fox Cache	Fox A	-22.0	12.2	OxA-17241	3870±30
	Towthorpe 106	N/A	Burial 1	-20.4	10.1	OxA-17244	3586±30
			Burial 2	-20.5	9.8	SUERC-13935	3535±35
			Burial 3	-21.2	12.0	SUERC-13936	3625±35
			Burial 4	-19.0	9.9	OxA-17245	3645±29
	Towthorpe 273	Inner Mound	Burial M	-21.5	10.5	GrA-33108	3750±35
	Willie Howe	N/A	Burial 1	-22.5	9.9	SUERC-18222	3700±35
			Burial 2	-21.0	9.4	SUERC-18223	3645±35
			Burial 3	-20.9	10.3	SUERC-18224	3690±35

Table 42. Strontium and oxygen isotope data from Neolithic and Bronze Age burials on the Yorkshire Wolds.

Date	Site	Subdivision	Burial	$^{87}Sr/^{86}Sr$	Sr ppm	^{18}O ‰
Early Neolithic	Calais Wold 275	Linear Zone	Burial 7	0.708896	39	-
			Burial 8	0.708437	46	-
			Burial 9	0.709865	49	17.9
	Towthorpe 3	NM Chamber	Burial D	0.710458	56	18.3
	Towthorpe 273	Grave B	Burial H	0.709349	72	17.8
			Burial I	0.709570	86	-
			Burial K	0.708594	44	18.9
Middle Neolithic	Towthorpe 273	Simple Burials	Burial G	0.71021	68	17.9
		Grave A	Burial C	0.709138	50	17.5
Late Neolithic	Aldro 116	Grave C	Burial 3	0.7080361	40	18.6
			Burial 4	0.708315	39	18.4
			Burial 5	0.708588	31	18.3
			Burial 6	0.709818	66	17.7
	Calais Wold 275	Old Land Surface	Burial 3	0.709325	55	18.2
	Towthorpe 273	Inner Mound	Burial L	0.709849	41	18.3
Early Bronze Age	Aldro 116	Grave A	Burial 1	0.710981	69	-
		Grave B	Burial 2	0.708512	35	-
	Calais Wold 23	Grave	Burial 1	0.708023	50	17.8
				0.712010	44	18.5
	Calais Wold 100	Grave B	Burial 2	0.707952	92	16.4
	Towthorpe 72	Grave B or D	Burial 1	0.709227	72	19.0
	Towthorpe 73	Grave	Burial 1	0.709195	82	-
	Towthorpe 273	Inner Mound	Burial M	0.709997	49	17.7

Table 43. Baseline BASr values for Eastern Yorkshire.

National Character Area	Bedrock	Sample Type	Sample ID	$^{87}Sr/^{86}Sr$
Holderness	Cretaceous Chalk	Plant	Hull-1	0.708489
Howardian Hills	Jurassic Clay	Plant	SCAR-3	0.708707
			SCAR-5	0.709366
Humberhead Levels	Triassic Rocks	Plant	Hull-5	0.709372
			Hull-4	0.710181
		Dentine	FLIX-1d	0.709008
North York Moor and Cleveland Hills	Jurassic Clay	Plant	SCAR-1	0.709509
			SCAR-2	0.709693
			SCAR-4	0.711132
	Triassic Rocks	Dentine	Crow skull	0.708143
Vale of Pickering	Triassic Rocks	Dentine	GRIS-1d	0.710619
Vale of York	Triassic Rocks	Dentine	YRS-2-R	0.709350
			YRS-37-R	0.709373
Yorkshire Wolds	Cretaceous Chalk	Plant	E-Wet-1	0.707805
		Dentine	WWH-351d	0.707771
			WWH-388d	0.707900
			WWH-161d	0.707933
			WWH-173d	0.707989
			AL19	0.708161
			WWH-121d	0.708226
			CW8	0.708603
			WWH-348d	0.708657
			WWH-275d	0.708700
	Triassic Rocks	Dentine	DH2	0.708920

Table 44. Geographic assignments for Neolithic and Bronze Age burials on the Yorkshire Wolds based on probability densities calculated using 1km, 5km, 10km and 20km search radii.

Date	Site	Subdivision	Burial	National Character Area
Early Neolithic	Calais Wold 275	Linear Zone	Burial 7	01 Yorkshire Wolds
				05 Yorkshire Wolds
				10 Yorkshire Wolds
				20 Yorkshire Wolds
			Burial 8	01 Yorkshire Wolds
				05 Yorkshire Wolds
				10 Yorkshire Wolds
				20 Yorkshire Wolds
			Burial 9	01 Yorkshire Wolds
				05 Vale of York
				10 Vale of York
				10 Vale of York
	Towthorpe 3	NM Chamber	Burial D	01 North York Moors and Cleveland Hills
				05 Southern Magnesian Limestone
				10 Southern Magnesian Limestone
				20 Southern Magnesian Limestone
	Towthorpe 273	Grave B	Burial H	01 Yorkshire Wolds
				05 Yorkshire Wolds
				10 Yorkshire Wolds
				20 Vale of York
			Burial I	01 Vale of Pickering
				05 Howardian Hills
				10 Vale of York
				20 Vale of York
			Burial K	01 Yorkshire Wolds
				05 Yorkshire Wolds
				10 Yorkshire Wolds
				20 Yorkshire Wolds
Middle Neolithic	Towthorpe 273	Simple Burial	Burial G	01 Southern Magnesian Limestone
				05 Vale of Mowbray
				10 Vale of Mowbray
				20 Vale of Mowbray
		Grave A	Burial C	01 Yorkshire Wolds
				05 Yorkshire Wolds
				10 Yorkshire Wolds
				20 Yorkshire Wolds

Table 44 (cont.).

Date	Site	Subdivision	Burial	National Character Area
Late Neolithic	Aldro 116	Grave C	Burial 3	01 Yorkshire Wolds
				05 Yorkshire Wolds
				10 Yorkshire Wolds
				20 Yorkshire Wolds
			Burial 4	01 Yorkshire Wolds
				05 Yorkshire Wolds
				10 Yorkshire Wolds
				20 Yorkshire Wolds
			Burial 5	01 Yorkshire Wolds
				05 Yorkshire Wolds
				10 Yorkshire Wolds
				20 Yorkshire Wolds
			Burial 6	01 Yorkshire Wolds
				05 Vale of York
				10 Vale of York
				20 Vale of York
	Calais Wold 275	Old Land Surface	Burial 3	01 Yorkshire Wolds
				05 Yorkshire Wolds
				10 Yorkshire Wolds
				20 Vale of York
	Towthorpe 273	Inner Mound	Burial L	01 Humberhead Levels
				05 Howardian Hills
				10 Vale of York
				20 Vale of York
Early Bronze Age	Aldro 116	Grave A	Burial 1	01 Yorkshire Dales
				05 Southern Magnesian Limestone
				10 Pennine Dales Fringe
				20 Pennine Dales Fringe
		Grave B	Burial 2	01 Lincolnshire Wolds
				05 Yorkshire Wolds
				10 Yorkshire Wolds
				20 Yorkshire Wolds

Table 44 (cont.).

Date	Site	Subdivision	Burial	National Character Area
Early Bronze Age	Calais Wold 23	Grave	Burial 1	01 Lincolnshire Wolds
				05 Lincolnshire Coast and Marshes
				10 The Brecks
				20 North Downs
				01 Shropshire, Cheshire & Staffordshire Plain
				05 Cumbria High Fells
				10 Dyffryn Hafern/Severn Valley
				20 Bryniau Maesyfed/Radnorshire Hills
	Calais Wold 100	Grave B	Burial 2	01 Lincolnshire Wolds
				05 The Fens
				10 Cotswolds
				20 Mull
	Towthorpe 72	Grave B or D	Burial 1	01 Yorkshire Wolds
				05 Yorkshire Wolds
				10 Yorkshire Wolds
				20 Vale of Pickering
	Towthorpe 73	Grave	Burial 1	01 Yorkshire Wolds
				05 Howardian Hills
				10 Yorkshire Wolds
				20 Vale of Pickering
	Towthorpe 273	Inner Mound	Burial M	01 Southern Magnesian Limestone
				05 Vale of York
				10 Humberhead Levels
				20 Vale of Mowbray